Original Article

Dental Anxiety and Oral Health-Related Quality of Life in Children Following Dental Rehabilitation under General Anesthesia or Intravenous Sedation: A Prospective Cross-Sectional Study

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Abstract

Purpose: The study aimed to investigate dental anxiety and oral health-related quality of life among children undergoing dental rehabilitation under general anesthesia (GA) and intravenous sedation (IVS). **Materials and Methods:** Participants were 99 healthy children aged 3–5 or 6–12 years operated under GA or IVS. Dental anxiety before treatment and 1 month postoperatively were measured using the Frankl behavior scale (FBS), the venham picture test (VPT), the early childhood oral health impact scale (ECOHIS), and the children's fear survey schedule-dental subscale (CFSS-DS). Data were analyzed using Student's *t*-test and Mann–Whitney U-test. **Results:** ECOHIS scores decreased in all groups. VPT scores increased in the 3–5-year-olds treated under GA ($P = 0.003$). Postoperative CFSS-DS anxiety scores were lower in IVS groups. FBS scores were significantly higher for both age groups ($P < 0.001$). There was no effect of numbers of extracted or treated teeth. **Conclusions:** Dental rehabilitation under GA and IVS improved the quality of life and dental behavior. In the 6–12-year-olds, there was no statistically significant difference between children undergoing dental operations under GA and those undergoing dental operations under IVS. Dental anxiety decreased in 3–5-year-olds after treatment under GA but not after IVS.

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Introduction

The previous research has shown that high caries prevalence is a chronic disease that has a negative impact on quality of life and dental behavior.[1] High-quality and efficient dental treatments cannot be performed on uncooperative children, and unpleasant dental visits can negatively affect the child's attitude toward future dental treatments.[2,3] Anxious children often need pharmacological behavior management techniques for their comprehensive dental treatments.[1,4] In addition to cognitive or physical challenges, the main reason parents prefer dental rehabilitation under general anesthesia (GA) and sedation for their child is because of a previous difficulty to accept dental treatment resulting from the child's dental anxiety.[5]

Often, deep sedation and GA are differentiated; however, the two procedures are treated as a single physiologic state of the patient regarding the training, monitoring, facilities, and personal requirements to manage and to rescue the patient. In addition, moderate and deep sedation is performed in a fully equipped dental room whereas GA is performed in operatory rooms in medical facilities. Although the state and risks of deep sedation may be indistinguishable from those of GA, intubation, duration of the operation, and discharge duration are the

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major differences between intravenous sedation (IVS) and GA.[6]

For over 20 years, several indexes have been used to measure the effects of oral health on quality of life. The early childhood oral health impact scale (ECOHIS) is the most common of these tools.[4,7] The ECOHIS was developed in the United States by Pahel *et al*.[8] to assess the adverse effects of oral and dental health problems on preschool children's quality of life. It was later translated into various languages, such as Brazilian, Chinese, French, and Turkish; the validity of these versions was compared with the English version.[4,9,10]

To date, numerous methods have been developed to evaluate dental anxiety.[2] A prominent measure is the Frankl behavior scale (FBS), which assesses the behavior based on the visual evaluation.[3] However, due to the limitations in verbal communication with young children, the venham picture test (VPT) is frequently used with younger patients.[3] Another frequently used scale is the childrens' fear survey schedule-dental subscale (CFSS-DS), developed by Cuthbert and Melamed[5] and validated in several languages, including Turkish.[11,12]

The present study aimed to compare the effects of dental anxiety, dental behavior, and dental health on quality of life in children undergoing dental treatments under GA or IVS. The effect of the number of extracted teeth and the number of restored teeth on dental anxiety, dental behavior, and quality of life were also assessed. The hypotheses were as follows: (1) comprehensive treatment with both pharmacological methods (GA and IVS) will have a positive effect on both the child's and the parents' quality of life. (2) There will be no difference between the two approaches regarding dental anxiety or ECOHIS scores. (3) There will be no difference between GA and IVS in their effectiveness at reducing the child's dental anxiety for further dental treatments.

Materials and Methods

This cross-sectional, prospective study was performed between October 15, 2014, and February 15, 2015, with the patients whose dental treatments were carried out under GA or IVS in Baskent University's Department of Pediatric Dentistry, Ankara, Turkey.

Participants

A total of 99 patients aged 3–12 years who met the inclusion criteria which are as follows: being healthy (the American Society of Anesthesiologists physical status I [ASA I]), cognitive competence to complete the survey, and in need of pharmacological behavior management techniques because of lack of cooperation. Lack of cooperation was assessed by a pediatric dentist (SBC) with 