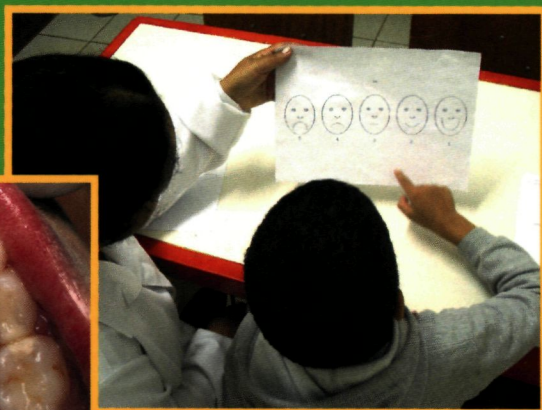


The impact of the ART approach on dental anxiety and pain experience in school children in Brazil



*Paranoá
study*

Danielle Matos de Menezes Abreu

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The impact of the ART approach on dental anxiety and pain experience in school children in Brazil

An academic essay in Medical Sciences

Doctoral thesis

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from Radboud University Nijmegen,
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according to the decision of the Council of Deans
to be defended in public on Thursday 13 October 2011
at 10.30 hours
by**

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Original Publications

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de Menezes Abreu, DM, Leal SC, Faber J, Frencken JE. Correlation between two picture scales to assess dental anxiety in Brazilian children. *Braz J Oral Sci* 2011; in print.

de Menezes Abreu, DM, Leal SC, Mulder J, Frencken JE. Dental anxiety in 6 - 7 year-old children treated in accordance with conventional restorative treatment, ART and an ultra-conservative treatment protocols. *Acta Odontol Scand* 2011; epub ahead of print

de Menezes Abreu, DM, Leal SC, Mulder J, Frencken JE. Pain experience after conventional, atraumatic and ultraconservative restorative treatments in 6- to 7-yr-old children. *Eur J Oral Sci* 2011; 119: 163-168.

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CHAPTER 1

Introduction and aims of the PhD research

Chapter objectives

This chapter summarizes the dental caries situation amongst Brazilian children and reports on the impact of pain experience and dental anxiety acquired during childhood, in relation to oral health and quality of life. The concepts of pain related to dental treatment and of dental anxiety are presented. Alternatives to conventional restorative dental treatment are discussed, highlighting their low invasive approach and their potential to be more child-friendly. An overview of some instruments used for assessing dental pain and dental anxiety in young children is also provided. Finally, the primary and specific aims of the PhD study are stated.

1.1 Dental caries experience in Brazilian children and quality of life

The Ministry of Health of Brazil carried out a national oral epidemiology survey (*SB Brasil*) amongst 5- to 74-year-old people in 2010. The results showed a caries prevalence of 43% for children aged 5, with a mean dmft score of 2.3. At the age of 12 years, the caries prevalence was 56% and the mean DMFT score was 2.1. Caries prevalence was 60% in the group aged 15 to 19, with a mean DMFT score of 4.2. These results were obtained through examining 38.000 people, representing the population of the five different regions of Brazil (1).

Besides reporting caries prevalence, the *SB Brasil* (1) also identified the main dental treatment needs of different age groups. Amongst children, untreated carious lesions was the major problem, with the d-component representing more than 80% of the dmft-index at the age of 5. Furthermore, 21% of the 5-year-old children reported that they had been suffering from dental pain during the last six months before the epidemiological survey. These outcomes indicate that much needs to be done in terms of intensifying oral health promotion and increasing the number of dental treatments, in order to improve the oral health status of Brazilian children.

The situation presented above is a matter for concern, as the impact of poor oral health on the children's quality of life is unquestionable. It is known that untreated dentine cavities may lead to pain and discomfort which may initiate the development of dental anxiety (2). It has also been affirmed that negative dental experience, as well as dental anxiety are related to avoidance of dental care (3). This association has an immediate effect on the oral health status of young people (4-6). These facts are illustrated as a vicious cycle in which all of the variables have a direct impact on the quality of life (Figure 1).

In order to improve oral health and, consequently, quality of life, this cycle must be broken at its beginning; preferably during childhood, as dental caries has an effect on the general health and well-being of young children. Sleep disturbances, absence from school and behavior troubles are said to be frequently related to dental problems during early childhood (7,8). One or more

negative impacts on their well-being, resulting from dental pain, were reported for 59,3% of Brazilian preschool children (9). It is, furthermore, known that some negative dental experiences acquired during childhood can initiate social and psychological disturbances in adult life, affecting performance at work, relationships and daily living (10).

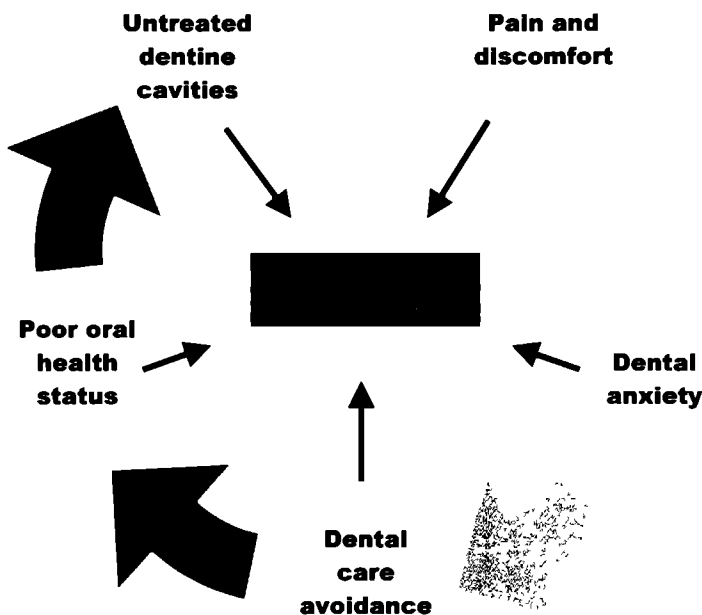


Figure 1 – Vicious cycle representing the impact of untreated dentine cavities on quality of life.

1.2 Pain related to dental treatment

Untreated dentine cavities are considered the main entry point of the vicious cycle. They may lead to pain and discomfort over time. Besides toothache derived from untreated dentine cavities, pain may occur as a consequence of an inappropriately administered dental treatment. This is a polemic issue, as it involves both knowledge of the most suitable treatment approach to be used with each patient, and the technical skills necessary for correctly performing the selected approach.

Understanding the process of pain that is related to dental treatment is challenging, as pain itself can often be considered a psychological reaction. Pain is a highly complex and subjective experience that is used by the organism to make the individual aware of danger (11). It has been found that in many situations, pain sensation is not related to tissue damage, but to the idea of such damage. This often happens in dentistry, in which conditioned stimuli such as the sound of the drill and the sight of the local anaesthesia needle can initiate a psychological pain reflex (12).

Administering local anaesthesia is frequently pointed out as the only part of a dental procedure that is perceived as causing pain (13). On the other hand, the absence of local anaesthesia may lead to a pain stimulus when the drill is used for cavity preparation (14). In light of this, a treatment approach that would cause little or no pain, even in the absence of local anaesthesia, would be beneficial.

In pediatric dentistry, children and their parents commonly complain about a previous dental treatment that hurt the child and led to uncooperative behaviour from that child (15). This indicates that a pain-free dental treatment approach is urgently needed in order to reduce the occurrence of “dental trauma” during childhood.

At this point, toothache and pain derived from dental treatment will lead to the same consequences: the individual will enter the vicious cycle shown in Figure 1.

1.3 Dental anxiety

Dental anxiety is the next step in the vicious cycle. It can be defined as an unpleasant feeling of apprehension about dental treatment, which is not necessarily connected to a specific external stimulus (16). This phenomenon is often initiated by negative or traumatic dental experiences during childhood, such as a history of extraction, and may also be influenced by having a dentally anxious parent (4).

A critical literature review estimated that 9% of the world population suffers from dental anxiety (17). It should therefore be considered a serious health problem, as dental anxiety has long-term effects because it remains stable and is difficult to alleviate (18). An example is the irregular pattern of dental attendance presented by highly dentally anxious individuals (3). Moreover, dental anxiety and irregular dental attendance have been pointed out as being predictors of dental caries incidence (6). The poor oral health status of dentally anxious individuals, together with their newly developed untreated dentine cavities, will complete the vicious cycle and may lead to a decreased quality of life.

1.4 Minimal Intervention Dentistry for managing dental caries

On the basis of what has been discussed so far, it is obvious that oral care providers should avoid any painful treatment that has the potential to contribute to the development of dental anxiety, especially during childhood. For this purpose, the use of minimally invasive dental treatments in conjunction with behaviour management and precise indications for the administration of local anaesthesia would be particularly helpful. Because behaviour management requires specific special skills that not all oral care providers possess (19), the replacement of conventional restorative treatment by less invasive techniques would be most desirable.

Minimally invasive treatment is part of the philosophy of Minimal Intervention Dentistry (MID). MID is firstly based on prevention, remineralization, monitoring of enamel carious lesions and, in case restorative

treatment is required, minimal removal of demineralized dental tissues and the use of adhesive filling materials (20). Monitoring the patient allows the professional to institute caries preventive management techniques early, as well as restorative intervention, as soon as the carious lesion progresses into a cavity. MID has the potential to reduce the need for restorative care.

However, in some cases the patient seeks dental treatment when cavities are already large. These can be treated by using less invasive techniques; such as the Atraumatic Restorative Treatment (ART), in which only hand instruments and adhesive restorative materials are used (21). In treating larger cavities in primary teeth of young children, a relatively new care approach (ultra-conservative treatment) can be used. ART and ultra-conservative treatment approaches will be discussed in the following sections.

Atraumatic Restorative Treatment (ART)

The Atraumatic Restorative Treatment (ART) was introduced in the mid-1980s as part of a primary oral health-care program of a dental school in Tanzania, Africa. The initial idea was to provide dental treatment to underserved communities where electricity and treated water were not available (22).

The technique consists of two components: sealants for caries-prone pits and fissures and sealant restorations for cavitated dentin lesions. ART involves using only hand instruments for the removal of soft demineralized tooth tissues. This ensures that a maximum of healthy tooth tissues are preserved. Local anaesthesia is seldom required, as the removal of necrotic tooth tissues causes little to no pain. Therefore, ART can be considered atraumatic with regard to both the tooth and the patient who is undergoing dental care. The caries removal process is followed by restoration of the cavity and sealing of any associated fissures and pits with an adhesive material, preferably a high-viscosity glass ionomer (21,22).

Many studies on ART have been reported since its initiation. A recently published systematic review concluded that amalgam restorations and ART restorations using high-viscosity glass ionomer are equally successful (23). With regard to ART sealants using high-viscosity glass ionomer; the findings of a

meta-analysis showed that its caries preventive effect is high (annual caries incidence of 1%) (24).

Another interesting observation about ART concerns its excellent short-term cost-effectiveness, which makes it an element of care suitable for inclusion in public oral health care policies (25).

The acceptability of ART by the patients needs to be highlighted, as a number of studies have demonstrated its potential to cause less pain and discomfort than is caused by the conventional restorative treatment (26-29). These studies were conducted among children and adolescents across a wide age range (5 to 18 years old). In each study a different method of assessing pain or discomfort felt during dental treatment was used. For this reason, it is difficult to carry out a systematic review regarding the notion that ART is less painful than the conventional treatment.

With regard to dental anxiety, only two studies had compared ART and conventional restorative treatment (30,31), and it is interesting to note that their outcomes differed. Mickenautsch et al. (30) concluded that the patients treated according to the ART approach presented lower levels of dental anxiety than did those who received conventional restorations. In the second study, there was no difference in levels of dental anxiety amongst children treated with ART and conventional restorative treatment (31). These two studies share the same error of having used the dental anxiety scales after the dental treatment session was completed, which did not comply with the protocol for the use of these instruments of measurement.

Although many studies have been carried out on ART, only a few have investigated its effect on dental anxiety and pain experience and, due to the reasons mentioned in the previous paragraphs, those that have investigated it cannot be fully trusted. Further investigation is, therefore, needed in the field of ART acceptability among the people seeking oral care.

Ultra-conservative treatment

Another example of a less invasive dental treatment is called ultra-conservative treatment. It comprises supervised plaque removal from large cavities and placing of ART restorations in small cavities in primary teeth. The medium-sized cavities are enlarged with hand instruments, to allow adequate plaque removal. If enlargement is not possible, an ART restoration is made.

The argument used for not restoring these large cavities, but keeping them plaque free, is vested in the fact that a large percentage of untreated cavitated deciduous teeth exfoliate without any symptoms (32,33). These findings were based on retrospective data from children who had not received any hygiene instructions or caries management other than the extraction of painful decayed teeth. So it could be argued that applying the ultra-conservative treatment would lead to an even higher number of exfoliated deciduous teeth without symptoms. Furthermore, as this approach does not involve the use of burs or local anesthesia, it is also expected that it will be less anxiety-provoking than the conventional restorative treatment. However, these hypotheses have not yet been studied.

1.5 Instruments for assessing pain and dental anxiety in children

Assessing pain and dental anxiety may be one of the most perplexing tasks for pediatric dentists and researchers who work with children. This can in part be explained by the children's lack of ability to report on the subjective experience of pain (34), as well as difficulties involved in recognizing and interpreting the physiological and cognitive manifestations of anxiety (35).

The different approaches available for measuring pain and dental anxiety in children include observational/behavioural, physiological and self-reporting measures (36,37). Although observational/behavioural techniques are commonly used in young children (35), the fact that they rely on observations by others of each child's reaction may result in bias in their outcomes, as some of these reactions can be related to issues other than the dental treatment received. With regard to the physiological measures, which often involve heart

and respiration rates, oxygen saturation and condition of the eye pupil, it can be argued that other situations, such as fever or effort (e.g., walking from home to the dentist), can affect their reliability (34).

Self-report instruments are considered the most reliable tools for pain and dental anxiety assessment, as they reflect the individual's own opinion about the dental treatment. Although it has been affirmed that young children cannot understand and use self-report scales (37), instruments containing pictures are usually well accepted by both children and their parents (38). In addition, picture scales for pain assessment have been extensively tested, presenting significant evidence regarding their reliability and validity (37-40). However, information on the psychometric properties of dental anxiety picture scales is unavailable (35,36).

Pain assessment instruments

Different instruments aimed at assessing pain in children have been developed; such as behavioural measures, numerical rating scales, visual analogue scales and pictorial face scales (34,41). The latter type has been considered the best measurement instrument for use with young children (42). Table 1 presents a summary of the recommended facial picture pain scales for use in young children. This recommendation was based both on a systematic review that investigated the psychometric properties of different self-report pain instruments for children (37) and on a systematic review which reported advantages and disadvantages of different face-based pain scales available for children (42).

A number of studies have identified the Wong-Baker FACES Pain Rating Scale (Wong-Baker) (39) as the one preferred by children and parents (37-40,42). It is quick and simple to use, requiring minimal instruction (42). Moreover, substantial evidence regarding the validity and reliability of the Wong-Baker scale has been reported (37). Experiences in using this scale are derived from studies carried out in the medical field. Its use in dental settings is restricted and, therefore, requires further investigation.

The Faces Pain Scale (FPS) (43) and the Faces Pain Scale-Revised (FPS-R) (44) present high validity and reliability. However, interpretability and

acceptability of these scales have limited evidence (37). Furthermore, when given a choice, children prefer the Wong-Baker to both the FPS and the FPS-R (42).

The Oucher (45) has evidence of validity and reliability but, in comparison with the Wong-Baker, FPS and FPS-R, it has a cultural limitation because it is a photographic scale (37,42). Beside this practical issue, the Oucher is considered to have low feasibility and clinical utility (37). In light of these reasons, this scale was excluded from use in this PhD study.

Table 1 – Recommended faces pain scales for children, according to age group and the number of publications in which the scales were used

Scale	Age	Number of publications
Wong-Baker FACES Pain Rating Scale ³⁹	3 - 18	≥ 56
Faces Pain Scale (FPS) ⁴³	3 - 12	≥ 26
Faces Pain Scale-Revised (FPS-R) ⁴⁴	4 - 12	≥ 22
Oucher ⁴⁵	3 -18	≥ 29

Based on Stinson *et al.* (37) and Tomlinson *et al.* (42)

Dental anxiety assessment instruments

A large number of instruments for assessing dental anxiety are in use. A literature search revealed a few instruments that have potential for use in children (Table 2). One is the *Corah's Dental Anxiety Scale (CDAS)* (46) that is the most widely used one, for both adults and children (35). As it is a complex questionnaire, the CDAS requires a parent to fill it in. In order to overcome this drawback for use in young children, the pictorial version of the CDAS was developed (47). As completing this picture scale takes at least 10 minutes per child, this scale was considered impractical for use in this PhD study.

CDAS was modified into the *Modified Child Dental Anxiety Scale (MCDAS)* (48). Its faces version, labeled *MCDAS_f* (49), comprises 5 faces ranging from very happy to very sad and corresponding to numbers 1 to 5. This helps the young children to understand the instrument. However, the validation of the *MCDAS_f* was conducted among 8- to 12-year-old children, who are at least 2 years older than the children we intend to investigate in this study. For that reason, this scale was not the first choice.

The *Venham Picture Test (VPT)* was the first picture dental anxiety scale developed for use in young children. It is quick and simple to apply and is indicated for use in 3-to 18-year-old children (50). However, some difficulties have been reported, especially regarding the ambiguous pictures presented in the scale cards (51). Furthermore, although the VPT has been used in many studies, the proper protocols described by the scale originators are not always adhered to, resulting in questionable outcomes (31). Considering the reasons mentioned above, studies using the VPT correctly need to be carried out, as suggested in the present study.

The *Facial Image Scale (FIS)* is said to be easier and faster to apply than the VPT (52,53). Moreover, it has been affirmed that being a simple row of five faces, the FIS could overcome the disadvantage of the ambiguous situations presented in the VPT cards (51). This instrument has been used in only few studies (53-56), which makes it an interesting subject for the present investigation. It is, moreover, indicated for use in children from 3 to 18 years old, which covers the age group that we shall investigate.

The *Combined Dental Anxiety Scale (Com-DAS)* is a combination of the faces from the FIS and the questions from the CDAS (57). It has been used in only one study and, unfortunately, the authors did not thoroughly describe the methodology used. For that reason the Com-DAS could not be considered for use in the present investigation.

Other instruments for assessing dental anxiety in children have also been described, but most of them have been cited in only one paper. Furthermore, they are mostly behavioural and observational tests, which are not the focus of this PhD study.

Table 2 – Dental anxiety scales indicated for use with children, according to type, age group and means of completion

Scale	Type	Age	Completed by
Corah's Dental Anxiety Scale (CDAS) ⁴⁶	Questionnaire	3 +	Parent
Pictorial version of the Corah's Dental Anxiety Scale ⁴⁷	Pictorial	5 - 9	Child
Faces version of the Modified Child Dental Anxiety Scale (MCDAS) ⁴⁸	Pictorial	8 - 12	Child
Venham Picture Test (VPT) ⁵⁰	Pictorial	3 - 18	Child
Facial Image Scale (FIS) ⁵²	Pictorial	3 - 18	Child
Combined Dental Anxiety Scale (Com-DAS) ⁵⁷	Pictorial	8 - 12	Child

1.6 Aims of the PhD research

The primary aim of this PhD research was to investigate the impact of the Atraumatic Restorative Treatment (ART) approach upon dental anxiety and the pain experience in school children in Brazil. The hypothesis was that the ART approach, in comparison to conventional restorative treatment, would result in less dental anxiety and pain from dental treatment.

The specific aims were as follows:

1. To review dental anxiety and pain related to the ART approach;
2. To investigate whether restorations produced through the ART approach are less painful than those of the conventional restorative treatment;
3. To test the usefulness of the Venham Picture Test (VPT) and the Facial Image Scale (FIS) in Brazilian children aged 5 to 7;
4. To assess the levels of dental anxiety in children 6 – 7 years old, treated according to the conventional, ART and ultra-conservative restorative treatments;
5. To assess the pain levels in children 6 – 7 years old, treated according to the conventional, ART and ultra-conservative restorative treatments;
6. To investigate the changes in the levels of dental anxiety in children, after 14.5 months of sequential dental visits.

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CHAPTER 2

Dental anxiety and pain related to Atraumatic Restorative Treatment

This chapter is a modification of the publication by Leal SC, Abreu DM, Frencken JE. Dental anxiety and pain related to Atraumatic Restorative Treatment. J Appl Oral Sci 2009; 17 (sp. issue): 84-88.

Abstract

Atraumatic Restorative Treatment (ART) is considered to be well accepted, both by children and by adult patients. The objective of this review is to present and discuss the evidence regarding the acceptability of ART, from the patient's perspective. Aspects related to dental anxiety/fear and pain/discomfort have been highlighted, to facilitate better understanding and use of the information available in the literature. The ART approach has been shown to cause less discomfort than conventional approaches and can, therefore, be considered a very promising 'atraumatic' management approach for cavitated carious lesions in children, anxious adults and possibly, for the dental-phobic patients. However, in order to confirm these initial findings, further investigations using well-designed research protocols are required.

Introduction

The atraumatic restorative treatment is a minimum intervention approach for managing carious lesions. Only hand instruments are used for cavity preparation and cleaning followed by restoration of the cavity and sealing pits and fissures with an adhesive material such as glass ionomer cement⁶.

The 'atraumatic' component of the technique can be understood from different perspectives, such as those of tooth tissue preservation and patients' comfort. Undoubtedly, using only hand instruments to open and clean the cavity preserves more sound dental structure than does the traditional approach that recommends the use of the drill²⁴. In this respect, the ART approach is definitely less traumatic to the tooth than the conventional method. It also has the capacity to be more comfortable for patients, as the noise and vibration related to the bur are absent. This 'atraumatic' effect is further enhanced by the fact that local anesthesia is rarely used in the ART approach^{9,11}. This indicates that ART is a treatment that inflicts only a low level of trauma upon the patient. Finally, because the patients are more relaxed when ART is used in treating them, the technique may also reduce operator stress during interaction with the patient; and therefore, prove less traumatic to dentists than traditional methods¹³.

The objective of this review is to present and discuss evidence regarding the acceptability of ART from the patient perspective. Aspects related to dental anxiety/fear and pain/discomfort will be highlighted in order to engender better understanding and use of the information available in the literature.

ART acceptability: literature evidence

In general, results retrieved from different clinical trials, conducted in different regions of the world, show that ART is well accepted both by children and by adults treated in accordance with this approach^{6,18,22}. Specific methodological designs have been developed in order to demonstrate its effectiveness in terms of reducing patients' dental anxiety and causing less pain than the traditional approaches cause.

To investigate pain associated with both ART (using hand instruments) and a conventional approach (using high and low speed handpieces), in the removal of carious tissues, at the end of the restorative session a group of adolescents were asked whether any pain was felt during treatment. The authors concluded that ART was less painful than the conventional restoration technique¹⁸. This finding is in agreement with that of Schriks and van Amerongen¹⁹ (2003), who concluded that children treated according to the ART approach experienced less discomfort than those treated with rotary instruments. In both cases local anesthesia was not used. Nevertheless, in the latter study discomfort was not individually reported by the patient, but was assessed through physiological measurements (heart rate) and behavioral observations on specific moments during the treatment (entrance, start, deep excavation, matrix placement, restoration and at the end of treatment). Analysis of behavioral observations and physiological measurements showed only a moderate correlation, while behavioral scores demonstrated that children from the ART group were more relaxed throughout all the treatment procedures than were children treated with rotary instruments. The physiological measurements were able to detect significant differences between the groups during deep excavation only. However, the intercorrelation between different ways of assessing dental anxiety is usually low, which can be explained by the multidimensional fear construct. Each measurement technique taps into a unique part of the process¹.

Due to structural characteristics of dentin, it is expected that more pain will be experienced in relation to deep cavities. This association was demonstrated in a study that aimed to determine the level of sensitivity related to cavity size and lesion depth, experienced by adolescents during ART cavity preparation⁶. The report of pain and discomfort was, in general, low; more frequent experienced in large than in small cavities and in cavities with the floor close to the pulp. Tubules extending through the dentin, that are greater in density near the pulp than at the outer periphery, are the pathway for sensitive stimuli transmission¹⁴. This explains the association of cavity depth and reports of pain.

Little information is available regarding pain and discomfort related to the ART approach for both adults and young children. Pain assessment is not easily performed in children, as they have difficulties in expressing their emotions and feelings²⁷. This problem was described by Abreu et al.³ (2009). Pain experience in a group of young children (4 to 7 years old) after they had been treated according to the ART approach was compared with that of a group treated in accordance with a conventional approach using rotary instruments with local anesthesia and rubber dam. Children from the ART group reported less pain than those from the conventional one. The second finding was that 4 year-old children reported more pain than children aged 5 to 7 years old, independently of the treatment provided. The authors observed that the youngest children had experienced some difficulty in interpreting the pain rating scale used in the study.

In discussing dental anxiety in relation to ART, two contradicting studies have been published^{13,22}. Mickenautsch et al.¹³ (2007) concluded that patients (children and adults) treated with the ART approach were less-anxious than those treated by traditional methods using the drill and bur. In this study, patients' anxiety levels were assessed immediately after the restorative session had been completed. Two different interpretations of the results are possible: either the patients experienced less trauma using ART and were therefore less anxious or the patients treated by the ART approach were initially less anxious than those treated according to the traditional approach, and thus experienced less trauma. If dental anxiety in these studies would also have been assessed prior to the treatment, the treatment effect could have been established.

In the second study, the authors were not able to demonstrate any difference in dental anxiety levels amongst children from 3 treatment groups (traditional, ART and ART in combination with a chemomechanical caries removal gel). As in the previously discussed study, the dental anxiety assessment was performed at the end of the treatment session. This method does not follow the common way of assessing dental anxiety, which should be carried out before the start of the dental visit and not after it has been completed. This factor might be the reason for the contradictory findings of the two studies.

On the basis of the information provided, it can be concluded that dental/fear and pain/discomfort related to different restoratives procedures require further investigation. Studies should include confounding factors; such as age, gender, operator influence and cultural aspects^{7,19}. Furthermore, methodological aspects should be given due attention, as both fear/anxiety and pain/discomfort levels may also be influenced by subjective aspects like emotional responses and social determinants¹⁰. Lastly, fear/anxiety and pain/discomfort assessment instruments should be used according to the instructions described in the original protocols.

Anxiety, fear, pain and discomfort associated with dentistry

Dental anxiety can be defined as a feeling of apprehension about dental treatment, not necessarily related to a specific stimulus⁷, while dental fear is a normal emotional reaction to one or more specific threatening stimuli in the dental situation¹⁰. Both terms are currently being used interchangeably in the dental literature when referring to negative feelings related to dental treatment. According to Panksepp¹⁷ (1982), the difference between fear and anxiety seems to reflect only the intensity.

A critical literature review estimates that 9% of the world population suffers from dental fear/anxiety, with a decrease in prevalence as age increases¹⁰. The etiology of dental anxiety is multifactorial, being strongly correlated to a history of dental pain in both adults and children^{15,26}. A comparison of anxious and non-anxious children demonstrated that fear was more strongly associated with children's experience of pain and trauma than with objective dental pathology²³.

Dental anxiety/fear may negatively impact on a person's life. According to Cohen et al.⁵ (2000), physiological impacts include fright response and feelings of exhaustion after dental appointments, while behavioral impacts include dental avoidance. It is well established that anxious individuals frequently avoid dental treatment, either by failing to appear for their dental appointments or by delaying dental visits for long periods of time¹².

The interaction between anxiety and dental pain, as investigated by van Wijk and Hoogstraten²⁵ (2005), suggests that people who respond fearfully to pain are at an increase risk of ending up in a vicious cycle of anxiety, as shown in Figure 1. If this cycle is not broken, a severe form of dental fear might develop. This can be defined, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), as a specific phobia - dental phobia. This phobia is characterized by marked and persistent anxiety in relation either to clear discernable situations (e.g.: drill, needle) or to the dental situation in general⁴.

Some interesting results related to the prevalence of dental fear and dental phobia in comparison to 10 other common fears and subtypes of specific phobia were reported in a recent investigation. The prevalence of dental fear was considered high (24.3%), but lower than that of fear of snakes, heights or physical injuries. Surprisingly, among the phobias, dental phobia was the most prevalent (3.7%)¹⁶. These findings should alert both researchers and dental practitioners to this very real issue with the objective of seeking ways to improve the condition.

Dental fear usually starts in childhood with a negative experience, commonly expressed as having had a painful event and/or being treated by a rough dentist². Although it tends to decrease with an increase of age¹⁰, dental anxiety/fear can persist into middle and advanced adulthood¹⁶. It is essential, therefore, that dentists are capable to identify these patients, in order to plan the dental intervention that can reduce each individual's anxiety level.

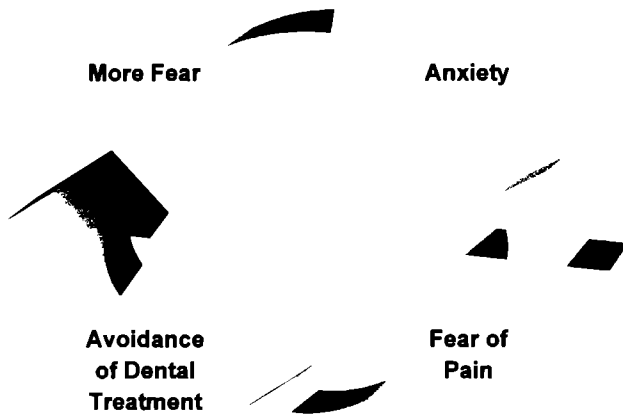


Figure 1 – Vicious cycle of anxiety: modified from Wijk and Hoogstraten (2005)

Perspectives: ART as a tool for patient management

As previously discussed, dental fear is a potentially distressing condition: not only for the patient, but also for the dentist. The best strategy for dealing with this condition in children would be to employ appropriate pediatric management techniques that could assist the practitioner in identifying dental-anxious children as early as possible and to use dental interventions that cause the least possible psychological negativity.

The most common fear-inducing aspects of the dental treatment are the procedures related to the needle and the drill^{20,21}. Individual vulnerability and perceptions of negative dentist behavior also play an important role in patients' dental anxiety development².

In light of all these aspects, Atraumatic Restorative Treatment may become an important "tool" for managing carious dental lesions, both for young children and for anxious adults. The ART approach is based using only hand instruments to open the cavity and remove carious tissue⁸. This aspect may have a positive impact on patients' experience of discomfort, as the drill is not

used. Because of that, the usual vibration and noise related to this equipment is not present and this facilitates better interaction between patient and dentist. In addition, because of removal of infected dentine only, local anesthesia is almost never required¹³. Thus, the ART technique is considered less traumatic, less painful and friendlier than the conventional restorative interventions. Further investigations, with well- designed research protocols are required in order to confirm these assumptions.

Conclusions

Dental fear/anxiety and dental pain/discomfort are multifactorial phenomena that can negatively impact on an individual's life. Dentists should be able to identify, and be prepared to treat, fearful patients in a way that reduces their levels of anxiety. The ART approach has been shown to cause less discomfort than other conventional approaches and is, therefore, considered a very promising "atraumatic" management approach for cavitated carious lesions in children, anxious adults and possibly, for dental-phobic patients. However, in order to confirm these initial findings, further investigations using well-designed research protocols are required.

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CHAPTER 3

Self-report of pain in children treated according to the atraumatic restorative treatment and the conventional restorative treatment – a pilot study

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Abstract

Objective: To compare the level of pain among children treated according to the Atraumatic Restorative Treatment (ART) and the Conventional Restorative Treatment (CRT). **Study design:** Forty children of both genders, 4-to 7-years old, presenting Class I cavitated dentin lesions in primary molars were randomly allocated to 2 groups. One group (CRT) received conventional restorative treatment using rotary instruments, while in the other one (ART) hand instruments were used to perform the restorations. All children were treated by the same operator. A high-viscosity glass-ionomer cement (Fuji IX) was used to restore the teeth in both groups. Children's pain was measured at the end of the first restorative treatment session using the Wong-Baker FACES Pain Rating Scale (dependent variable). Age, gender, treatment time and treatment group were independent variables. ANOVA and ANCOVA tests were used to analyze the data. **Results:** The CRT procedure took longer than the ART procedure ($p < 0.001$). Children from the ART group reported less pain than those from the CRT group ($p = 0.0037$). Four year olds reported more pain than 5-to 7-year olds ($p < 0.0001$) in both groups. **Conclusions:** Restorations placed using ART were less time consuming, children felt less pain when the ART approach was used, and younger children (4-years) reported more pain than the older ones for both restorative treatments.

Introduction

Pain is frequently associated to dental treatment, especially in pediatric dentistry. It can be defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage. However, many people report pain in the absence of tissue damage or any likely pathophysiological cause; usually this happens for psychological reasons.¹

In dentistry, the administration of local anesthesia is, in some cases, perceived as the only painful part of the dental treatment² and it has been reported a factor in avoiding dental care.³ Furthermore the sound and vibration of a bur has been experienced and explained as pain.⁴

Over the last two decades, a new philosophy that recommends a more conservative approach to manage carious lesions has emerged – Minimum Intervention Dentistry.⁵ One of the treatments following this recommendation is the Atraumatic Restorative Treatment (ART) that is said to cause little or no pain to the patient.⁶

ART consists of removing decayed tooth tissues using only hand instruments and restoring the cleaned cavity with an adhesive material, frequently a high-viscosity glass ionomer cement.⁶ Reasons for the virtual absence of pain experienced with ART include the fact that local anesthesia is hardly needed ^{4,7-9}, and the absence of rotary instruments that minimizes patient's anxiety and discomfort.¹⁰ ART is being considered an excellent introduction to dental care and can help to overcome the pain related to the use of the drill and local anesthesia¹¹. Due to these advantages, the use of ART in daily dental practice has been propagated.^{7,11,12}

Studies assessing pain or discomfort related to ART report that this approach is more patient-friendly when compared to other restorative treatments.^{4,8-10,13} However, they differ concerning the methodology used to assess the level of pain.

Different instruments have been developed aimed to measure pain related to the dental treatment.^{14,15} Among them, are faces scales which became the most popular approach to elicit children's self-reports of pain.¹⁵ These scales

had been proven to be more appropriate for use with younger children than the scales that are based on numbers, colors or words.^{16,17} In the present pilot investigation the “Wong-Baker FACES Pain Rating Scale” (Wong-Baker) was selected as it was especially developed to evaluate pain in young children that still have difficulty to express their emotions and feelings^{16,17}, and as it had not been used frequently whilst it was considered the best faces scale to assess pain in medical, but not dental, treatment according to a systematic review.¹⁵

This study aims to test the hypothesis that children will experience less pain when treated with ART than with the conventional restorative treatment (CRT).

Material and methods

Study design

The present randomized controlled clinical trial was carried out in the Pediatric Dentistry Clinic of the Brazilian Dental Association in Brasília, Brazil. Ethical approval was obtained from the Research Ethics Committee of the Brasília Medicine School (056/2006). Children's parents or guardians received and signed the individual informed consent form containing information about the research and the treatment approaches.

Children were selected from those attending the dental clinic of the Brazilian Dental Association. The study inclusion criterion was having at least one carious lesion involving the occlusal surface of primary molars without pulp involvement and without pain. The children were randomly allocated to a test and control group using a series of computer generated random numbers.

Treatment procedures

The control group was treated according to the conventional restorative treatment (CRT) that was performed under local anesthesia and rubber dam protection using rotary equipment. Cavity cleaning was restricted to removing all carious tissues in enamel and dentine using the drill. The test group was treated according to the ART guidelines using hand instruments only.⁶ The restorative material used for both approaches was the high-viscosity glass ionomer

cement, - Fuji IX (GC®, Japan), which was hand mixed by a trained dental assistant according to the manufacturers' instruction. Both groups were treated in the dental clinic of the Brazilian Dental Association by one and the same operator without the presence of a parent in the treatment room.

Evaluation

The Wong-Baker FACES Pain Rating Scale (Wong-Baker) consists of 6 pictures representing feelings ranging from "no pain" to "extreme pain" (Figure 1). The originators of the scale suggest that the operator describes the scale to the children, mentioning that each face is for a person who feels happy because (s)he has no pain (hurt) or sad because (s)he has some or a lot of pain.^{16,17} At the end of the first restorative treatment session, the assistant showed the scale to the children without mentioning the word pain. The children were asked to point to the picture that best described their feelings regarding the treatment they just received.

Treatment time was recorded by the dental assistant from the beginning of procedure (when the dentist first lift the instruments) until the restoration was concluded (bite adjustment), using a stopwatch.

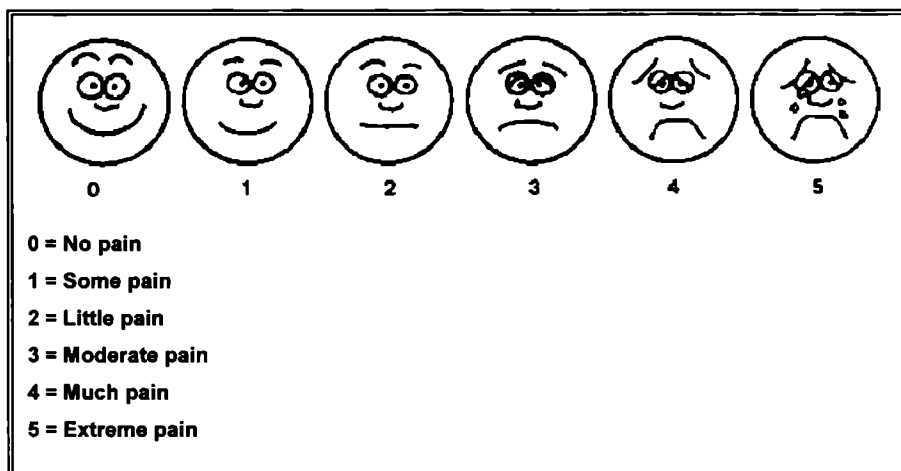


Figure 1. Wong-Baker FACES Pain Rating Scale

Statistical analysis

The dependent variable was the Wong-Baker score while the independent variables were age, gender, treatment group and treatment time. Because of the skewness of the data, the Wong-Baker was recoded into 3 categories (score 0, 1 and ≥ 2). ANOVA was used to analyze the effects and interactions of three independent variables (age, gender and treatment group) in one model. As the treatment time between ART and CRT groups differed statistically significantly, an ANCOVA with treatment time as co-variable was carried out on the dependent variable. The statistically significant level was set at 5%.

Results

The sample consisted of 40 children (21 boys and 19 girls) with a mean age of 5.3 years (SD=1.2) ranging from 4-to 7-years.

ANCOVA test did not show an effect of treatment time on each of the treatment groups. The ANOVA test showed an age and treatment effect but no interactions on the recoded Wong-Baker scores. Four year olds reported statistically significantly more pain than 5-to 7-year olds ($p<0.0001$). Children treated using ART felt statistically significantly less pain than those treated using CRT ($p=0.0037$). The time needed to treat children using ART was statistically significantly shorter than for those children treated by CRT ($p<0.001$).

Table 1 shows the treatment time by treatment group, table 2 shows the mean Wong-Baker scores by treatment group and age, and table 3 shows the frequency distribution of Wong-Baker scores by age.

Table 1. Time (minutes) required for restorations' placement in the Atraumatic Restorative Treatment (ART) and Conventional Restorative Treatment (CRT)

Treatment	Minimum	Maximum	Average	SD
ART	10	30	19.0*	4.8
CRT	25	45	33.5*	5.9

* $p<0.001$

Table 2. Mean and standard deviation (SD) of Wong-Baker FACES Pain Rating Scale scores by treatment group and age.

N=number of children, ART=Atraumatic Restorative Treatment; CRT=Conventional Restorative Treatment

Treatment group	Age (years)					
	4			5-7		
	Mean	SD	N	Mean	SD	N
ART	1.7	2.0	7	0.2	0.4	13
CRT	2.5	1.2	6	0.9	1.3	14

Table 3. Frequency distribution (%) of Wong-Baker FACES Pain Rating Scale scores according to treatment group and age

ART=Atraumatic Restorative Treatment, CRT=Conventional Restorative Treatment

Treatment / Age (yrs)		No	Some	Little	Moderate	Much	Extreme
ART	4	30	42	-	-	14	14
	5	50	50	-	-	-	-
	6	100	-	-	-	-	-
	7	100	-	-	-	-	-
CRT	4	-	18	50	-	32	-
	5	50	32	-	-	-	18
	6	-	100	-	-	-	-
	7	75	25	-	-	-	-

Discussion

There are few literature reports that investigated the patient feelings related to the ART in comparison to CRT. Some studies assessed pain through simple questions or more elaborated questionnaires.^{4,8,18,19} Schriks and van Amerongen¹⁰ assessed discomfort through the Venham Picture Test, which was also used by Topaloglu-Ak *et al.*²⁰ to evaluate dental anxiety. The Venham Picture Test was developed to assess dental anxiety, and its originators recommend that this scale must be applied at the beginning of each dental

visit.¹⁴ As the aim of the present investigation was to assess self-reporting pain related to ART and CRT, the Wong-Baker FACES Pain Rating Scale was chosen. According to Chambers *et al.*¹⁵, after comparing different faces scales for the measurement of pediatric pain the conclusion was that the majority of children and parents preferred the scale by Wong and Baker.

Despite the advantages presented above, the scale has some limitations. The major one refers to the "no pain" face being represented by a smiling face, what can result in higher pain ratings when compared to scales with neutral "no pain" faces.¹⁵ In the present study, it was observed that the youngest children (4-year-olds) had some difficulty to understand the task and seemed to be confused with so many options presented in the scale. For example, score 5 – "extreme pain" was only selected by those who really cried during the operative procedure. What about those who felt a lot of pain but did not cry? Apparently, they did not select the face number 5, once the tears are more connected to the cry itself than to the pain intensity.

Another issue to be addressed is the dental anxiety level as a confounding factor for the pain reports. In this study, the youngest children reported more pain in both treatment groups, with significant difference in the answers given by the 4 and 5-to 7-years-old children. This fact can be related to level of dental anxiety presented by the children prior to the treatment session, as according to Vassend *et al.*²¹ dental anxiety is significantly related to pain reports. Although Newton and Buck²² affirmed that children do not have a fully developed ability to recognize manifestations of anxiety, it is known that young children are usually more apprehensive than older ones.²³ Therefore, the best strategy to eliminate this potential bias should be measuring the level of dental anxiety before the treatment session, and the intensity of pain immediately after the treatment is finished.

The ART approach presents some advantages in relation to conventional treatments. It is said to reduce the occurrence of pain and discomfort and the need for local anaesthesia.¹⁸ These advantages justify the indication of the ART approach for young children who are affected by dentin carious lesions, once needle-related procedures are a common source of pain and distress for children²⁴. However, there are few reports comparing pain experienced during

ART and conventional treatment approaches, especially in pre-school children.¹³ In addition, two other aspects must be highlighted: 1- the restoration procedures in the different studies conducted with the objective to assess pain or discomfort were performed by more than one operator, what can influence the children's behaviour pattern and 2- the way conventional treatment is defined. Although it is established that adhesive materials, such as glass-ionomer, should preferably be used with the rubber dam protection²⁵, there is no study in which ART and conventional restorations placed under this condition have been compared.

The results of the present investigation showed that children from the ART group reported less pain than those from the CRT group. This was expected, because administering local anesthesia and placing rubber dam was part of the protocol for the CRT procedure. Even in studies where ART was compared to the traditional approach without dental injections, the same findings were observed.¹⁰ In a previous study, van de Hoef and van Amerongen²⁶ demonstrated that local anesthesia had no influence on discomfort during treatment when ART and CRT were performed with and without local anesthesia. However, their results referred to differences on behaviour during "deep dentin excavation" and "start of restoration", whereas body movement was associated to discomfort. The moment in which the local anesthesia was administrated was not taken into account.

The ART restorations took less time to be completed than the conventional ones. This finding can initially cause some surprise, once previous studies have shown an increase on time required for the ART approach.^{9,27} This difference can be explained as in the present study the CRT was conducted with the use of the rubber dam and local anesthesia. Additionally, it should be considered that the total time for the whole procedure was recorded, from the moment the operator lift the instruments until bite adjustment, not only the time for cavity preparation and restoration placement. In accordance with our results, Lin *et al.*¹³ affirm that the use of the routine technology (drill and slow hand piece) for cavity preparation and carious tissues removal can take more time than the ART approach in cases where a lot of necrotic tissue need to be removed. They

concluded that ART could have been better accepted by pre-school children because it was faster than the traditional approach.

In the present study, the four year olds reported more pain for both treatment approaches. However, this finding could be influenced by their young age, so it is not possible to state that they really felt pain. As the assistant did not mention the word pain when describing the scale to the children and based on their behaviour observation, it is possible that the chosen Wong-Baker score was not only related to pain, but also to any sort of discomfort felt during the restorative procedures. It means that children who are not in pain are not necessarily happy.

Taking into account the arguments discussed above the recommendation would be to repeat the study on a larger number of individuals to confirm the results of this pilot study.

Conclusions

- The children felt less pain when the restorations were performed by the ART approach;
- The youngest children reported more pain in both treatment groups;
- ART was less time consuming than the conventional restorative treatment.

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CHAPTER 4

Correlation between two picture scales to assess dental anxiety in Brazilian children

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Abstract

The assessment of dental anxiety may be one of the most difficult aspects for pediatric dentists and for researchers who work with young children. **Aim:** This study aimed to test the correlation between two scales developed to assess dental anxiety in children: the Venham Picture Test (VPT) and the Facial Image Scale (FIS). **Methods:** One hundred and nine children of both genders, aged 5 to 7 years old, were invited to respond to the VPT and the FIS in the waiting room, minutes before attending a scheduled dental visit. The VPT comprises eight cards, with two figures on each card; one 'anxious' and one 'non-anxious'. The children were asked to point at the figure they felt most like at that moment. The FIS comprises a row of five faces ranging from 'very unhappy' to 'very happy'. The children were asked to point at the face which could best reflect their feelings at that moment. ANOVA and Spearman's Rank Correlation Coefficient were used to analyze the data. **Results:** The results showed no correlation between the VPT and the FIS scores. There were no age and gender effects observed on the dental anxiety scores obtained with either scales. **Conclusion:** It was concluded that the VPT and the FIS were not correlated, suggesting that cultural aspects shall be taken into account before selecting one of the instruments to be used in dental settings.

Introduction

Dental anxiety is an important aspect to be considered in relation to children's behaviour management during a dental visit. It is a worldwide phenomenon, recognized as one of the major barrier for the utilization of dental care^{1,2}. Furthermore, dental anxiety has been identified as a potential predictor of dental caries incidence³.

Dental anxiety can be defined as apprehension about dental treatment, which is not necessarily connected to a specific external stimulus⁴. In young children it often occurs because they do not fully understand the procedures related to the dental treatment⁵. Additionally, it is known that this behaviour is strongly related to unpleasant occurrences during childhood; such as negative and traumatic dental or medical experiences^{6,7}.

Despite the huge number of innovations and new technologies in dental care, one of the major challenges faced by the dental professional is still related to patient management. In lights of this, determining a way in which the least traumatic dental treatment can be provided and, thereby decreasing the dental anxiety amongst individuals, would be particularly helpful. For this purpose, dental professionals, especially paediatric dentists, need to be able to identify the dental anxiety levels of their patients prior to the start of the treatment. This information would definitely assist them in selecting the most suitable treatment approach according to the specific characteristics of each patient.

It is not easy to assess dental anxiety, especially in young children, owing to its multidimensional construct⁸. One widely used approach involves quantifying dental anxiety through psychometric tests, such as those involving picture scales and questionnaires. Although the validity of these techniques is questionable when they are used with adults, these tests have been considered suitable for measuring dental anxiety in children⁸, especially because few validated assessment methods for this specific age group are available.

Other measurement techniques, which rely on observation of reactions of the individual during dental treatment (e.g. behavioural measurements), are also considered useful for assessing dental anxiety in young children⁸.

Furthermore, changes in heart rate and blood pressure are known to be reliable physiological measures of dental anxiety⁹.

A combination of these techniques is often used in studies investigating dental anxiety^{10,11,12}. However, while questionnaires and scales refer to the cognitive component of dental anxiety, observational techniques are concerned with the behavioural aspect and physiological reactions are related to the physiological component. For that reason, correlations between these different components are often low or even do not exist, as each of them covers an unique aspect of the dental anxiety construct⁸.

In pediatric dentistry, special attention has been given to the use of picture scales to assess dental anxiety, as they seem to be the only instrument that can be answered by the young children themselves. Questionnaires are frequently answered by parents and observational methods also require the involvement of another person. There are few such instruments available for use with young children. The best-known ones are the Venham Picture Test (VPT)¹³ and the Facial Image Scale (FIS)¹⁴. These picture scales have been tested and used in dental anxiety studies in different parts of the world¹⁵⁻¹⁸, in cultural circumstances different from those of Brazil.

Modified versions of the VPT, with the inclusion of female and colored figures on the scale, have been used in Brazilian studies assessing children's dental anxiety¹⁹⁻²². However, investigations using the original version of the VPT, as well as the FIS, are unknown up to this date. Considering this, it is supposed that these two dental anxiety scales should be tested before their use in dental anxiety studies in Brazil. For this purpose, the aim of the present investigation was to assess the correlation between the Venham Picture Test and the Facial Image Scale in 5- to 7-year-old Brazilian children.

Material and Methods

Study population and sampling procedure

The present investigation was conducted in the Dental Clinic of the University of Brasília and in the Paediatric Dentistry Clinic of the Brazilian

Dental Association in Brasília, Brazil. Ethical approval was obtained from the Research Ethics Committee of the Brasília Medicine School (081/2008).

For inclusion, children had to be between 5 and 7 years old and scheduled for dental treatment at either dental clinic. All the included children were regular patients of both dental clinics. Besides that, they were attending the school at grades 1 and 2, and their socio-economic level was medium-low to low. The intake period was 8 weeks. Before the start of the scheduled dental visit, the children and their parents or guardians were approached in the waiting room, where the aim of the study was explained to them by the first author. The final sample comprised those children whose parents or guardians had agreed to sign the individual informed consent forms.

Dental anxiety evaluation

The instruments used to assess dental anxiety were the Venham Picture Test (VPT)¹³ and the Facial Image Scale (FIS)¹⁴, which are shown in Figure 1 and Figure 2, respectively.

The VPT comprises eight cards, with two figures on each; one being 'anxious' and the other one being 'non-anxious'. The cards were shown in their original order (1 to 8), and the children were asked to point at the figure that most closely pictured their feelings at that moment. The score for this scale was given by the sum of times that the 'anxious' figures were chosen. Therefore, the lowest score would have been 0 (least anxious), while the highest would have been 8 (most anxious).

The FIS comprises a row of five faces ranging from 'very unhappy' to 'very happy' and numbered from 5 to 1. The children were asked to point to the face which could best describe their feelings at that moment. The scores for this scale vary from 1 (least anxious) to 5 (most anxious).

To avoid an effect caused by the sequence of instruments' application, the VPT was always administrated first. The scales were individually applied and, according to the scales protocols, parents were asked not to contribute or interfere with their children's answers. Immediately after having received permission, the first author asked the children: 'Which of these figures best describes your feelings while you are waiting to be seen by the dentist?'. No

explanation was added. Using the two scales, each child assessed their own level of anxiety.



Figure 1 – Venham Picture Test (VPT)

From Venham, Bengston and Cipes¹³ (1977).

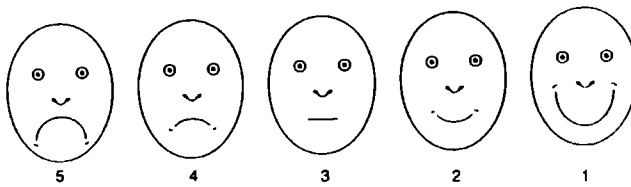


Figure 2 – Facial Image Scale (FIS)

From Buchanan and Niven¹⁴ (2002).

Statistical analysis

ANOVA was used to test for effects of the independent variables (gender and age) on the dependent variables, the VPT and FIS scores. Spearman's Rank Correlation Coefficient was used to test the correlation between VPT and FIS scores. The statistically significant level was set at $\alpha=5\%$.

Results

Disposition of subjects

The sample comprised 109 children with a mean age of 6 years: 49 girls and 60 boys aged 5-to 7-year olds. ANOVA showed no age and gender effects on the VPT and FIS scores.

Dental anxiety scales

The means and standard deviations for the VPT and FIS scales were 1.85 (1.91) and 1.66 (0.85), respectively. From the total sample, 77 children had low VPT scores (0, 1 and 2). Seven children had scores of 6 and 7. None had the highest score. Regarding the FIS, 89 children chose the most positive faces (1 and 2), while only 2 selected the most negative ones (4 and 5). The frequency distribution for the VPT and FIS scores is presented in Table 1.

Spearman's Rank Correlation Coefficient showed no statistically significant correlation between the VPT and FIS scores ($r=0.05$, $p=0.62$), indicating that these two instruments were differently interpreted by the children in this study.

Table 1 – Frequency distribution of dental anxiety scores for Venham Picture Test (VPT) and Facial Image Scale (FIS)

N=number of children *=not applicable

SCALE	DENTAL ANXIETY SCORES																	
	0		1		2		3		4		5		6		7		8	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
VPT	40	37	17	16	20	18	10	9,2	9	8,2	6	5,5	4	3,7	3	2,8	0	0
FIS	*	*	60	55	29	27	18	17	1	0,9	1	0,9	*	*	*	*	*	*

Discussion

Considering the importance of dental anxiety and its influence on the clinical management of individuals, being able to detect and assess its severity through using appropriate methods is essential for dental practitioners. Among the different measurement instruments available for this purpose, two self-reporting dental anxiety scales – the Venham Picture Test (VPT)¹³ and the Facial Image Scale (FIS)¹⁴ – were used in assessing the anxiety levels of Brazilian children in this investigation.

The VPT emerged in the 70's, and was one of the first dental anxiety scales specifically developed for children¹³. The major advantage of this instrument is the ease of its administration, which requires only one or two minutes. The VPT originators affirm that this is the best instrument for use in very young children¹³. Nevertheless, this instrument still needs to be investigated, as the main flaw attributed to the VPT is its lack of reliability and validity^{8,23}. Additionally, children who had participated in an investigation that used the VPT said that the meaning of some figures was unclear, which may have invalidated the scores obtained with the scale²⁴.

In the present study another problem regarding the VPT was observed. The cards that compose this scale have male figures and when they were presented to some girls, they replied that none of the pictures looked like them,

because the pictures were of boys. A solution to this problem could have been the use of the modified female version of the VPT¹⁹. This was not done, because the purpose of this investigation was to test the original version of both dental anxiety scales.

The FIS was first presented in 2002. Its originators have highlighted the scale's main advantages as being: (I) the easy and swift application (less than one minute); (II) the fact that it can be applied in children as young as 3 years old¹⁴. However, little information about the reliability and validity of FIS exists, which can be explained by the fact that it is a relatively new instrument. In a literature search, only one publication on the reliability of the FIS was found. The results of that study showed consistency in the responses to this scale at two different moments: (I) during the time in the waiting room and (II) when the child was seated in the dental chair, just before receiving the treatment¹⁵.

In the present investigation, some children hesitated when they were asked to point at the face that best described their current state of dental anxiety. They were confused because in the FIS the first face is 'very unhappy' and last one is 'very happy', corresponding to numbers 5 and 1, respectively. In Brazil the opposite order would be expected.

In light of the arguments presented above, it was not possible to determine whether VPT or FIS is the best instrument for assessing dental anxiety in Brazilian children. Nevertheless, there are indications that the FIS is possibly more child-friendly, and quicker and easier to apply than the VPT¹⁶. It was also found that it could overcome some disadvantages related to the ambiguous situations of the VPT cards²⁴. Furthermore, in this study the FIS seemed to be better understood by the children than the VPT.

The main outcome of the present investigation was that no correlation between FIS and VPT scores was observed. This result differs from the one of the FIS validation study that was carried out in the United Kingdom¹⁴. In the mentioned study, the authors reported a significant correlation between the FIS and VPT, with the latter being regarded as the gold standard¹⁴. It is not unlikely that cultural differences between children from the United Kingdom and Brazil may have influenced the self-reported outcomes of dental anxiety in these two studies. Folayan, Idehen and Ojo²⁵ (2004) affirmed that culture has influence on

the dental anxiety experience, the interpretation of its meaning and the responsiveness to it. This indicates that a multi-country, multi-centre study is needed to clarify the effect of culture on the use of self-reporting dental anxiety measurement instruments.

The lack of correlation between FIS and VPT indicates that children interpreted the instruments differently. It suggests that the use of one single measurement technique (e.g. picture scales) for dental anxiety may not be reliable, as FIS and VPT provided different results for the same child. Considering this, either of the scales should not be used as the sole instrument for assessing dental anxiety in schoolchildren. As Brand⁹ (1999) has shown that dental anxiety induces physiological reactions such as changes in blood pressure and heart rate, the recommendation is that self-reporting dental anxiety scales should be used in conjunction with physiological measurement instruments. Although these two measurement instruments relate to different parts of the dental anxiety construct, it would be interesting to verify whether their outcomes indicate the same direction.

In conclusion, the two dental anxiety scales tested in the present investigation – the Venham Picture Test (VPT) and the Facial Image Scale (FIS) – were not correlated, suggesting that cultural aspects shall be taken into account before selecting one of the instruments to be used in dental settings.

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Dental anxiety in 6 - 7 year-old children treated in accordance with conventional restorative treatment, ART and an ultra-conservative treatment protocols

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Abstract

Objective. To test the hypothesis that dental anxiety levels of children treated in accordance with the conventional restorative treatment (CRT) are higher than in children treated with the atraumatic restorative treatment (ART) or ultra-conservative treatment (UCT) protocols. **Materials and methods.** In total, 302 children aged 6–7-years old, with at least two dentine carious lesions, constituted the sample. A parallel group study design was used with ART and UCT as test groups and CRT as the control. The treatment was divided into two sessions. In the first session, one carious tooth (class II in a primary molar) was randomly selected and treated according to one of the treatments. All other treatments were performed in the second session. Before the first (FIS Tx-1) and before the second session (FIS Tx-2) the level of dental anxiety was assessed using the Facial Image Scale (FIS). The GLM test and Spearman's Rank Correlation Coefficient were used to analyse the data. **Results.** No treatment group effect was observed on the FIS Tx-2 score ($p = 0.64$). A FIS Tx-1 score ($p < 0.0001$) effect on the FIS Tx-2 score was observed. The correlation coefficient between FIS Tx-1 and FIS Tx-2 scores was $r = 0.30$ ($p < 0.0001$). **Conclusion.** At the beginning of the second session there was no difference in dental anxiety levels of the children treated in the first session according to the three treatment protocols. A high dental anxiety score before the first session was a predictor of a high dental anxiety score at the second treatment session.

Introduction

Dental anxiety has been recognized as a significant barrier to receiving dental care [1]. It is known that highly dental-anxious individuals generally have a high probability of irregular dental attendance or total avoidance of dental care [2]. The major impact of such behaviour is that their dental health is worse than that of non-anxious individuals [3]. Furthermore, it has been affirmed that dental anxiety is likely to be a predictor of dental caries and may be a risk factor for dental caries experience [4], although it has been demonstrated that no association exists between DMFT scores and dental anxiety in children [5]. This contradiction may indicate that the association between dental anxiety and dental caries in a child population is not straightforward and may be related to other factors such as age of the child and culture in which it is being raised.

In order to reduce the burden of dental diseases in dental-anxious individuals, the use of stimuli that provoke dental anxiety, such as the injection needle and the drill [6], needs to be reduced or eliminated. Improvements in administration of local anaesthesia have been achieved through the introduction of novel tools and techniques; such as electronic anaesthesia, the intraoral lidocaine patch, computerized anaesthesia (e.g. Wand System) and Syrijet® [7]. Quieter hand pieces have been introduced and dentists have been taught behavioural skills aimed at easing the stress of patients needing restorative treatment, in an attempt to reduce the prevalence of people experiencing dental anxiety. However, despite these technological advances, dental anxiety remains widespread, particularly among the very young [8].

Therefore, the possibility that a less anxiety-provoking restorative treatment technique might exist was considered very important, especially for professionals who deal with young children. A literature search into this topic revealed the existence of the Atraumatic Restorative Treatment (ART). This preventive and restorative treatment approach was recommended as being excellent for introducing potentially anxious individuals to dental care and thus helping them to overcome their fears related to traditional treatment that uses burs and local anaesthesia [9].

ART involves removing only the demineralized carious tissue, using specific hand instruments, and restoring the cavities with an adhesive material; usually a glass ionomer cement [10]. The 'atraumatic' aspect of this technique is related to the tooth itself, as only infected dentine is removed, and to the person receiving the dental treatment, who will feel little or no pain or discomfort during the restoration procedures [11]. This treatment approach is considered an example of minimal intervention dentistry [12]. It has been initially indicated for, among others, individuals who experience extreme fear and/or anxiety about dental procedures [13]. ART is also currently used in mainstream dentistry in private dental clinics in high-income countries [14].

Among many studies conducted on ART during the last two decades, only a few have dealt with ART and dental anxiety. The outcomes of those studies were very similar and showed that, when compared with the conventional approach, individuals treated with ART had lower or equal levels of dental anxiety [15-18]. However, none of these studies were conducted in a very young population and some methodological flaws were detected regarding the assessment of dental anxiety.

Another treatment that may provoke low levels of dental anxiety is the, so-called ultra-conservative treatment. Retrospective studies have reported that a large percentage of untreated cavitated deciduous teeth exfoliate without any symptoms [19,20]. In the former study caries management consisted of regular reinforcement of simple dietary and tooth brushing advice, while no specific caries management measures were administered in the latter study. It can be argued that, if supervised plaque control for cleaning large cavities takes place and if small cavities are restored, the number of untreated cavitated teeth that will exfoliated normally, will be even higher than reported. A prospective study, investigating aspects of this approach including the assessment of levels of dental anxiety, has not been carried out.

It is known that very young children have difficulty in understanding and reporting some emotions, such as anxiety or fear. Therefore, selecting the best instrument for self-reporting of dental anxiety is not an easy task [21]. The Facial Image Scale (FIS) is a validated and child-friendly picture scale that is recommended as an easy and fast instrument for assessing dental anxiety in

children from 3 to 18 years old [22,23]. Therefore, it was considered suitable for measuring dental anxiety in relation to different treatment approaches, currently applied in paediatric dental care.

The hypothesis tested was that dental anxiety levels of children treated in accordance with conventional restorative treatment are higher than in children treated with ART or an ultra-conservative treatment. Determinants of dental anxiety were also investigated.

Materials and Methods

Sampling procedure

The present investigation was part of a major study assessing the cost-effectiveness of three different carious dentine lesion treatment approaches in 6- and 7-year-old children. These were conventional restorative, ART and ultra-conservative treatments. The sample of subjects for the present investigation resulted from data derived from an oral health epidemiological survey carried out among grade 1 and 2 children of six public schools in the urban area of Paranoá, a satellite city of Distrito Federal located about 25 kilometers from Brasília, the capital of Brazil. Caries experience was assessed according to the ICDAS II criteria [24]. The inclusion criterion for children in the treatment study was the presence of 2 or more dentine carious lesions in primary molars, without pulp involvement and pain. The study followed a parallel group design. As only two schools were equipped for providing conventional treatment using drill and burs, these had to be chosen for the conventional group. The two remaining treatment groups (ART and ultra-conservative) were divided over the remaining four schools by flipping a coin.

This study was approved by the Research Ethics Committee of the Brasília Medicine School, reference 081/2008, and was registered at the Dutch Trial Registration Centre, with reference number 1699. Children's parents or guardians received and signed individual informed consent forms containing information about the aim of the study and the treatment approaches. None of the parents declined to sign the consent form.

Treatment approaches

The following three treatment groups constituted the main study: conventional restorative, ART and ultra-conservative. Three well-trained pediatric dentists performed the treatments in primary and permanent teeth of children on the school premises. Table I shows the number of restorations placed by operator and by treatment group during the first session. Participating children were asked whether they had toothache and, if so, which tooth was painful (Pain EPI).

Conventional restorative treatment

Conventional treatment involved use of the drill and burs for opening the cavity and removing carious tissues in primary and permanent teeth. Local anaesthesia was administered when requested by the children. The cleaned cavity was restored with amalgam (Permite[®] Regular set, SDI) and caries-prone pits and fissures of permanent molars were sealed with a resin-based sealant material (FluroShield[®], Dentsply).

Atraumatic Restorative Treatment (ART)

ART restorations were performed according to the protocols developed for this approach [10]. The cavities in primary and permanent molars were opened and cleaned, using hand instruments only. Local anaesthesia was administered when requested by the children. Cleaned cavities were restored with a high-viscosity glass-ionomer (KetacMolar Easymix[®], 3M ESPE). Caries-prone pits and fissures in permanent molars were sealed according to the ART approach, using KetacMolar Easymix[®].

Ultra-conservative treatment

This treatment consisted of cleaning large cavities in primary molars by using hand excavators to remove soft carious tissues. Medium-sized cavities in single and multiple tooth surfaces in primary molars were enlarged with a hatchet, to facilitate easy cavity cleaning. Small cavities in primary teeth and all cavities in permanent molars were restored according to the ART approach. The cavity size was defined as follows. One half of the occlusal surface was

taken as a reference. Three sizes were distinguished; small (covering <1/3 of half the tooth surface), medium (covering between 1/3 and 2/3 of half the tooth surface) and large (covering >2/3 of half the tooth surface). Permanent molar pits and fissures were not sealed. Children in this group received special training in brushing their teeth. This cleaning included removing plaque from inside the opened cavities and from the permanent molars with a toothbrush and fluoridated toothpaste. Children were supervised by dental assistants during all schooldays.

Table I. Number of restorations at the first treatment session placed by operator and by treatment group.

Treatment group	Operator			Total
	1	2	3	
Conventional	48	12	66	126
ART	35	5	45	85
Ultra-conservative	39	23	29	91
Total	122	40	140	302

ART=Atraumatic Restorative Treatment

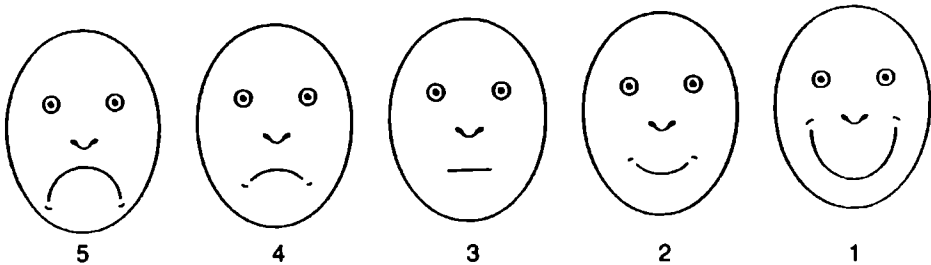


Figure 1.Facial Image Scale (FIS)

Dental anxiety evaluation

The instrument used to measure dental anxiety in the present study was the Facial Image Scale (FIS) [22], which is shown in Figure 1. The FIS comprises a row of five faces ranging from 'very unhappy' to 'very happy' and numbered from 5 to 1, and aims to assess state anxiety. The children were asked to point to the face which they felt most closely depicted their feelings at that moment.

In accordance with the protocols for the FIS application, each child was approached outside the examination/treatment room by a trained assistant before the start of the examination/treatment session. The child's FIS score was recorded before the start of the epidemiological examination (FIS EPI), and before the start of the first (FIS Tx-1) and the second (FIS Tx-2) treatment sessions.

To allow comparison of dental anxiety levels of the children in the three groups, the dental treatment was divided into two sessions. In the first session, only one cavity was restored. The choice of which tooth should be restored in this session was based on the type of lesion (class II cavities) and on the location of the tooth in the dental arch (lower jaw). When there was more than one option, the selection was randomly done by envelope drawing. Treatment time of the first session was recorded by the dental assistant, using a stopwatch. After this session the assistant showed the Wong-Baker FACES Pain Rating Scale (Wong-Baker) [25] to the children, to evaluate the intensity of pain experienced during the procedures. The children were asked, without mentioning the word 'pain', to point to the picture which best described their feelings about the treatment that they had just received. In the second session all other treatments were performed. Some children required more than two treatment sessions. The outcomes related to pain will be presented elsewhere.

Statistical analysis

A power calculation preceded the sampling procedure. Considering the short interval between the measurement points of dental anxiety and parents' wish to have their children's teeth treated, it was anticipated that very few children would drop out. On the basis of an accepted difference of 20%

between the levels of anxiety of the conventional (45%) and the ART treatment (25%), a confidence level of 95% and a power of 0.8, it was calculated that 294 children would need to be sampled.

The dependent variable was the FIS Tx-2 score. The independent variables were treatment group (conventional, ART and ultra-conservative), gender, dmfs score, Pain Epi (yes/no), operator at first treatment (Tx-1) and history of extraction (yes/no) as class variables and Wong-Baker score, treatment time, FIS EPI and FIS Tx-1 scores as continuous variables. The scores for dmfs were categorized as low (2-9), medium (10-17) and high (≥ 18). GLM test (ANCOVA) was used to test for effects of the independent variables on the dependent variable. The Wong-Baker scale was presented incorrectly to 33 children, because the question was posted wrongly, in the conventional treatment group, and 25 children from this group received local anaesthesia in the first treatment session. Therefore, 2 GLM tests were done, one with Wong-Baker score on 244 children (excluding the 33 and 25 children) and one without Wong-Baker score on all children. Spearman's Rank correlation coefficient was used in testing relationships between the dependent and independent continuous variables. The statistically significant level was set at $\alpha=5\%$.

Table II. Percentage (%) distribution of 6-7 year-olds by gender and treatment group.

	Treatment group					
	Conventional		ART		Ultra-conservative	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Gender						
Boys	69	22.8	50	16.6	47	15.5
Girls	57	18.9	35	11.6	44	14.6

n=number of children; ART=Atraumatic Restorative Treatment

Results

Disposition of subjects

The sample consisted of 302 children (166 boys and 136 girls), with a mean age of 6.8 years ($SD=0.4$), ranging from 6-7 year-olds. Table II shows the frequency distribution of the children by gender and treatment group. No gender effect was observed in the three treatment groups ($p=0.6$).

Dental anxiety and treatment

The ANCOVA test of the FIS Tx-2 score on the independent variables on the group of children without those having the Wong-Baker scale wrongly presented and those who had received local anaesthesia ($N=244$) showed no treatment group ($p=0.65$), gender ($p=0.62$), dmfs score ($p=0.23$), history of extraction ($p=0.52$), operator at first treatment ($p=0.55$), treatment time ($p=0.75$) and FIS EPI ($p=0.33$) effects. Only a Pain EPI ($p=0.02$) and a FIS Tx-1 score ($p=0.0001$) effects on the FIS Tx-2 score were observed. The effect of the Wong-Baker score ($p=0.043$) was considered borderline.

The ANCOVA test of the FIS Tx-2 scores on the independent variables but the Wong-Baker score, on all children ($N=302$) revealed no treatment group ($p=0.44$) effect, a borderline pain EPI ($p=0.048$) effect and a FIS Tx-1 (<0.0001) effect. The ANCOVA test of the FIS Tx-2 scores on treatment group, Pain EPI and FIS Tx-1 on all children, revealed a FIS Tx-1 ($p<0.0001$) effect but no treatment group ($p=0.64$) or pain EPI ($p=0.06$) effects.

Spearman's Correlation Coefficient showed a statistically significant correlation between FIS Tx-1 and FIS Tx-2 scores ($r=0.30$, $p<0.0001$), indicating that a high FIS Tx-1 score was a predictor of a high score for FIS Tx-2. The mean and standard deviation of FIS TX-1 and those of FIS Tx-2 scores by treatment group are summarized in Table III and the frequency distributions of FIS Tx-1 and FIS Tx-2 scores are presented in Table IV.

Table III. Mean (M) and standard deviation (SD) of dental anxiety scores before the first (FIS Tx-1) and the second (FIS Tx-2) treatment sessions, by treatment group.

Treatment group	<i>n</i>	FIS Tx-1		FIS Tx-2	
		<i>M</i>	SD	<i>M</i>	Std
Conventional	126	2.00 ^a	0.96	1.95 ^a	1.04
ART	85	1.99 ^b	1.02	1.85 ^b	0.84
Ultra-conservative	91	1.84	0.87	1.84	0.97

n = number of children, ART=Atraumatic Restorative Treatment

^a ^b *p* > 0.05

Table IV. Percentage (%) distribution of dental anxiety score before the first (FIS Tx-1) and before the second (FIS Tx-2) treatment sessions

Treatment session	Dental anxiety score				
	1	2	3	4	5
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)
FIS Tx-1	120 (39.7)	99 (32.8)	64 (21.2)	16 (5.3)	3 (1.0)
FIS Tx-2	128 (42.4)	105 (34.8)	50 (16.5)	13 (4.3)	6 (2.0)

n = number of children

Discussion

Dental anxiety is considered a multidimensional construct comprising behavioural, cognitive and physiological components [21]. As a result of its complexity, assessing dental anxiety is not easy; especially in young children who still lack the ability either to recognize or interpret manifestations of anxiety or to answer questionnaires regarding this subject [26]

Many instruments aimed at measuring dental anxiety have been developed. Regarding self-reporting instruments, which are related to the cognitive component of dental anxiety, picture scales are considered the best measurement tools to use with young children. A literature search into dental anxiety scales [21,26,27] revealed that, for 6-7-year-old children, only two picture scales are available; the Venham Picture Test (VPT) [28] and the Facial Image Scale (FIS) [22]. The FIS was the chosen instrument in the present study, as it is easy to handle and fast to apply [22,23]. Furthermore, it was affirmed that the FIS could overcome some disadvantages of the ambiguous situations presented on the VPT flash cards [29].

Anxiety arises as a reaction to an anticipated stressor [30]. Because of its relation to expectation, dental anxiety should be measured before treatment starts. This was the main reason for dividing the dental treatment of the children in the present study into two sessions. In the first session one tooth in each child was treated, using one of the three different approaches. At the beginning of the second session, children expressed their dental anxiety levels (FIS Tx-2) based on the dental treatment that they had been submitted to during the first session. This methodology allowed a realistic comparison of the conventional, ART and ultra-conservative treatments, regarding dental anxiety.

As mentioned before, dental anxiety has also a physiological component. This was not assessed in the present study. It would have been interesting to measure the heart rates of the children while they were in the waiting room, for example, as it is known that dental anxiety induces an increase in the heart rate [31]. Although this was not done in the present investigation, it should be considered in future studies, as the FIS, in common with other dental anxiety scales, has the limitation of measuring only the cognitive component of dental anxiety.

The analyses had to be carried out in two parts as a number of children had to be excluded because their Wong-Baker scores were unreliable. As the first analysis revealed a borderline effect of the Wong-Baker score on the dental anxiety score before the second treatment session, a second GLM analysis was warranted without the Wong-Baker score as an independent variable on the total group of children. This resulted in the absence of a statistically significant

difference in the level of dental anxiety in children among the three treatment groups after one treatment session; the hypothesis was rejected. This finding was unexpected, as ART and ultra-conservative treatment had been expected to be better accepted than the conventional restorative approach. This expectation was supported by studies that had reported ART to be more comfortable than the conventional treatment and less likely to evoke dental anxiety [15-17]. Another outcome was the significant correlation between the levels of dental anxiety related to the first and second treatment sessions. It shows that the treatment provided had not significantly reduced the level of dental anxiety measured at the second treatment session.

In contrast to most other studies investigating dental anxiety related to ART and conventional restorative treatment [15-17], the operators in the present study were trained and experienced paediatric dentists used to dealing with young children. The only other comparative study, in which paediatric dentists treated the subjects, also found no difference between the dental anxiety levels related to ART and conventional treatment [18]. It may be possible that the ART approach, when applied by well-trained and experienced paediatricians, will not lead to lower levels of dental anxiety than those associated with conventional restorative treatment at the hands of general dental practitioners. A follow-up investigation on this topic may be needed to clarify the issue.

A study of the literature on this topic indicated that different measurement instruments were used and that the protocols used in the previously published studies, differed from their original description, which may have affected the study outcomes. For example, studies from Pakistan [15] and Indonesia [16] concluded that ART was more comfortable than conventional restorative treatment. In comparing the results of the present investigation with those of the two previous studies, it was noted that these did not specifically measure dental anxiety, as the authors assumed that discomfort could mean pain or anxiety. Furthermore, they used different instruments and methodologies, assessing the individuals' feelings during or after the treatment procedures. This may explain why both studies showed operator and gender effects; an outcome that was not found in the present study.

It must be emphasized that different instruments for assessing dental anxiety are available. These instruments were developed, tested and validated regarding a specific situation (e.g. anxiety states) and population (e.g. individuals' ages). For that reason, the instructions for using such instruments should be followed strictly and entirely. However, this is not always done, as demonstrated by the studies conducted by Mickenautsch et al. [17] and Topaloglu-Ak et al. [18]. Mickenautsch et al. [17] concluded that ART was less anxiety-provoking than conventional treatment. However, the authors had assessed dental anxiety levels immediately after children had been treated, using the Short Form of Children's Fear Survey Schedule (CFSS-SF), which is the correct methodology for measuring the fear element [32]. However, although being interconnected, fear and anxiety are two distinct entities [33]. Therefore, dental anxiety was not really assessed in the abovementioned study.

The same flaw applies to the Topaloglu-Ak et al. study [18], which used the Venham Picture Test (VPT) to assess the dental anxiety levels of children in Turkey. The VPT was applied after the procedures had been completed, although the originators of this scale stated that it must be applied before the treatment starts [28]. Although the outcomes from the Turkish study confirm those of the present investigation, the fact that those results have been obtained through use of an incorrect methodology makes them invalid.

Dental anxiety is culture-related. Folayan et al. [34] affirmed that comparisons of studies from different regions are limited, since cultural factors influence the context in which anxiety is experienced, as well as the interpretation of its meaning and the responses to it. As the present investigation was carried out in Brazil, among 6-7-year-olds, in a low socio-economic area, a rational expectation could be that the results from the present study can be extrapolated only to other communities in Brazil sharing the characteristics of the study population in this research.

Another important issue concerns the instrument used to measure dental anxiety in the present study. The Facial Image Scale is a recently validated instrument, and more information is needed about its validity and reliability in different settings. Therefore, it is suggested that before considering wide extrapolation of the results of the present investigation, this scale should be

tested further regarding its reliability in measuring dental anxiety in different societies.

Conclusions

It is concluded that no difference in the levels of dental anxiety at the second treatment session was present among children in the three treatment groups studied, and that the level of dental anxiety before the first treatment session was a predictor for dental anxiety at the second treatment session. Further research on dental anxiety should include a physiological assessment to confirm the outcomes of the cognitive measures obtained with dental anxiety scales.

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CHAPTER 6

Pain experience after conventional, atraumatic and ultraconservative restorative treatments in 6- to 7-yr-old children

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Abstract

The hypothesis was tested that children's pain experienced by children during conventional restorative treatment is higher than during atraumatic restorative treatment (ART) or an ultraconservative treatment. The sample consisted of 244 children, 6- to 7 yr of age, who had at least 2 teeth with dentine carious lesions. Before the first treatment session (Tx-1), in which one of the carious teeth was treated using one of the treatments, the level of dental anxiety was assessed using the Facial Image Scale (FIS). The child reported the intensity of pain experienced during the procedure using the Wong-Baker FACES Pain Rating Scale. When conventional restorative treatment was used, more children needed local anaesthesia. Analyses excluding the data of children who had received local anaesthesia showed no treatment group effect on the Wong-Baker score, a FIS Tx-1 effect on the Wong-Baker score, and a statistically significant correlation between FIS Tx-1 and Wong-Baker scores. There was no significant difference in the pain levels of children treated using conventional restorative treatment, atraumatic restorative treatment or ultraconservative treatment. Local anaesthesia had to be administered more frequently to children in the conventional restorative group than to those in the other two treatment groups.

Introduction

Pain is defined by the International Association for the Study of Pain as an 'unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage' (1). However, it is known that the pain sensation is not necessarily dependent on tissue damage; in dentistry, it may also be initiated by conditioned stimuli such as the sound of the drill or the use of the needle during local anaesthesia (2).

Reports of pain in dentistry are common, especially when burs are used without the application of local anaesthesia (3). Furthermore, pain related to dental treatment has been shown to be an important factor in the aetiology of dental fear (4). According to ROBERTS (5), painful dental treatments can cause fear, whereas fear and anxiety can increase the amount of perceived pain. Thus, dentists need to try to use an approach in which little or no pain is felt by the patients. This is particularly important in paediatric dentistry, as it is known that dental anxiety and fear are related to negative or traumatic dental experiences during childhood (6).

A new philosophy, which involves the replacement of conventional treatment with less invasive dental treatments, has been proposed since the early 1990's. According to this philosophy, prevention, the use of adhesive dental materials and remineralization techniques, and the monitoring of initial carious lesions constitute the best approach for caries management (7).

Following the concept of minimal intervention, atraumatic restorative treatment (ART) advocates the use of hand instruments and adhesive materials for the treatment of carious lesions (8). In accordance with this approach, hand excavators are used to remove the infected dentine from the cavities and the tooth is restored with a high-viscosity glass ionomer, which is also placed on the adjacent pits and fissures to prevent development of carious lesions (9). In comparison with conventional treatment using a drill and burs, ART has been shown to cause less pain and discomfort to the patient receiving dental treatment (3, 10, 11). Moreover, it has been considered as less anxiety-provoking than the conventional technique (12). In light of these considerations, ART may be a more suitable approach for very young children, in order to

reduce the degree of pain experienced during the procedures and also to avoid the initiation of dental fear and anxiety. However, this has not been investigated.

The aim of the present investigation was to test the hypothesis that the level of pain experienced by 6- to 7-yr-old children treated with conventional restorative treatment is higher than for children treated using ART and an ultraconservative treatment. In addition, determinants of pain levels were investigated.

Material and Methods

This study was a controlled clinical trial conducted in six public schools in the urban area of Paranoá; a satellite city of Distrito Federal located about 25 km from Brasília, the capital of Brazil.

The study sample was nested in an oral health epidemiological survey of 6- and 7-yr-old children attending these schools. This survey forms part of a major study assessing the cost-effectiveness of three different dentine carious lesion treatment approaches in children: conventional, ART and ultraconservative. The sampling procedure was based on the caries experience of the children, assessed using the International Caries Detection and Assessment System (ICDAS) II criteria (13). There were 1,136 6- to 7-yr-old children in the six schools, and 835 participated in the study. The inclusion criterion for this study was the presence of two or more dentine carious lesions of all cavity classifications in primary molars, without pulp involvement and pain. The study was conducted using a parallel-group design. As only two schools were equipped for providing conventional treatment using a drill and burs, these schools had to be chosen for the conventional group. The remaining four schools were placed in the two treatment groups that remained, by the flip of a coin.

This study was approved by the Research Ethics Committee of the Brasília Medicine School, reference 081/2008, and was registered at the Dutch Trial Registration Centre with reference number 1699. The parents or guardians of each child received and signed individual informed consent forms containing

information about the aim of the study and the treatment approaches. Children whose parents declined to sign the consent form were excluded from the study.

Treatments

Dental treatments were carried out by three well-trained paediatric dentists at the school premises. Table 1 shows the number of restorations placed at the first session by operator and by treatment group.

Conventional treatment: Conventional treatment involved using the drill and burs to open the cavity and remove carious tissues in primary and permanent teeth. Local anaesthesia was administered when requested by the child. The cleaned cavity was restored with amalgam (Permite Regular set; SDI, Melbourne, Vic., Australia), and caries-prone pits and fissures of permanent molars were sealed with a resin-based sealant material (Fluro-Shield; Dentsply, Petrópolis, Rio de Janeiro, Brazil).

ART: The ART restorations were performed using the protocols developed for this approach (9). Only hand instruments were used for opening and cleaning the cavities in primary and permanent molars. Local anaesthesia was administered when requested by the child. Cleaned cavities were restored with a high-viscosity glass-ionomer (KetacMolar Easymix; 3M ESPE, Sumaré, São Paulo, Brazil). Caries-prone pits and fissures in permanent molars were sealed using the ART approach.

Ultraconservative treatment: In the ultraconservative treatment, hand excavators were used to clean large cavities in primary molars by removing soft carious tissues. Medium-sized cavities in single and multiple tooth surfaces in primary molars were enlarged using a hatchet instrument to facilitate the cavity-cleaning process. Small cavities in primary teeth, and all cavities in permanent molars, were restored using the ART approach. The cavity was categorized, according to size, as follows (taking one-half of the occlusal surface as a reference): small (covering $<1/3$ of half of the tooth surface), medium (covering between $1/3$ and $2/3$ of half of the tooth surface), and large (covering $>2/3$ of half of the tooth surface). Permanent molar pits and fissures were not sealed. Children in this group received special training in brushing their teeth. This cleaning included plaque removal from inside the opened cavities and from the

permanent molars using a toothbrush and fluoridated toothpaste. Children were supervised by dental assistants during all schooldays.

Pain was assessed using the Wong-Baker FACES Pain Rating Scale (14), shown in Fig. 1. This scale consists of a row of six faces ranging from 'no hurt' to 'hurts worst' and numbered from 0 ('no hurt') to 5 ('hurts worst'). The originators of the scale suggest that the operator should describe the scale to the children, mentioning that each face represents a person who is happy because feels no pain (no hurt) or sad because feels some, or a lot of, pain (15).

The dental treatment was divided into two sessions. Before the first treatment session (Tx-1), the Facial Image Scale (FIS) (16) was used to assess the dental anxiety level of each child (FIS Tx-1). In accordance with the protocols for the FIS application, each child was approached outside the treatment room by a trained assistant before the start of the first treatment session. Children were asked to point to the face which they felt most closely depicted their feelings at that moment.

When a child entered the treatment room, a heart monitor (Timex; Dumont Saab, Manaus, Amazonas, Brazil) was put around their chest. The assistant checked if it was working properly and then turned it off. During the first session, only one cavity was restored. The choice of which tooth should be restored in this session was based on the type of lesion (class II cavities) and on the location of the tooth in the dental arch (lower jaw). When there was more than one option, the selection was performed randomly by envelope drawing. The heart monitor was turned on as soon as the treatment procedure started and at the end of the session it was turned off. The average and peak values for the heart rate were recorded. The duration of treatment in the first session was recorded by the dental assistant, using a stopwatch. At the end of this session the assistant showed the Wong-Baker to the children without mentioning the word 'pain'. The children were asked to point to the picture that best described their feelings about the treatment that they had just received.

In the second session other necessary treatments were performed but the heart monitor was not used, the time was not recorded and the Wong-Baker was not applied. Some children required more than two treatment sessions.

Table 1 – Number of restorations placed at the first treatment session by operator and by treatment group

TREATMENT GROUP	Operator			Total
	1	2	3	
Conventional	48	12	33 (21)	93
ART	35	5 (1)	45 (3)	85
Ultra-conservative	39	23	29	91
Total	122	40	107	269

ART, atraumatic restorative treatment.

The values in parenthesis refer to the number of children who were given local anaesthesia

Statistical analysis

A power calculation preceded the sampling procedure. Because of the short interval between the measurement points of pain and considering the parents' wish to have their children's teeth treated, it was anticipated that very few children would drop out. On the basis of an accepted difference of 20% between the conventional treatment (45%) and ART (25%) in the prevalence of pain, a confidence level of 95% and a power of 0.8, it was calculated that 294 children would need to be sampled.

A chi-square test was first used to test for an effect of local anaesthesia on the treatment groups. As there was an effect, the Wong-Baker and heart rate peak scores of the children who had received local anaesthesia were not used in further analyses to assess children's reported pain after the first treatment session in the three treatment groups. Therefore, all other statistical analyses were performed on the data derived from children who had not received local anaesthesia. Data from the children who had received local anaesthesia were analyzed separately. A sensitivity analysis, using a general linear model (GLM), was performed on all 269 children, assuming that those children who had received local anaesthesia had chosen a Wong-Baker score 5 (hurts worst).

The dependent variable was the Wong-Baker score. The independent variables were gender, DMFT, dmft, treatment group, FIS Tx-1 score, cavity size, operator at first treatment, treatment time, and the value of the heart rate peak. The scores for DMFT and dmft were categorized as low (0-3), medium (4-6), and high (≥ 7) and those for cavity size as small, medium and large. The FIS Tx-1 was considered a continuous variable. The GLM was used to test for effects of the continuous and categorical independent variables on the dependent variable. Pearson's correlation coefficient was used in testing relationships between Wong-Baker and FIS Tx-1 scores. The level of statistical significance was set at $\alpha=5\%$.

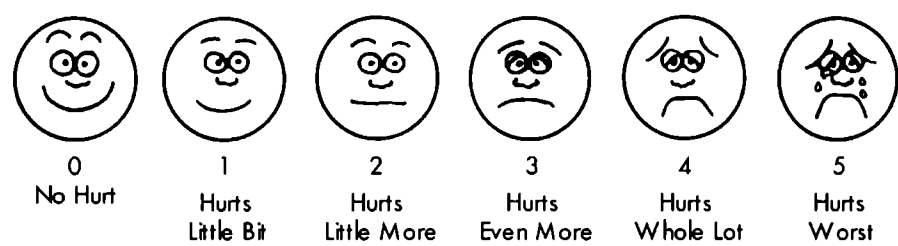


Figure 1 – Wong-Baker FACES Pain Rating Scale (Wong-Baker).

From HOCKENBERRY & WILSON (14) Used with permission

Results

The initial sample comprised 302 children (166 boys and 136 girls). The Wong-Baker scale was presented incorrectly to 33 children in the conventional treatment group, and for that reason they were excluded from analysis. Twenty-five children received local anaesthesia in the first treatment session. As the chi-square test showed an association of local anaesthesia administration with treatment group ($P < 0.0001$), these 25 children were excluded from the main data analyses.

The final sample used in the analyses consisted of 244 children (140 boys and 104 girls), with a mean age of 6.8 yr (SD=0.4, range 6-7 yr). The frequency distribution, and the mean and SD for Wong-Baker scores of self-reported pain by treatment group, are presented in Table 2. The majority of children reported little pain sensations during treatment (i.e. gave Wong-Baker scores 1 and 2).

The GLM analysis showed no effects of gender ($P = 0.86$), DMFT ($P = 0.31$), dmft ($P = 0.73$), treatment group ($P = 0.55$), treatment time ($P = 0.19$), cavity size ($P = 0.71$), or heart rate peak ($P = 0.26$) on the Wong-Baker score. Only operator at first treatment ($P = 0.02$) and FIS Tx-1 ($P = 0.01$) showed an effect on the Wong-Baker score. Additional GLM analysis with only operator at first treatment and FIS Tx-1 on the Wong-Baker score revealed no operator at first treatment effect ($P = 0.05$), but a FIS Tx-1 effect ($P = 0.009$).

Local anaesthesia had been administered by two operators; one operator administered it 24 times (21 times to children in the conventional restorative group and three times to children in the ART group) and one operator administered it once (to a child in the ART group). Analysis of the the data for children who had or had not received local anaesthesia administered on the independent variables, revealed an operator effect ($P = 0.004$), a cavity size effect ($P = 0.004$) and a treatment time effect ($P < 0.0001$). One operator administered statistically significantly more local anaesthesia than the other two operators. Children who had received local anaesthesia had statistically significantly larger size cavities filled than those who had not received local anaesthesia. There was no statistically significant difference in cavity size

between the three treatment groups at baseline ($P = 0.17$). Treating children with and without local anaesthesia took generally 25 and 13 min, respectively.

Sensitivity analysis on the data, including the group of children who had received local anaesthesia, showed a treatment group effect ($P = 0.01$) when the Wong-Baker score of the anaesthetized children was set at 5. As one operator administered local anaesthesia statistically significantly more frequently than the other two operators, the GLM was also applied on the data set of the two operators only, to test for effects of the Wong-Baker score on the independent variables. No statistically significant effects were observed.

Pearson's correlation coefficient showed a statistically significant correlation between FIS Tx-1 and Wong-Baker scores ($r = 0.17$, $P = 0.007$), indicating that a high dental anxiety score before the first treatment session was a factor predicting a high score for self-reported pain at this session. However, the explanatory power was low. The regression coefficient was 0.23.

Table 2 – Frequency distribution (%) of self-reported Wong-Baker scores, together with mean and SD by treatment group after the first treatment session excluding children who received local anaesthesia

TREATMENT GROUP	Wong-Baker scores						Mean	SD	n
	0	1	2	3	4	5			
Conventional	33.3	29.2	25.0	4.2	5.6	2.8	1.3	1.3	72
ART	25.9	28.4	29.6	9.9	3.7	2.5	1.4	1.2	81
Ultra-conservative	33.0	35.2	17.6	7.7	4.4	2.2	1.2	1.2	91

ART, atraumatic restorative treatment, *n*, number of children

Discussion

Local anaesthesia is often identified as the major reason for pain during dental treatment (2). This appears to be contradictory, because anesthesia is a means of offering pain-free treatment, providing comfort for children and ensuring their cooperation, thus allowing the dentists to perform their task more effectively (2). Because of this contradiction and because, in the present investigation, the major objective was related to the self-reporting of pain, it was decided that local anaesthesia would be administered only when requested by the child. It was thought that this approach would make it possible to infer that those children who requested local anaesthesia were really feeling some pain. However, sometimes local anaesthesia was administered at the start of the treatment when the dentist judged that the procedure would cause unbearable pain, and this invalidated the self-reporting of pain in these children. That was the main reason for excluding them from the main analyses.

Local anaesthesia was administered significantly more frequently to children in the conventional restorative treatment group than to children in the ART and ultraconservative treatment groups, indicating that conventional restorative treatment may have caused more pain than the two other treatments. Findings from the sensitivity analysis in part support this assumption, as a treatment group effect was observed when the Wong-Baker score of the 25 children who had received local anaesthesia was reported to be 5 (hurts worst). Local anaesthesia was administered predominantly by one operator, which may indicate an operator preference for local anaesthesia. The fact that local anaesthesia had been administered significantly more frequently when large-sized cavities needed to be restored may justify the action of administering local anaesthesia by the operator.

Having to administer local anaesthesia in a study assessing pain from different treatments is a confounding factor. Its use indicates that pain has, or would have been, felt during treatment and therefore the fact that local anaesthesia has been administered could be considered as pain related to the treatment provided. Despite the absence of a difference in pain reported among the children who had not received local anaesthesia, the fact that significantly

more children in the conventional restorative group had received local anaesthesia may imply that the conventional treatment had caused children to experience pain more frequently than ART or ultraconservative treatment. However, the above holds true only when the Wong-Baker score of the children receiving local anesthesia is set at 5. As assigning a score to a missing observation is an arbitrary decision, we are of the opinion that it is not possible to conclude that conventional restorative treatment caused children pain more frequently than the other two treatments. Therefore, we accept the finding that there was no difference observed in the level of self-reported pain of children treated in accordance with three dental treatment approaches: conventional restorative treatment, ART and an ultraconservative treatment. This finding indicates that despite the different elements of these techniques, such as instruments used for cavity preparation and time required for performing the procedures, the scores for pain did not differ statistically significantly amongst the participating children.

The main outcome of the present study differs from previous studies on pain and discomfort related to ART and to conventional restorative treatment, which found ART to be the least painful approach (3, 10, 11). The difference in outcome could be explained by the fact that different pain/discomfort assessment instruments had been applied in the studies referred to and in one study perhaps to the age of the children (3). In that study, secondary school students were asked, after the treatment, whether or not they had felt pain (3), whilst the Venham index was used on children from Indonesia with an average age of 6.3 yr (11). A self-reported pain instrument was only used in one study (10). Another reason for this difference in outcome may be that in the present study, all the operators were experienced pediatric dentists, which may not have been the case in the other studies. It is to be expected that professionals who are familiar with dealing with young children would provide less-painful dental treatment than professionals who are not. Furthermore, the cultural and socio-economic factors, and their impact on the understanding, perception and reporting of pain, must be considered (17). An example of this relationship was demonstrated by AGGARWAL *et al.* (18), who affirmed that a child with high dental treatment requirements from a low-income community would report pain

more intensively than a child from a higher socio-economic level community. Given that the present study was conducted among children from a low socio-economic background only, we may exclude this possible explanatory factor as a reason for the absence of a difference in pain sensation amongst children of the treatment groups. More research on this topic is required.

A third result of the present investigation was the relationship between the levels of dental anxiety and the children's self reported pain. This outcome was expected, as it is known that anxiety influences the capacity of children to remember painful procedures (19). In dentistry it could not be different, as stated by KLAGES *et al.* (20): 'anxiety sensitivity predicts anticipation and experience of pain in dental procedures'. VERSLOOT *et al.* (21) also affirmed that dental anxiety is considered a predictor of pain, especially in very young children. Another study, on Brazilian children, confirmed the association of dental anxiety and pain, showing that a history of dental pain can increase the level of dental anxiety in young children (22). In light of this relationship, the importance of having a relatively painless, low-anxiety-provoking dental treatment available for use in daily clinical practice is easily understood.

No correlation was found between the peak heart rate values and the scores for self-reported pain, although it is known that acute pain is expected to cause an immediate increase in heart rate (23). However, it should be highlighted that the Wong-Baker is a cognitive instrument, whereas heart rate is a physiological measurement, which are different parts of the multidimensional nature of pain. This may explain why there was no correlation between these two variables in this study.

The major limitation of the present investigation concerns the instrument used to assess self-reported pain in the children. The Wong-Baker is said to be preferred by children and parents when compared with other facial scales for the measurement of pain (24). However, the smiling 'no pain' anchor, and the tears on the face in the upper anchor, may lead to either an over-estimation or an under-estimation of pain by some children (25). For example, in this study, none of the six children who chose the tearful face cried during the dental treatment, whereas the seven children who did cry did not choose that face.

The findings of the present study showed that the pain felt during dental treatment had no relationship with the type of dental treatment used. As this investigation was carried out in Brazil, on 6- to 7-yr-old children from a low socio-economic area, it is expected that the results can be extrapolated only to other communities in Brazil sharing the characteristics and needs of the study population in this research.

Concerning the secondary outcome, the significant correlation found between dental anxiety and pain is in line with results from studies carried out in other parts of the world (2, 20-22, 26, 27).

In conclusion, local anaesthesia had to be administered more frequently to children in the conventional restorative group than to children in the other two treatment groups. No significant difference was found in the pain levels of children treated using the conventional restorative treatment, the ART or with an ultraconservative treatment. Children's self-reported pain was related to the level of dental anxiety experienced before the start of the treatment session. Longitudinal studies are needed to investigate whether this association persists during subsequent dental visits.

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Conflict of interest: The authors declare that they have no conflict of interest.

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CHAPTER 7

Patterns of dental anxiety in children after sequential dental visits

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Abstract

BACKGROUND: Although the aetiology of dental anxiety is still not completely understood, there is consensus that previous negative dental experiences are related to the development of a dentally anxious individual. **AIM:** The present study sought to determine whether gradually exposing Brazilian children to the dental environment would decrease their levels of dental anxiety over a 14.5-month period. **STUDY DESIGN AND METHODS:** The study was carried out on 302 children of both genders, aged 6 to 7 years old. Dental anxiety was assessed using the Facial Image Scale (FIS) at five time points: 1) before an epidemiological examination; 2) before the first treatment session; 3) before the second treatment session; 4) before the first evaluation session 5) before the second evaluation session. **STATISTICS:** ANOVA, Student-T tests and ANCOVA were used to analyze the data. **RESULTS:** There was a statistically significant decrease in levels of dental anxiety between time points 1 and 5. Eighty-nine percent of the children with FIS score 1 or 2 at baseline had the same scores at the last time point, whereas 82% of children with FIS score 4 or 5 at baseline had a FIS score of 1 or 2 at the last time point. **CONCLUSION:** A gradual exposure of children to the dental environment in sequential dental visits of different natures in a school premise caused a decrease in their levels of dental anxiety over a 14.5-month period.

Introduction

Dental anxiety can be defined as a feeling of apprehension about dental treatment, which is not necessarily connected to a specific external stimulus [Folayan and Fatusi, 2005]. It is a common and potentially distressing problem, both for the public and for dental professionals. Many studies have described dental anxiety as an adaptative process, which could be initiated during childhood and would decrease over time [Venham et al., 1977; Folayan and Idehen, 2004; Folayan and Fatusi, 2005;]. However, sometimes this feeling can carry into adulthood, and becomes a serious health problem. Dental anxiety may lead to avoidance of dental care, to increasing the risk of caries lesion development and oral diseases [Vassend, 1993; Milsom et al., 2003; Taani et al., 2005; Wigen et al., 2009]. Poor oral health can cause disturbances in social life and negatively affect work performance. It can also initiate a depression process, as self-esteem and self-confidence are also profoundly reduced in affected individuals [Cohen et al., 2000].

Dental anxiety has been a matter of concern for many years. However, its etiology is still not completely understood [Townend et al., 2000; Klinberg, 2008]. Studies have demonstrated that previous negative dental experience, especially when involving pain and an irregular pattern of dental visits, is related to the development of dental anxiety [Berggren and Meynert, 1984; Vassend, 1993; Abrahamsson et al., 2002; Milsom et al., 2003; Oliveira and Colares, 2009]. Another risk factor for the development of dental anxiety is the use of drills and needles during dental treatment [Louw et al., 2002; Schriks and van Amerongen, 2003; Kuseu and Akyuz, 2008].

It is generally accepted that dental anxiety is predominantly initiated during childhood [Milsom et al., 2003]. Therefore, it is necessary that professionals understand how this phenomenon begins, in order to try to prevent its occurrence. A gradual exposure to dental environment and to dental procedures has been shown to successfully minimize dental anxiety development in young adults and adolescents [Murray et al., 1989; Peretz and Mann, 2000; Klaassen et al., 2008]. However, very few longitudinal studies on dental anxiety in young children exist. Venham et al. [1977] studied the

responses of children during sequential dental visits. Analysis of four different behaviour dimensions, including dental anxiety, showed that the negative behaviour decreased as the children became familiarized with the dental environment and treatment provided. Surprisingly, the self-reported dental anxiety did not change over six dental visits.

A recent study which followed a cohort from 5 to 9 years of age showed an increase in the prevalence of dental anxiety from 8.8% at age 5 to 14.6% at age 9 [Tickle et al., 2009]. Unfortunately, the authors did not specify what kind of dental intervention those children were submitted to during the four years between the two dental anxiety assessments. Nor did they closely follow the studied cohort. Therefore, these results are not useful for explaining and understanding the changes in dental anxiety over time.

In light of these considerations, investigating the effect of sequential dental visits on the state of dental anxiety in children would aid understanding of a dentally anxious individual development. The present study seeks to determine whether gradually exposing children to the dental environment will decrease their levels of dental anxiety.

Materials and methods

Study population and sampling procedure

The sample for the present investigation resulted from an oral health epidemiological survey of 6- and 7-yr-old children attending 6 public schools in Paranoá, a city near to Brasília, the capital of Brazil. This survey forms part of a major study assessing the cost-effectiveness of three different dentine carious lesion treatment approaches in children. These were conventional, ART and ultra-conservative. The sampling procedure was based on the caries experience of the children, assessed according to the ICDAS II criteria [Pitts, 2004]. The inclusion criterion for children was the presence of 2 or more dentine carious lesions in primary molars, without pulp involvement and of pain. This was a requirement for conducting the main study on the cost-effectiveness of the three dental treatments.

This study was approved by the Research Ethics Committee of the Brasília Medicine School, reference 081/2008. Children's parents or guardians signed individual informed consent forms, and also answered a question about whether it was their child's first dental visit. Children whose parents declined to sign the consent form were excluded from the study.

Intervention – Epidemiology

During the epidemiological examination, each child was first submitted to an assessment of the Visible Plaque Index (VPI) and the Gingival Bleeding Index (GBI), by one of three trained and calibrated examiners. The same examiner then brushed the child's teeth in order to improve the visualization of the tooth surfaces, and performed a dental examination, using a mirror, a CPITN probe and the three-way syringe. The examiner also used cotton rolls to clean and dry the tooth surface when necessary.

Intervention – Treatment

The treatment sessions were performed by three well-trained pediatric dentists who applied the dental treatments to primary and permanent teeth. In order to test one of the aims of the major study, the treatment was divided in two parts. During the first session one class II cavity was treated according to one of the treatment approaches. Other necessary restorative treatment was carried out during the second session. The three different treatment approaches used were:

Conventional Treatment: It involved the use of the drill and burs to perform amalgam restorations. Local anaesthesia was administered when requested by the children. Caries-prone pits and fissures of permanent molars received resin-based sealants.

Atraumatic Restorative Treatment (ART): ART restorations followed the protocols developed for this approach [Frencken et al., 1996]. Local anaesthesia was administered when requested by the children. Caries-prone pits and fissures in permanent molars were sealed with a high-viscosity glass-ionomer according to the ART approach.

Ultra-conservative treatment: Hand excavators were used to clean large cavities in primary molars by removing soft carious tissue. Medium-sized cavities in single and multiple tooth surfaces in primary molars were enlarged with a hatchet instrument, to facilitate easy cavity cleaning. Small cavities in primary teeth and all cavities in permanent molars were restored according to the ART approach. Permanent molar pits and fissures were not sealed. Children received special training in brushing their teeth, including plaque removal from inside the opened cavities and from the permanent molars, with a toothbrush and fluoridated toothpaste. This special tooth brushing was supervised by dental assistants during all schooldays, for the whole study period.

Intervention – Treatment evaluation

The effectiveness of the three treatment approaches was evaluated at 8.5 and 14.5 months after epidemiological examination by two independent, external and calibrated pediatric dentists. To do the evaluation they used a mirror with an intra-oral light attached, a CPITN probe, the three-way syringe and cotton rolls. Children had their teeth brushed by a dental assistant before the first and second evaluation sessions.

Dental anxiety evaluation

The Facial Image Scale (FIS) [Buchanan and Niven, 2002], which is shown in Figure 1, was used to assess state dental anxiety. It comprises a row of five faces ranging from 'very unhappy' to 'very happy' and numbered from 5 to 1 and aims to assess state anxiety. Each child was asked to point to the face which they felt most closely depicted their feelings at that moment.

Dental anxiety of the children was assessed and recorded at five time points in a 14.5-month period, as follows: 1) before the start of the epidemiological examination (FIS EPI); 2) before the start of the first treatment session (FIS Tx-1); 3) before the start of the second treatment session (FIS Tx-2); 4) before the start of the first evaluation session (FIS Ev-1) and 5) before the start of the second evaluation session (FIS Ev-2).

In accordance with the protocols for the FIS application, each child was approached outside the examination/treatment/evaluation room by a trained assistant before the start of each session, without being aware of the procedures that were to follow. At all stages of the study, which were performed on the school premises, examiners, assistants, operators and evaluators were blinded to the outcomes of the FIS application.

Statistical analysis

The data were entered into a database, checked for errors and analyzed, using SAS software (version 9.2). The dependent variable was the dental anxiety score (FIS). The independent variables were gender, first dental visit (yes/no), history of extraction (yes/no), DMFT and dmft scores (low (0-3), medium (4-6), and high (≥ 7)), treatment approach, and time points (1=start, 2=2 months, 3=2.5 months, 4=8.5 months and 5=14.5 months).

Effects of time points were tested using a mixed model (ANOVA) where time point was a fixed and children a random factor. The differences between the separated time points were calculated, using Student-T tests within the model. An ANCOVA model was used on each of the time points in testing the effects of the other independent variables. The statistically significant level was set at $\alpha=5\%$.

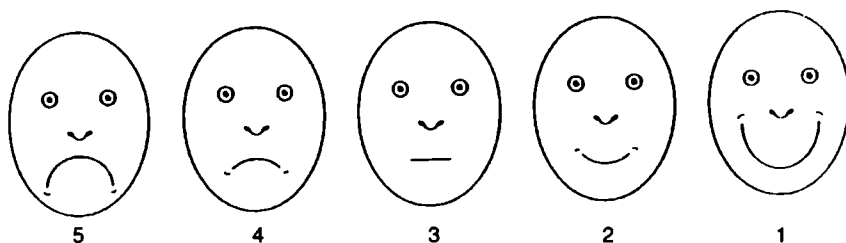


Figure 1 – Facial Image Scale (FIS)

Results

Disposition of subjects

The initial sample consisted of 302 children (166 boys and 136 girls), with a mean age of 6.8 years (SD=0.4), ranging from 6 to 7 years of age. There was no loss-to-follow up of children up to time point 3. At time points 4 and 5, the loss-to-follow up was 7.9% and 14.2%, respectively (Figure 2). There was no statistically significant difference in baseline FIS scores between the longitudinally-followed children and the loss-to-follow-up group ($p>0.05$).

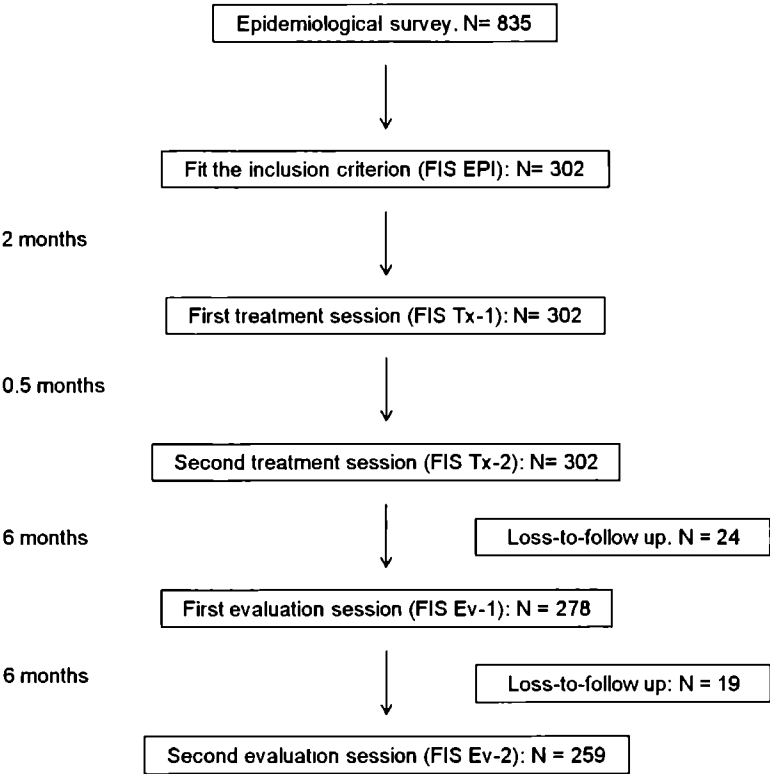


Figure 2 – Flow diagram of children throughout the study

N=number of children

The effect of time points on dental anxiety

The mean and standard deviation of the FIS scores at the five time points are presented in Table 1.

The mixed model showed an effect of time points on the FIS scores ($p<0.0001$). The results of the Student-T tests showed that the dental anxiety of the children at time point 1 was statistically significantly higher than at time points 2 to 5. There was no statistical difference in the children's dental anxiety between time points 2 and 3, and between time points 4 and 5. All the other comparisons of the time points were statistically significantly different. The difference in the mean FIS scores between time point 1 and time point 5 was 0.6. The pattern of FIS scores of the children over the five time points is illustrated in Figure 3. Eighty-nine percent of the children with FIS score 1 or 2 at baseline had the same scores at the last time point, whereas 82% of children with FIS score 4 or 5 at baseline had a FIS score of 1 or 2 at the last time point.

The effect of other variables on dental anxiety

There were no effects from gender, first dental visit, history of extraction, DMFT, dmft or treatment approach on the dental anxiety scores of the children in each of the five dental visits.

Table 1 – Mean and standard deviation (STD) of dental anxiety scores (FIS) by time point

TIME POINT	N	MEAN	STD
1) FIS EPI	302	2.3	1.2
2) FIS Tx-1	302	2.0	1.0
3) FIS Tx-2	302	1.9	1.0
4) FIS Ev-1	278	1.7	0.8
5) FIS Ev-2	259	1.7	0.9

N=number of children, EPI=epidemiological examination; Tx-1=first treatment session, Tx-2=second treatment session, Ev-1=first evaluation session, Ev-2=second evaluation session

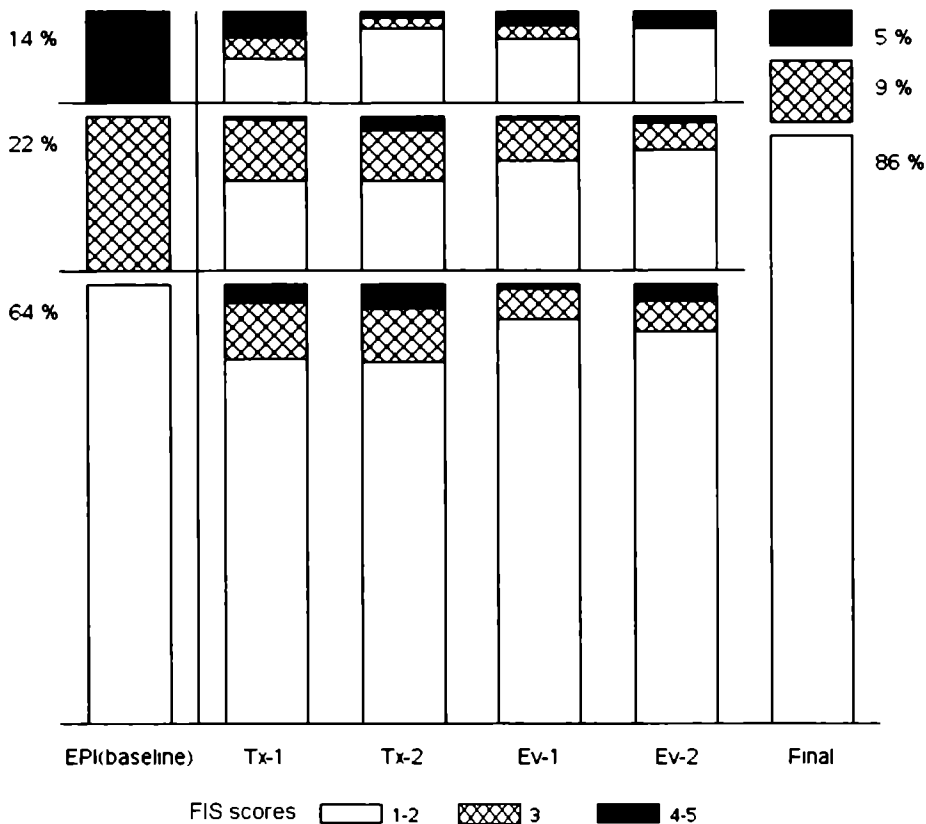


Figure 3 – Pattern of dental anxiety scores of the children over a 14.5-month period

Discussion

The primary purpose of this study was to investigate the effect of sequential dental visits on children's dental anxiety over a 14.5-month period. This investigation provides information on how acquired experiences, regarding aspects of oral health, can influence the level of dental anxiety in a child during follow-up visits. Of importance is the selection of the appropriate instrument to assess dental anxiety. Self-report scales were given preference, as the study was conducted on the school premises, in the absence of the parents. In view

of the young age of the study group, the picture scales were considered most appropriate. The Facial Image Scale (FIS) was developed and validated to assess state anxiety in individuals from 3-to 18-years old [Buchanan and Niven, 2002]. This scale was used in the current investigation as it is simple and easy to handle and takes less than one minute to be completed [Buchanan and Niven, 2002; Olumide et al., 2009]. The same well-trained assistants performed this task during all five time points, ensuring that the established protocols for dental anxiety assessment were strictly followed.

In using a self-reporting measurement technique, only the cognitive component of the dental anxiety construct was covered [Aartman et al., 1998]. The study outcomes should therefore be treated with caution.

The main outcome of this study was a decrease in the children's levels of dental anxiety over time, which was not affected by any of the independent variables. The fact that the dental history of the children had no effect on their self-reporting of dental anxiety was a surprise, as it was expected that having a previous history of extraction would have increased the level of dental anxiety [Milsom et al., 2003]. It is interesting to notice that between time points 2 and 3, in which children received restorative treatment, there was no statistically significant decrease in levels of dental anxiety. The same is true for time points 4 and 5, in which the children only had their restorations and sealants evaluated. Dental anxiety decrease occurred after the epidemiological survey and after the 2nd restorative session, which suggests that it may be related to increased familiarity with the dental environment and the dental procedures.

This outcome differs from that of Tickle et al. [2009], who reported an increase in dental anxiety prevalence. The difference between the present study and the one conducted by Tickle may be the absence of frequent contact with the dental environment in the latter. In contrast, during the 14.5-month period of the present investigation, the same dental team was present at the school premises. Very few children moved from a low to a high FIS score, the reverse was seen more often.

The outcomes of the present investigation are also not in line with that of Venham et al. [1977], carried out more than 30 years ago. In their study, although the behaviour of the children improved after six dental visits, the self-

reported dental anxiety remained unchanged over time. This difference might be explained by the different measurement instruments used – Venham Picture Test and Facial Image Scale - and also by the different nature of the dental visits.

In the Venham study the first dental visit involved a prophylaxis performed with a rotary hand-piece, which some children could have considered threatening. However, in the present investigation the dental treatment of the children gradually evolved from an epidemiological examination, a totally non-invasive procedure, to a first restorative session, in which only one tooth was treated, and then to a second standard restorative session. This flow of events may have positively influenced the study outcome, as it has been proposed that meeting the dentist on a non-threatening occasion, in order to get accustomed to the professional and the practice environment, works well in engendering acceptance by children of invasive treatment and in controlling dental anxiety [Chapman and Kirby-Turner, 1999].

Another interesting outcome of the present investigation was the positive effect that the invasive treatment had on the children, as they experienced a statistically significant decrease in levels of dental anxiety, even after the restorative sessions. This was a surprise, as it known that local anaesthesia and burs are often pointed out as anxiety-provoking parts of the dental treatment [Rafique et al., 2008].

It is important to address that the dental treatment of the children in the present study was performed by pediatric dentists, who have special skills and are well-trained in behaviour management techniques, such as 'tell-show-do' [Lyons, 2009]. This may be a reason for the decrease in the children's levels of dental anxiety, and also for the fact that none of the children refused to undergo dental treatment in any the five dental visits. One could hypothesize that, in the hands of general practitioners, the outcomes could be different. Further investigation might clarify this point.

Furthermore, peers at school may also have been a factor in the observed decrease in levels of dental anxiety, as it is obvious that they talked to each other about what happened during the dental visits and thus influenced each other, which does not occur when children visit a dentist in a private

practice environment. Furthermore, measuring dental anxiety in the school premises might have had a positive influence on the level of dental anxiety of the children, as the environment is regarded by them as less threatening than a dental clinic.

The outcomes of the present investigation show that a mixture of (non-) invasive dental treatments in a school setting reduced levels of dental anxiety in this group of children. As the choice of the study area was done selectively, the external validity may not be very high. At best, the outcomes can only be extrapolated to other communities in Brazil sharing the characteristics of the study population in this research.

Conclusion

In conclusion, a gradual exposure of children to dental environment in sequential dental visits of different natures in a school premise caused a decrease in their levels of dental anxiety over a 14.5-month period.

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CHAPTER 8

Summary, General Discussion, Conclusions and Recommendations

This chapter presents a summary of the chapters that constitute the PhD thesis and discusses the aspects related to the methodology used in the individual studies. The outcomes of the studies in relation to improvements in the oral health of Brazilian children are discussed. Conclusions drawn from the thesis are provided and the chapter ends with a list of recommendations.

8.1 Summary

This thesis was based on the findings of 6 studies developed and conducted in order to investigate the impact of the ART approach on the dental anxiety and pain experience of Brazilian children.

Chapter 1 described the caries situation among Brazilian children according to the results of a national epidemiological survey carried out in 2010, which presented four important findings:

- The prevalence of caries in the primary dentition was high (43%) at the age of 5;
- The prevalence of dental caries in permanent dentitions was high: 56% at age 12 and 60% in 15- to 19-year-olds;
- The “d” component represents more than 80% of the dmft index at age 5;
- 21% of the 5-year-old children reported that they had experienced dental pain during the previous six months.

Analysis of these findings clearly indicates that proper preventive and restorative dental treatment for Brazilian children is urgently needed.

Chapter 1 also points to the relationship between poor oral health status and quality of life, illustrated through a vicious cycle of untreated dentine cavities, pain and discomfort, dental anxiety and avoidance of dental care. The low demand for dental treatment can be understood as resulting from avoidance of the most well-known approach for caries management, which involves administering local anesthesia and the use of the drill and burs, as these two factors are known to provoke pain and anxiety. Use of a less invasive and traumatic technique, such as the Atraumatic Restorative Treatment (ART) and an ultra-conservative restorative treatment, instead of the conventional restorative treatment, was therefore suggested. The expectation was that these two approaches would be able to break the vicious cycle by providing increased comfort and decreased anxiety during dental treatment.

As adequate instruments for measuring dental anxiety and pain from dental restorative treatment in young children were not readily available, a review of the literature was carried out. The following potentially suitable measurement instruments were identified: Venham Picture Test (VPT) and

Facial Image Scale (FIS) for measuring dental anxiety, and the Wong-Baker FACES Pain Rating Scale (Wong-Baker) for measuring pain from dental restorative treatment. This chapter ends with a list of primary and specific study aims.

Chapter 2 describes a review on pain and dental anxiety, in relation to ART. This review was carried out in order to discuss the evidence regarding the acceptability of ART from the patient's perspective. Aspects related to dental anxiety/fear and pain/discomfort are highlighted to facilitate better understanding of these conditions. The review showed that the ART approach seems to cause less discomfort than conventional approaches do and that ART could therefore be considered a very promising 'atraumatic' technique for use in treating cavitated carious lesions in children and addressing the fears of anxious adults and, possibly, of dental-phobic patients. The conclusion was reached that further investigations, using well-designed research protocols, were required to confirm these initial findings.

This recommendation led to a pilot study, described in Chapter 3, on self-reported pain in relation to ART and conventional restorative treatment in children.

Chapter 3: Forty boys and girls, 4 to 7 years old and presenting Class I cavitated dentin lesions in primary molars were randomly allocated to 2 groups. One group received conventional restorative treatment (CRT) using rotary instruments, while in the other one hand instruments were used to perform the restorations according to the ART approach. All children were treated by the same operator. A high-viscosity glass-ionomer cement (Fuji IX) was used to restore the cavities in both groups. The Wong-Baker FACES Pain Rating Scale was used for measuring children's pain at the end of the first restorative treatment session. It was concluded that ART restorations placed were the less time-consuming, that children felt less pain when the ART approach was used, and that younger children (4 years old) reported more pain than the older ones did, for both restorative treatments.

Although the outcomes of the pilot study confirmed the findings of the review, dental anxiety aspects, which are said to be related to the level of pain

during dental treatment, were considered neither in the published studies on ART acceptability nor in the pilot study on pain.

This lack of information demanded a thorough investigation into the influence of dental anxiety on self-reporting of pain by young children. For this it was necessary first to select the best instrument for assessing dental anxiety in young children. This process is described in Chapter 4, in which the Venham Picture Scale (VPT) and the Facial Image Scale (FIS) were tested in 5-to 7-year-old Brazilian children.

Chapter 4: One hundred and nine children of both genders were invited to respond to the VPT and the FIS in the waiting room, minutes before attending a scheduled dental visit. The VPT comprises eight cards, each showing two figures next to each other; one 'anxious' and one 'nonanxious'. The FIS comprises a row of five faces ranging from 'very unhappy' to 'very happy'. Each child was asked to point at the face which could best reflect their feelings at that moment in each of the scales. The results showed no correlation between the VPT and the FIS scores. There were no age and gender effects observed on the dental anxiety scores obtained on either of the scales. It was concluded that the VPT and the FIS were not correlated, suggesting that cultural aspects should be taken into account before selecting one of the instruments to be used in dental settings.

As the FIS was considered easier and faster to apply than the VPT, this measurement instrument was selected for use in the main study on dental anxiety in relation to three restorative treatments, as described in Chapter 5.

Chapter 5: The hypothesis tested was that the dental anxiety levels of children treated in accordance with the conventional restorative treatment are higher than in children treated with the atraumatic restorative treatment (ART) or an ultra-conservative treatment. A total of 302 children aged 6 to 7 years old, with at least 2 dentine carious lesions in primary teeth, constituted the sample. A parallel group study design was used, with ART and an ultra-conservative treatments as test groups and conventional restorative treatment as the control. The treatment was divided into two sessions, in order to allow realistic comparison of dental anxiety among the three treatment approaches. In the first session, one carious tooth (class II in a primary molar) was randomly selected

and treated according to one of the treatments. Before the first (FIS Tx-1) and second treatment sessions (FIS Tx-2), the level of dental anxiety was assessed, using the FIS. The FIS Tx-2 was the dependent variable, as it was supposed to reflect the dental anxiety levels of the children regarding the treatment that they had received during the first treatment session. The conclusion was that there was no difference in dental anxiety levels of children treated according to the conventional restorative treatment, ART and an ultra-conservative treatment. The hypothesis was rejected. A secondary finding was that a high dental anxiety score before the first treatment session was a predictor of a high dental anxiety score before the second treatment session.

As it was not possible to determine whether ART and ultra-conservative restorative treatment were less anxiety-provoking than the conventional restorative treatment, the next step was to investigate the levels of pain induced by these three dental treatment approaches. This was the purpose of the study described in the next chapter.

Chapter 6: The hypothesis tested was that the levels of pain experienced by children during the conventional restorative treatment are higher than those experienced during ART or an ultra-conservative restorative treatment. The initial sample consisted of 302 children, aged 6 – 7 years old, who had at least 2 teeth with dentine carious lesions in primary teeth. Before the first treatment session, in which one of the carious teeth was treated according to one of the treatments, the level of dental anxiety (FIS Tx-1) was assessed, using the FIS. After this treatment session, each child, using the Wong-Baker FACES Pain Rating Scale, reported the intensity of pain experienced during the restorative procedure followed. In addition, a heart monitor around the chest was used to assess the peak heart rate value of each child, as a secondary measure of pain sensation. The results showed that when conventional restorative treatment was used, more children needed to have local anaesthesia administered. Analyses, without data of children who had local anaesthesia administered, showed no significant difference in the pain levels of children treated in accordance with the conventional restorative treatment, ART or an ultra-conservative restorative treatment. There was no correlation between the peak heart rate values and the scores of self-reported

pain. Dental anxiety level prior to the treatment session was a confounding factor for the self-reporting of pain.

The outcomes of the two studies described above did not confirm the findings of the review described in Chapter 2. Possible factors explaining the differences between the outcomes of the review and those of the two studies are further discussed in the general discussion section.

Children in the main study had been exposed a number of times to dental procedures. These were: 1) an epidemiological examination; 2) the first treatment session; 3) the second treatment session; 4) the first evaluation session and 5) the second evaluation session. As the effect upon children's dental anxiety, of sequential dental visits of different natures had been investigated only once, in the seventies, and as we hypothesized that regular visits to the dentist would reduce the levels of dental anxiety, we analyzed the longitudinal data over a 14.5-month period (**Chapter 7**). The dental anxiety level of each child was assessed before each of the five dental visits, using the FIS. The total loss-to-follow up of children was 14.2%. The results showed a statistically significant decrease in levels of dental anxiety from time points 1 to 5. Between time points 2 and 3 and time points 4 and 5, in which the nature of the visits was the same, there was no change in children's levels of dental anxiety. Dental anxiety decrease occurred after the epidemiological survey (time point 1) and after the 2nd restorative session (time point 3), suggesting that decrease may have been related to increased familiarity with the dental environment and the dental procedures.

8.2 General discussion

Methodological aspects

Data from pain and dental anxiety presented in this thesis were exclusively collected through picture scales. The limitations of this kind of instrument have been discussed in many scientific reports (1-5), as well as in the individual studies that compose this thesis. However, it needs to be emphasized that for obtaining self-reporting of pain or dental anxiety from young children, the picture scales are the only measurement instruments available.

This is especially true for children who, like most of those included in the present investigations, are unable to read or write.

After overcoming this initial issue, the picture scales used in this study were selected differently for pain and dental anxiety. This was due to the strong evidence reported in the literature regarding the effectiveness of the facial pain scale eventually selected: Wong-Baker FACES Pain Rating Scale (Wong-Baker) (1,3,5-7). In contrast, such strong evidence is not yet available regarding the facial measurement instruments for assessing dental anxiety.

The Wong-Baker has high levels of validity and reliability and is considered, both by children and by parents, to be the best faces-scale for pain assessment (1,3,5-7). However, its use in dental settings is limited, and this fact was a determinant factor in the decision to make the Wong-Baker the pain measurement instrument to be used in the studies making up this thesis.

Although sufficient time was allocated to training staff on the use of the Wong-Baker scale, this instrument was wrongly applied to 33 children in the studies reported in chapters 5 and 6. This flaw occurred because one of the dental assistants asked a different question from the one in the study protocols when presenting the scale to the participating children. Instead of asking them how they felt during the dental treatment, she asked: 'How do you feel now that your dental treatment is finished?' As a result, the children's answers were not related only to their feelings during the dental treatment. They may also have been a reflection of their feelings about finally leaving the dental chair, for example. It was thus decided that the Wong-Baker data of these 33 children should be excluded from the main analysis, as they were not reliable.

Another aspect related to the Wong-Baker that requires discussion concerns the 25 children who needed local anaesthesia to be administered in the first treatment session. As it was expected that no pain would be felt after they received local anaesthesia, and as the worst pain would have been felt in the absence of it, a sensitivity analysis, in which the Wong-Baker score of the 25 children was set at the highest score ('5'), was performed. The results revealed that conventional restorative treatment was considered more painful than ART and ultra-conservative restorative treatment. This is because 21 of the 25 children who received local anaesthesia were allocated to the

conventional restorative treatment group. In addition, an operator effect and a cavity size effect were observed. Local anaesthesia was administered 24 times by the same operator and the children who had been anesthetized presented larger cavities than the other children included in the study. This difference in cavity size may explain the attitude of this operator in administering more local anaesthesia than the other two operators.

Giving score '5' to the children who received local anaesthesia could be seen as an arbitrary decision. Moreover, the difference in cavity size between these 25 and the other children participating in the study may infer a bias in the study design, as the effect shows that the treatment groups were not homogenous with respect to cavity size at baseline. Thus, the decision to exclude these 25 children from the studies described in chapters 5 and 6 was justifiable.

Regarding the choice of the measurement instrument for assessing dental anxiety in children; no evidence supporting the use of a particular instrument could be found in the literature. The most well-known picture scale is the Venham Picture Test (VPT) (8), which has been used in many studies assessing dental anxiety in children (9-14). The VPT is said to be very easy and fast to administer and it is also considered to be a well-tested instrument (15). However, hardly any information about the reliability and validity of the VPT has been published (2,4). The same applies to the Facial Image Scale (FIS) (16), which has currently been used in only four studies as an instrument for assessing dental anxiety in children (10,17-19).

Because of the lack of evidence about the validity and reliability of both the VPT and the FIS, the study described in Chapter 4 was conducted in order to test which of these two scales would be most suitable for use in the planned studies on testing the effect of ART on the dental anxiety in children. The outcomes did not yield the expected result. No correlation was found between the scores from VPT and FIS. However, as the children reported a preference for the FIS, arguing that it was easier to understand than the VPT, the former instrument was selected. This preference had already been suggested (9). The fact that the FIS is a relatively recently developed instrument was another

reason for choosing this dental anxiety scale for use in the studies described in chapters 5, 6, and 7.

It is known that pain and dental anxiety can be measured by different assessment approaches: behavioral, physiological and self-reporting, each of which assesses different aspects of pain and dental anxiety (2,7). Two of these techniques – self-reporting (Wong-Baker) and physiological (heart rate) – were used to assess pain in the study described in Chapter 6. No correlation was found between the two approaches, as they assess different components of the pain construct (7,20). In line with the proposal of Champion *et al.* (21), it is suggested that the combination of different methods should be used for assessment both of pain and of dental anxiety in further investigations in children. Furthermore, it should be emphasized that instrument selection should include consideration with regard to which of the three aspects – behavioral, physiological and cognitive – will be assessed.

Pain and dental anxiety related to ART

Pain related to dental treatment

It was hypothesized that the ART approach, in comparison to conventional restorative treatment, would lead to lower levels of pain related to dental treatment. The outcome of the pilot study on pain accepted the hypothesis, but that of the main study did not. This difference may be explained by the age of the children in these two studies: 4 - 7-year-olds in the pilot and 6 - 7-year-olds in the main study. In the pilot study, the 4-year-old children reported more pain than the 5 - 7-year-olds. It is common knowledge that, in general, the pain threshold level in younger children is lower than in older ones. Age difference may therefore well be the reason for the different results regarding pain related to ART and conventional treatment reported in the two studies. Another explanation may be related to the use of the rubber dam as part of the conventional restorative treatment. In the pilot study, a rubber dam was used, but in the main study it was not. Placing a rubber dam can cause discomfort, which can be interpreted by the children as a pain sensation. Although this hypothesis was not investigated in the pilot study, it may well be

another reason for the differences observed between the two studies, regarding pain related to dental treatment.

The results and outcomes of this thesis differ from those of previous studies on pain related to ART restorations. The majority of publications on this topic have found ART to be less painful than conventional restorative treatment (22-25). However, the study described in Chapter 6 is the first to have concluded that ART did not cause less pain than that caused by conventional restorative treatment.

It needs to be highlighted that different methodologies have been used in the studies about pain related to ART, referred to earlier. Most of them have relied upon simply asking the children whether any pain was felt during dental treatment (22,23,25). In only one study (24) a combination of behavioural and physiological measures was used to assess discomfort felt during dental treatment. In their research, the authors assumed that discomfort could mean anxiety or pain related to the dental treatment received. In this matter, the studies described in chapters 3 and 6 were pioneers on the use of a self-reporting instrument for the assessment of pain related to ART in children. This difference in pain assessment methods may be a reason for the difference in outcomes reported between the previous ones and the studies presented in this thesis.

Dental anxiety

Regarding the assessment of dental anxiety, a self-reporting picture scale (Venham Picture Test) has been used in young children only once (13). The authors found no difference between ART and conventional restorative treatment in the levels of related dental anxiety, which is the same outcome as that of the study described in Chapter 5. Another study on dental anxiety has found ART to be less anxiety-provoking than the conventional restorative treatment (26). In their research, the authors applied a dental fear scale (Short Form of the Dental Subscale of the Children's Fear Survey Schedule) to the children after the restorative treatment session was completed. This is not the appropriate methodology for assessing dental anxiety. Furthermore, the mean age of the participating children was 9.6 years, which is higher than in the

present investigation. Considering the reasons addressed, the outcomes of this thesis cannot be compared to the ones from Mickenautsch *et al.* (26).

Another outcome of this thesis was the decrease in levels of dental anxiety over sequential dental visits, presented in Chapter 7. It is interesting to note that the decrease occurred equally over the three restorative treatment groups. This means that independently of the restorative treatment provided, the children were less anxious after a 14.5 month period than they were at the beginning of the investigation. It also needs to be highlighted that the decrease in dental anxiety occurred after the first contact with the dental team (epidemiological examination), and later on after the second restorative treatment session. This can be related to increasing familiarity with the dental environment and dental procedures, as well as with the dental professionals involved in this investigation. Furthermore, the behaviour management techniques used by the operators might also have influenced the decrease in dental anxiety levels of the children.

Discussion of findings

Besides the reasons already addressed (e.g. age and methodological aspects), the fact that the three operators who performed the restorations in the studies described in chapters 5 and 6 were well-trained paediatric dentists may also have been a factor contributing to the absence of a difference in pain and dental anxiety between the children in the three restorative treatment groups studied. These specialists are used to dealing with young children and, during the treatment sessions, they used behavioural management techniques such as 'tell-show-do' (27). This reasoning is supported by the fact that, in the only other study that did not find differences between ART and conventional restorative treatment, in the levels of dental anxiety, the operators were also paediatric dentists (13). The other studies on dental anxiety and pain related to ART and conventional treatment (22-26) did not specify whether the operators were general clinicians or specialists. Therefore, the finding that ART does not cause less pain and less dental anxiety than the conventional restorative treatment may be more related to the management of the children, than to the treatment approach itself. It would, therefore, be very interesting to test the effect of

general dental practitioners on the children's self-reporting of pain and dental anxiety induced by ART and conventional restorative treatment. This would provide information about whether ART would lead to lower levels of pain and dental anxiety in children in general dental practice.

8.3 Contribution of the thesis to the improvement of the oral health of Brazilian children

Studies on dental anxiety and pain related to dental restorative treatment among Brazilian school children are not available. Therefore, the present PhD thesis provides new information on a topic that, although being of interest for both professionals and parents, has not been investigated before.

Chapter 1 presented a model in which the relationships between untreated caries lesions, pain, dental anxiety, oral health status and quality of life are connected. The main entry point of the vicious cycle is considered to be 'untreated caries lesions', which is represented by the d-component of the dmft index. The mean dmft score of the participating children was high (5.7), with the d-component predominating the dmft score. Despite the high prevalence of untreated dental caries, the levels of dental anxiety in the participating children at baseline were not high. The same applies to the levels of pain reported after the first treatment session. The outcomes indicate that these children can be treated on school premises, without the presence of their parents, and that they do not require special behavioral management techniques. Therefore, complex approaches, such as sedation and general anaesthesia, seem not to be necessary for treating school children in this socially deprived area of Brasilia.

The conclusion that any of the tested dental treatment approaches can be used to treat children restoratively could be drawn from the main findings of this PhD thesis. However, unlike the conventional restorative treatment, the ART approach has the advantage of not requiring dental equipment for the management of dental caries lesions. Therefore, introducing the preventive and restorative components of ART in schools is preferable to using conventional restorative treatment. It facilitates access to dental treatment in a child-friendly

and atraumatic way, which has a high chance of decreasing the prevalence of untreated dental caries.

By introducing the ART approach on the school premises, the vicious cycle mentioned in Chapter 1 may be interrupted. This could have a positive impact on the oral health status of the children, leading to improvements in their wellbeing and quality of life, and is therefore worth investigating.

8.4 Conclusions

This thesis aimed to investigate the impact of the ART approach on dental anxiety and pain experienced in school children in Brazil. The following conclusions are based on the findings of the studies discussed:

1. In the pilot study ART was less time consuming than conventional restorative treatment, in 4- to 7-year-old children. They reported less pain when the ART approach was used, and younger children (4 years old) reported more pain than the older ones did, for both restorative treatments;
2. The VPT and the FIS were not correlated in assessing dental anxiety in children aged 4-7 years. FIS was found to be faster and easier to apply than VPT, and children had a preference for FIS;
3. There was no significant difference in dental anxiety levels of 6- to 7-year-old children treated according to the conventional restorative treatment, ART and an ultra-conservative treatment. A high dental anxiety score before the first treatment session was a predictor of a high dental anxiety score before the second treatment session;
4. No significant difference was found in the pain levels of 6- to 7-year-old children treated in accordance with the conventional restorative treatment, ART and an ultra-conservative treatment. Dental anxiety level prior the treatment session was a confounding factor for the self-reporting of pain;
5. There was a decrease in dental anxiety levels of 6- to 7- year-old children over 14.5 months of sequential dental visits. This finding may be related

to increased familiarity with the dental environment and the dental procedures.

8.5 Recommendations

1. Dental professionals should avoid, as much as possible, treatment approaches that may initiate the process of dental anxiety in young children, as it may lead to a vicious cycle of decreasing quality of life.
2. Introducing young children to the dental professional and to dental procedures, particularly when they still do not need extractions and invasive restorative treatments, has a high probability of preventing the onset of dental anxiety. For this purpose, the ART approach should be considered an option for introducing dental care for Brazilian children currently without access to oral care, as it has been shown to provide quality preventive and restorative care and can be executed on the school premises without the need of complex dental equipment. Furthermore, ART being less invasive than conventional treatment, may also be more child-friendly, especially for those experiencing dental treatment for the first time
3. Further studies on pain and dental anxiety related to ART are still required in order to evidence the acceptability of this dental treatment approach among young children. These should include paediatric and non-paediatric dentists as operators, as this protocol may provide information on whether the specific management techniques that the specialists possess can influence the final outcomes of the investigations.
4. In further investigations into dental anxiety and pain related to dental treatment, physiological and/or behavioural measures should be combined with the self-reporting measurement scales, in order to assess different dimensions of pain and dental anxiety.

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HOOFDSTUK 8

Samenvatting, algemene beschouwing, conclusies en aanbevelingen

In dit hoofdstuk wordt een samenvatting gegeven van de voorgaande hoofdstukken, alsmede een beschouwing over de gebruikte onderzoeksmethoden bij de afzonderlijke onderzoeken. Verder worden de bevindingen van de onderzoeken besproken in het kader van verbetering van de mondgezondheid van Braziliaanse kinderen. Het hoofdstuk eindigt met de conclusies van het promotieonderzoek en met een lijst van aanbevelingen.

8.1 Samenvatting

Dit promotieonderzoek is gebaseerd op de bevindingen van 6 onderzoeken naar de invloed van de ART-benadering op de behandelangst en pijnbeleving van Braziliaanse kinderen.

Hoofdstuk 1 beschrijft de cariëssituatie van Braziliaanse kinderen n.a.v. de resultaten van een landelijk epidemiologisch onderzoek uit 2010. Dit leverde 4 belangrijke conclusies op:

- De prevalentie van tandcariës in het tijdelijke gebit op 5-jarige leeftijd was hoog (43%);
- De prevalentie van tandcariës in het blijvende gebit was hoog: 56% bij 12-jarigen en 60% bij 15 tot 19-jarigen;
- Op 5-jarige leeftijd was 80% van de tandcaviteiten niet behandeld;
- 21% van de 5-jarigen gaf aan in de 6 maanden voorafgaand aan het epidemiologisch onderzoek, tandpijn te hebben gehad.

Deze conclusies wijzen erop dat adequate preventieve en restauratieve zorg voor Braziliaanse kinderen echt noodzakelijk is.

Verder wordt de relatie tussen slechte mondgezondheid en kwaliteit van leven beschreven a.d.h.v. een vicieuze cirkel van onbehandelde tandcaviteiten, tandpijn en gevoeligheid, behandelangst en het vermijden van mondzorg. De geringe vraag naar behandeling van tandcariës wordt verklaard door het willen vermijden van de bekendste manier om tandcariës te behandelen: de verdoving en de boor. Beide laatstgenoemde zaken zijn bekende factoren die behandelangst en pijn bij restauratieve behandeling oproepen. Om dit te voorkomen werd voorgesteld om de patiëntvriendelijke benadering ART (Atraumatic Restorative Treatment) en de ultra-conservatieve behandelmethode te gebruiken. De verwachting was dat deze twee behandelmethoden de vicieuze cirkel zouden kunnen doorbreken.

Omdat adequate meetinstrumenten voor behandelangst en pijn bij restauratieve behandeling voor jonge kinderen niet voorhanden waren, werd een literatuuronderzoek uitgevoerd. Dit resulteerde in de volgende meetinstrumenten: De Venham Picture Test (VPT) en de Facial Image Scale (FIS) voor het meten van behandelangst, en de Wong-Baker FACES Pain

Rating Scale (Wong-Baker) voor het meten van pijn tijdens restauratieve behandeling. Dit hoofdstuk eindigt met een lijst van algemene en specifieke onderzoeksdoelstellingen.

Hoofdstuk 2 beschrijft een literatuuronderzoek naar behandelangst en pijn bij ART. Dit onderzoek werd uitgevoerd om het bewijs m.b.t. de acceptatie van de ART-benadering door patiënten, te bediscussiëren. Aspecten, die van belang zijn om behandelangst en pijn tijdens restauratieve behandeling beter te begrijpen, worden besproken. Het onderzoek toonde aan dat de ART-benadering minder ongemak zou veroorzaken dan de conventionele restauratieve behandelmethoden en dat ART dus een veelbelovende 'atraumatische' benadering voor tandcaviteiten bij kinderen is. Ook zou ART de behandelangst bij volwassenen en bij fobische mensen kunnen beteugelen. De conclusie van dit literatuuronderzoek was dat meer onderzoeken naar behandelangst en pijn bij behandeling door ART noodzakelijk zijn om deze voorlopige conclusies te staven. Hierbij dient gebruik te worden gemaakt van goed opgezette onderzoeksprotocollen.

Deze aanbeveling leidde tot een vooronderzoek naar de zelfrapportage van pijn bij restauratieve behandeling bij kinderen d.m.v. ART en de conventionele restauratieve methode.

Hoofdstuk 3 beschrijft dit vooronderzoek. Het werd uitgevoerd bij 40 jongens en meisjes van 4 tot 7 jaar die een klasse I caviteit in een tijdelijke molaar hadden. Aselect werden de kinderen ingedeeld in een conventionele restauratie groep (CRT) waarbij de boor werd gebruikt, en in een ART groep waarbij alleen handinstrumenten werden gebruikt voor het restaureren van de caviteiten. De restauraties werden door dezelfde behandelaar gedaan. Het vulmateriaal was een hooggevuuld glasionomeer (Fuji IX). De Wong-Baker schaal werd gebruikt om de pijn bij behandeling, na het beëindigen van de eerste restauratie, te meten. De conclusie van het onderzoek was dat het plaatsen van ART restauraties minder tijd vergde, dat de kinderen aangaven minder pijn te ervaren tijdens het plaatsen van een ART restauratie, en dat de jongste kinderen (4 jaar) meer pijn tijdens de behandeling met beide methoden voelden dan de oudere kinderen.

Ofschoon de bevindingen van het vooronderzoek die van het literatuuronderzoek bevestigen, was de relatie tussen de aspecten, die behandelangst oproepen en pijn bij de behandeling veroorzaken, noch besproken in het literatuuronderzoek noch in het vooronderzoek.

Dit gemis vroeg om een gedegen onderzoek naar de invloed van behandelangst op de pijnervaring tijdens behandeling bij jonge kinderen. Om dit te kunnen onderzoeken was het echter noodzakelijk eerst het beste instrument te selecteren om behandelangst bij kinderen te meten. Dit proces is in hoofdstuk 4 beschreven.

Hoofdstuk 4: In deze studie wordt de samenhang tussen VPT en FIS getest bij een groep van 5 tot 7-jarigen uit Brazilië. In totaal werd aan 109 kinderen gevraagd om de VPT en de FIS in de wachtkamer in te vullen, enkele minuten voordat ze een tandheelkundige behandeling zouden ondergaan. De VPT bestaat uit acht kaarten die elk twee figuren naast elkaar laten zien. De ene drukt angst uit, de andere niet. De FIS bestaat uit een rij van vijf getekende gezichten die verschillende gemoedsuitdrukkingen uitbeelden; van erg ongelukkig tot heel erg blij. Elk kind werd gevraagd om zijn/haar gemoed op dat moment aan te geven door met de vinger naar een van de tekeningen van zowel de VPT als de FIS te wijzen. Er bleek geen correlatie tussen de VPT en de FIS scores te bestaan. Ook werden met beide meetinstrumenten geen leeftijd- en geslachtseffecten waargenomen m.b.t. de behandelangst van de kinderen. De eerste conclusie was dat er geen samenhang tussen de VPT en de FIS was. De tweede conclusie was dat culturele aspecten van kinderen eerst beschouwd moesten worden, alvorens een bepaald meetinstrument in de tandartspraktijk te gebruiken.

Omdat gebleken was dat de FIS gemakkelijker en sneller kon worden uitgevoerd, werd dit meetinstrument geselecteerd om in de hoofdstudie de relatie tussen behandelangst en behandelmethoden te meten. Dit onderzoek wordt in hoofdstuk 5 beschreven.

Hoofdstuk 5: De hypothese die getoetst werd luidde als volgt: de behandelangst van kinderen, die met de conventionele restauratieve methode worden behandeld, is hoger dan die van kinderen die met de ART en de ultra-conservatieve methode worden behandeld. In totaal werden 302 kinderen van 6

en 7 jaar, die tenminste twee tandcaviteiten in het tijdelijke gebit hadden, geselecteerd. De studieopzet volgde het parallelgroep ontwerp met de ART-groep en de ultra-conservatieve behandelmethode als de controlegroepen. De behandeling werd in twee sessies verdeeld om een zo realistisch mogelijke vergelijking te krijgen van de behandelangst bij kinderen uit de drie behandelgroepen. Voor de eerste behandeling werd één klasse II-caviteit in een tijdelijke molaar aselekt geselecteerd en behandeld volgens een van de drie behandelmethoden. Voor de eerste (FIS Tx-1) en de tweede (FIS Tx-2) behandelsessie werden de mate van behandelangst d.m.v. de FIS gemeten. De FIS Tx-2 was de afhankelijke variabele omdat deze meting de mate van behandelangst aangeeft ná de eerste behandeling. Het onderzoek toonde geen verschil aan in mate van behandelangst tussen de kinderen van de drie onderzoeksgroepen. De hypothese werd dus verworpen. Een saillant resultaat was dat een hoge behandelangst voor de eerste behandeling een voorspeller was voor een hoge behandelangst voor de tweede behandeling.

Het bleek niet mogelijk aan te tonen dat de ART- en de ultra-conservatieve behandelmethode minder angst veroorzaken dan de conventionele restauratieve methode. De volgende stap was dus om de mate van pijnbeleving te onderzoeken bij de kinderen uit de drie groepen. Dit was het doel van het onderzoek dat in hoofdstuk 6 wordt beschreven.

Hoofdstuk 6: De hypothese luidde als volgt: de mate van pijn tijdens restauratieve behandeling met de conventionele methode is hoger dan die bij de ART- en de ultra-conservatieve methode. De steekproef bestond uit 302 kinderen van 6 en 7 jaar oud, die tenminste twee tandcaviteiten in het tijdelijke gebit hadden. Voordat de eerste behandeling werd uitgevoerd, werd de mate van behandelangst (FIS Tx-1) gemeten. Na de behandeling werd aan ieder kind gevraagd om de mate van pijnbeleving op de Wong-Baker schaal aan te geven. De mate van pijn werd ook gemeten d.m.v. een hartmonitor die over de borst van de kinderen was bevestigd. Het onderzoek toonde aan dat kinderen, die met de conventionele restauratieve methode werden behandeld, vaker een verdoving nodig hadden dan kinderen die met de andere twee methoden werden behandeld. Indien de gegevens van deze kinderen buiten de analyse werden gelaten, bleek er geen verschil te zijn in de mate van pijnbeleving bij de

kinderen uit de drie onderzoeksgroepen. Er werd geen correlatie gevonden tussen de maximum hartslag en de pijnscores die de kinderen op de Wong-Baker schaal aangaven. De mate van behandelangst vóór aanvang van de eerste behandeling was een storende factor voor het vaststellen van pijnbeleving tijdens die behandeling.

De resultaten van de twee laatstgenoemde onderzoeken zijn in tegenspraak met de resultaten van het literatuuronderzoek, beschreven in hoofdstuk 2. De factoren, die dit verschil zouden kunnen verklaren, worden in de algemene beschouwing besproken.

De kinderen uit de hoofdstudie waren een aantal keren aan tandheelkundige handelingen blootgesteld. Dit betrof: 1) epidemiologisch onderzoek; 2) eerste restauratieve behandeling; 3) tweede restauratieve behandeling; 4) eerste evaluatie van de restauraties en; 5) tweede evaluatie van de restauraties. Het effect van regelmatig in aanraking zijn geweest met verschillende tandheelkundige handelingen op de behandelangst van kinderen was slechts één keer eerder, in de jaren zeventig, onderzocht. De hypothese die werd getoetst was als volgt: regelmatig bezoek aan tandheelkundigen zal de behandelangst bij kinderen verminderen. De studie die de hypothese toetste, staat in hoofdstuk 7 beschreven.

Hoofdstuk 7: De behandelangst van de kinderen werd d.m.v. de FIS gemeten. In totaal konden de gegevens van 85,8% van de kinderen gebruikt worden. Het onderzoek toonde aan dat, gedurende de onderzoeksperiode van 14,5 maand, de behandelangst statistisch significant verminderde. Tussen meetpunt 2 en 3, en tussen meetpunt 4 en 5, bleek geen verschil in behandelangst van de kinderen te bestaan. De behandelangst nam af na het epidemiologisch onderzoek en na de tweede behandeling. Dit suggereert dat de afname wellicht verband houdt met de toename van bekendheid met de tandheelkundige omgeving en de tandheelkundige handelingen.

8.2 Algemene beschouwing

Methodologische aspecten

De gegevens m.b.t. behandelangst en pijn tijdens restauratieve behandeling, die in dit proefschrift zijn beschreven, zijn uitsluitend vergaard door gebruik te maken van tekening-schalen. De beperkingen van dit type meetinstrument zijn in vele wetenschappelijke studies beschreven (1-5), ook in de onderzoeken die in dit proefschrift gepresenteerd zijn. Het moet echter gezegd worden dat de tekening-schaal het enige type meetinstrument is om van de kinderen te vernemen hoeveel angst en pijn ze ervaren tijdens tandheelkundige behandelingen. Dit type instrument is met name van belang voor kinderen die nog niet kunnen lezen en schrijven, zoals de kinderen uit dit promotieonderzoek.

Na een keuze te hebben gemaakt uit de aanwezige tekening-schalen, werden er twee in dit onderzoek gebruikt; één voor het meten van behandelangst en één voor het meten van pijn tijdens restauratieve behandeling. De pijn-tekening-schaal kwam als beste uit een systematisch literatuuronderzoek naar pijnbeleving door kinderen bij medisch handelen (1,3,5-7). De Wong-Baker-schaal is valide en betrouwbaar en wordt, zowel door kinderen als door ouders, als de beste tekening-schaal voor het meten van pijn bij behandeling beschouwd (1,3,5-7). De Wong-Baker schaal wordt niet veel gebruikt in de tandheelkunde en dat was de beslissende factor om deze schaal in dit promotieonderzoek te gebruiken.

Ofschoon er voldoende tijd besteed was aan het onderwijzen van medewerkers in het gebruik van de Wong-Baker schaal, bleek dat 33 kinderen op een verkeerde wijze waren ondervraagd (hoofdstuk 5 en 6). Dit gebeurde omdat een van de assistenten een vraag verkeerd stelde. In plaats van de kinderen te vragen 'hoe ze zich voelden tijdens de restauratieve behandeling' werd hen gevraagd: 'hoe voel je je nu nadat de tandheelkundige behandeling is afgelopen'. Dit had tot gevolg dat de antwoorden geen betrekking hadden op de gevoelens van de kinderen tijdens de restauratieve behandeling. De antwoorden zouden ook een uiting kunnen zijn van hun gevoelens dat ze

eindelijk konden vertrekken. Daarom werd besloten om de gegevens van deze 33 kinderen niet in de analyse op te nemen.

Een ander aspect van het gebruik van de Wong-Baker schaal dat discussie oproept, betreft de 25 kinderen die een lokale verdoving kregen toegediend vóór of tijdens de eerste restauratieve behandeling. Omdat kinderen geen pijn meer voelen na verdoving en omdat men ervan uit kan gaan dat ze zonder verdoving de hoogste pijn score zouden aanwijzen, werd een gevoeligheidsanalyse uitgevoerd met de hoogste pijnscore van 5 voor deze 25 kinderen. Dit resulteerde in de bevinding dat de conventionele restauratieve behandeling als meer pijnlijk werd ervaren dan de ART en de ultra-conservatieve behandeling. De reden is dat 21 van die 25 kinderen tot de conventionele restauratieve behandelgroep behoorden. Verder werd er nog een effect van operator en van caviteitsgrootte waargenomen. De lokale verdoving was 24 van de 25 keer door dezelfde operator toegediend en de kinderen, wiens kiezen verdoofd moest worden, hadden een significant grotere caviteit dan de kinderen die geen verdoving nodig hadden. Het verschil in caviteitsgrootte zou het gedrag van de operator kunnen verklaren. Echter, het geven van de hoogste pijnscore van 5 aan de kinderen die een verdoving hadden gekregen, kan als een arbitraire beslissing worden opgevat. Bovendien kan het verschil in caviteitsgrootte tussen de 25 kinderen met een verdoving en de rest zonder verdoving als 'bias' worden opgevat, omdat de grootte van de caviteiten niet gelijkmatig over de drie behandelgroepen was verdeeld. Het besluit om deze 25 kinderen buiten de analyse te houden was dus een correct besluit.

Met betrekking tot het instrument, dat gebruikt werd om behandelangst bij de kinderen te meten, kan opgemerkt worden dat er geen voorkeur aanwezig was voor een bepaald instrument vóór aanvang van het onderzoek. De meest bekende tekening-schaal is de Venham Picture Test (VPT) (8) die in veel onderzoeken gebruikt was (9-14). Het was bekend dat de VPT erg gemakkelijk en snel toe te passen was en dat deze regelmatig getest was (15). Informatie over de validiteit en betrouwbaarheid van de VPT waren echter schaars (2,4). Hetzelfde gold voor de Facial Image Scale (FIS) (16), die tot dan toe slechts in vier onderzoeken was gebruikt om behandelangst te meten (10,17-19).

Omdat er weinig bewijs inzake de validiteit en betrouwbaarheid van beide meetinstrumenten voorhanden was, werd het onderzoek uitgevoerd dat in hoofdstuk 4 wordt besproken. Het doel was om na te gaan welke van de twee instrumenten het meest geschikt was om de relatie tussen ART en de behandelangst bij kinderen te onderzoeken. De resultaten vielen anders uit dan verwacht. Er werd geen correlatie gevonden tussen de resultaten van de VPT en de FIS. Maar omdat de kinderen een voorkeur uitspraken voor de FIS omdat deze duidelijker was dan de VPT, werd de eerste geselecteerd. Die uitkomst is al eens eerder gepubliceerd (9). Een andere reden was het feit dat de FIS een recentelijk ontwikkeld meetinstrument is.

Het is bekend dat pijn tijdens restauratieve behandeling en behandelangst op verschillende manieren kunnen worden gemeten. Het kan gebeuren door het meten van gedragsmatige aspecten, door het meten van fysiologische aspecten, en het kan gebeuren door zelfrapportage. Deze manieren stellen ieder een ander aspect van behandelangst en pijn tijdens restauratieve behandeling vast (2,7). Twee van deze methoden, zelfrapportage via de Wong-Baker schaal en de fysiologische manier via het meten van de hartslag, zijn gebruikt om pijn tijdens restauratieve behandeling te meten (hoofdstuk 6). Er werd geen correlatie tussen beide methoden gevonden, wellicht omdat ze twee verschillende aspecten van pijnbeleving vastleggen (7,20). Zoals Champion et al (21) reeds hebben voorgesteld, wordt in dit proefschrift voorgesteld dat, in toekomstig onderzoek bij kinderen, een combinatie van verschillende meetinstrumenten moet worden toegepast voor het meten van pijn tijdens restauratieve behandeling en van behandelangst. De keuze zal mede worden bepaald door welk aspect wordt onderzocht, het gedragsmatige, het fysiologische of het cognitieve.

Pijn bij restauratieve behandeling en behandelangst in relatie tot ART

Pijn bij restauratieve behandeling

Er werd verondersteld dat de ART-benadering tot minder pijn bij restauratieve behandeling zou leiden dan de conventionele restauratieve methode. Deze veronderstelling werd in het vooronderzoek aangetoond, maar

niet in het hoofdonderzoek. Het verschil in resultaat kan verklaard worden door het verschil in leeftijd van de onderzochte kinderen in de twee onderzoeken. In het vooronderzoek waren de kinderen 4 tot 7 jaar oud en in het hoofdonderzoek 6 tot 7 jaar. In het vooronderzoek gaven de 4-jarige kinderen meer pijn aan dan de 5 tot 7-jarigen. Het is algemeen aanvaard dat de pijngrens bij jonge kinderen lager ligt dan bij oudere kinderen en dat zou een verklaring kunnen zijn voor het verschil in pijn bij restauratieve behandeling tussen beide behandelmethoden in beide onderzoeken. Het verschil zou ook verklaard kunnen worden door het gebruik van rubberdam, dat bij de conventionele restauratieve aanpak in het vooronderzoek wel en in het hoofdonderzoek niet aangebracht werd. Het plaatsen van rubberdam kan ongemak veroorzaken dat door kinderen als pijn ervaren wordt. Dit facet is niet onderzocht.

De bevindingen uit dit promotieonderzoek laten een ander beeld zien van pijn tijdens restauratieve behandeling met ART dan voorgaande onderzoeken over dit onderwerp. De meeste onderzoeken toonden aan dat de behandeling met ART minder pijn tijdens de behandeling veroorzaakte dan de conventionele restauratieve methode. Het onderzoek uit hoofdstuk 6 is het eerste dat geen verschil in pijnbeleving aantoonde.

Verschillende meetmethoden werden toegepast in de voorgaande onderzoeken naar pijn tijdens de ART. Meestal vroeg men de kinderen naar hun pijnbeleving ná de behandeling (22,23,25). In één studie werd een combinatie van gedragswetenschappelijke en fysiologische instrumenten gebruikt om dit ongemak te meten (24). Bij dit laatste onderzoek gingen de auteurs ervan uit dat ongemak zowel pijn bij behandeling als behandelangst zou kunnen betekenen. In feite zijn de onderzoeken uit hoofdstuk 3 en 6 voorlopers van het gebruik van zelfrapportage voor het vaststellen van pijn na behandeling met ART bij kinderen. Het verschil in gebruik van meetinstrumenten zou een verklaring kunnen zijn voor het gevonden verschil tussen de onderzoeken uit de literatuur en die uit dit promotieonderzoek.

Behandelangst

Meten van behandelangst bij jonge kinderen d.m.v. zelfrapportage met de VPT was maar een keer eerder gepubliceerd (13). De auteurs vonden geen

verschil in behandelangst tussen de ART en de conventionele restauratieve behandelmethode. Dit resultaat komt overeen met dat uit hoofdstuk 5 van dit proefschrift. Een ander onderzoek vond de ART-benadering minder angstaanjagend dan de conventionele restauratieve methode (26). In dit onderzoek werd de Short Form of the Dental Subscale gebruikt om angst bij kinderen te meten. Het instrument werd niet vóór maar ná de behandeling toegepast. Dit is niet de geëigende manier om behandelangst te meten. Verder waren de onderzochte kinderen uit dit onderzoek ouder dan die uit het promotieonderzoek. Ze waren gemiddeld 9.6 jaar. Daarom is het moeilijk om de bevindingen uit het promotieonderzoek met het bovengenoemde onderzoek van Mickenautsch et al (26) te vergelijken.

Een andere bevinding die dit promotieonderzoek heeft opgeleverd is de vermindering van behandelangst na veelvuldig contact met tandheekkundigen en tandheekkundig handelen (hoofdstuk 7). De vermindering van behandelangst kwam voor bij kinderen uit alle drie de behandelgroepen. De manier van behandelen had dus geen invloed op de vermindering van behandelangst gedurende de periode van 14.5 maand. De vermindering vond plaats na het epidemiologisch onderzoek en later na het beëindigen van de tweede restauratieve behandeling. Waarschijnlijk zijn de bekendheid met het behandelteam en de behandelomgeving debet aan deze bevindingen. De professionaliteit van de behandelaars mag in deze echter niet onderschat worden.

Beschouwing van de bevindingen

Naast de redenen die al besproken zijn (leeftijd van de kinderen en methodologische aspecten) zou het feit dat drie gespecialiseerde kindertandartsen de behandelingen uitvoerden, ook een reden kunnen zijn voor de afwezigheid van een verschil in behandelangst en pijn tijdens restauratieve behandeling bij kinderen uit de drie behandelgroepen. Deze specialisten zijn ervaren in het behandelen van jonge kinderen en gebruiken gedragstechnieken om de kinderen gerust te stellen (27). Deze gedachte wordt ondersteund door het feit dat, in het enige andere onderzoek dat geen verschil in behandelangst tussen de ART en de conventionele restauratieve methode aantoonde, de

behandelaars ook gespecialiseerde kindertandartsen waren (13). Van de andere onderzoeken, die behandelangst en pijn tijdens restauratieve behandeling tussen ART en de conventionele methode hebben onderzocht, weten we niet of de behandelaars gespecialiseerde kindertandartsen waren of algemene tandartsen (22-26). Het zou dus kunnen zijn, dat het niet kunnen aantonen van minder behandelangst bij kinderen die met ART zijn behandeld t.o.v. van die met de conventionele restauratieve methode zijn behandeld, eerder ligt aan het geruststellen van de kinderen door specialisten, dan aan de behandelmethode op zich. Het zou dus interessant zijn om na te gaan of ART wel minder behandelangst oproept dan de conventionele restauratieve behandelmethode, indien de behandelaars algemene practici zijn. Onderzoek hiernaar zou van belang zijn voor de restauratieve behandeling van kinderen in de algemene tandartsenpraktijk.

8.3 Bijdrage van dit promotieonderzoek tot de verbetering van de mondgezondheid van Braziliaanse kinderen

Er zijn geen onderzoeken naar behandelangst en pijn tijdens restauratieve behandeling bij Braziliaanse kinderen beschikbaar. Daarom is dit promotieonderzoek belangrijk. Het geeft nieuwe informatie over een aspect van mondgezondheid dat van belang is voor de tandheelkundige professionals en voor de ouders.

In hoofdstuk 1 is een model gepresenteerd dat de verhoudingen tussen onbehandelde caviteiten, tandpijn, behandelangst, mondgezondheid en kwaliteit van leven verbeeldt. De onbehandelde caviteit, die door de d-component van de dmft index wordt uitgedrukt, is de ingang van het model. Het gemiddelde dmft getal van de onderzochte kinderen was hoog (5.7), terwijl de d-component het overgrote deel van de dmft-index uitmaakte. Ondanks de hoge prevalentie van onbehandelde caviteiten was de behandelangst bij de onderzochte kinderen aan het begin van het onderzoek niet groot. Hetzelfde gold voor de mate van aangegeven pijn tijdens behandeling ná de eerste restauratieve behandeling. De bevindingen laten zien dat deze kinderen op school behandeld kunnen worden zonder bijzijn van hun ouders en dat speciale

gedragstechnieken niet nodig zijn. Gecompliceerde behandeltechnieken, zoals lachgas en algemene verdoving, lijken niet nodig te zijn om de kinderen uit dit laag sociaal milieu in Brasilia te behandelen.

De conclusie van dit promotieonderzoek is dat alle onderzochte restauratieve behandelmethoden gebruikt kunnen worden om deze schoolkinderen te behandelen. De ART-benadering heeft echter geen apparatuur nodig, de conventionele restauratieve methode wel. Om die reden zou voor de ART-benadering gekozen kunnen worden bij het introduceren van preventieve en restauratieve zorg op school, want dat laatste is noodzakelijk. De ART-benadering zorgt ervoor dat tandheelkundige behandelingen op een kindvriendelijke en niet-traumatische manier worden uitgevoerd. Het geeft daarom de mogelijkheid om de prevalentie van onbehandelde caviteiten te verminderen.

Door ART in te voeren op scholen zou de vicieuze cirkel, die in hoofdstuk 1 wordt besproken, doorbroken kunnen worden. Dit zou een positieve invloed kunnen hebben op de mondgezondheid van de kinderen. Dat kan uiteindelijk leiden tot een verbetering van hun welzijn en kwaliteit van leven en dat is de moeite waard om te onderzoeken.

8.4 Conclusies

Dit proefschrift heeft tot doel de invloed van de ART-benadering op de behandelangst en pijn tijdens restauratieve behandeling te onderzoeken bij schoolkinderen in Brazilië. De hieronder genoemde conclusies zijn gebaseerd op de bevindingen van de afzonderlijke onderzoeken:

1. In het vooronderzoek, dat bij 4 tot 7 jarige kinderen werd uitgevoerd, was de ART-benadering sneller dan de conventionele methode in het restaureren van caviteiten. De kinderen, die met de ART werden behandeld, rapporteerden minder pijn. Bij beide behandelmethoden rapporteerden de jongste kinderen (4-jarigen) meer pijn dan de oudere kinderen (5 tot 7-jarigen);
2. Er kon geen samenhang gevonden worden tussen de VPT en de FIS voor het meten van behandelangst bij de 4 tot 7-jarigen. De FIS werd

sneller in gebruik bevonden en was gemakkelijker toepasbaar dan de VPT. Kinderen hadden ook een voorkeur voor de FIS;

3. Er was geen significant verschil in behandelangst bij de 6 tot 7-jarigen die met de conventionele restauratieve, de ART en de ultra-conservatieve behandelmethode werden behandeld;
4. Er was geen significant verschil in pijn tijdens behandeling bij de 6 tot 7-jarigen die door de conventionele restauratieve, ART en ultra-conservatieve behandel aanpak werden behandeld. De mate van behandelangst vóór de eerste behandeling was een storende factor bij de zelfrapportage van pijn;
5. De behandelangst bij de 6 tot 7-jarigen werd steeds minder gedurende de looptijd van het onderzoek. Deze bevinding wordt toegeschreven aan de toegenomen bekendheid met de tandheelkundige omgeving en de tandheelkundige procedures.

8.5 Aanbevelingen

1. Tandheelkundigen moeten zoveel mogelijk behandelingen, die angst bij jonge kinderen kunnen oproepen, vermijden, omdat dit kan leiden tot een vicieuze cirkel, die kan leiden tot vermindering van kwaliteit van leven.
2. Jonge kinderen bekend maken met tandheelkundigen en met tandheelkundig handelen, met name als ze nog geen extractie en restauraties nodig hebben, geeft een hoge kans om behandelangst te voorkomen. Om dit te bereiken moet de ART-benadering als een optie gezien worden om mondzorg bij Braziliaanse kinderen, die daar op dit moment geen toegang toe hebben, te introduceren. De ART-benadering heeft bewezen goede preventieve en restauratieve zorg te leveren. Het kan uitgevoerd worden op scholen zonder dat gecompliceerde apparatuur nodig is. Verder zorgt behandeling d.m.v. ART voor minder grote caviteiten dan conventionele restauratieve behandeling en is het kindvriendelijker, met name voor kinderen die voor de eerste keer een gebitselement gerestaureerd moeten krijgen.

3. Vervolgonderzoek naar de behandelangst en pijn tijdens de behandeling met ART is noodzakelijk om de acceptatie ervan bij jonge kinderen te bewijzen. Onderzoeksprotocollen moeten voorzien in behandeling door zowel kindertandartsen als algemeen practici, om na te gaan of de specifieke kennis om jonge kinderen te behandelen, die kindertandartsen bezitten, een reden is om de verschillen in behandelangst en pijn tijdens behandelingen te kunnen verklaren.
4. In vervolgonderzoek naar de behandelangst en pijn tijdens restauratieve behandeling moeten zowel gedragswetenschappelijke als fysiologische instrumenten, te samen met een zelfrapportage, worden gebruikt om alle dimensies van behandelangst en pijn tijdens behandelingen te kunnen meten.

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Pain and dental anxiety related to restorative treatment in children

Pain and dental anxiety are potential distressing conditions that may make it difficult, or even preclude the performance of conventional restorative treatment, especially in paediatric dentistry. The use of burs and drills, and that of injection needles are often pointed out as the main reasons for manifestations of dental anxiety related to dental restorative treatment.

The Atraumatic Restorative Treatment (ART) is considered to be less invasive than conventional restorative techniques for treating cavitated dentine carious lesions, as it uses only hand instruments to remove the soft decayed tooth tissues. The ART approach also brings a concept of being 'atraumatic' to the person having to undergo restorative dental care, in a way which could minimize the apprehension related to the use of burs and drills. Moreover, as local anaesthesia is hardly needed to perform ART restorations, pain related to administering an injection is also reduced.

The six studies which comprise this PhD thesis were conducted mainly to investigate whether the use of the ART approach would lead to lower levels of pain and dental anxiety compared to the conventional restorative treatment. A second aim was to investigate the effect of sequential dental visits on children's levels of dental anxiety. The studies also provide information on the instruments used to assess pain and dental anxiety in young children.

The findings showed no difference in the levels of pain and dental anxiety between the ART and the conventional restorative approach, although significantly more children treated with the conventional method needed to be anaesthetized locally. Gradual exposure of children to the dental environment and to restorative care had a positive impact on their feelings about dental care over a 14.5-months period.

These outcomes suggest that independently of the restorative treatment used, young children need to be gradually introduced to dental restorative treatment, in order to minimize the development of dental anxiety. Being a child-friendly caries management approach, the use of ART should receive wider attention among dentists.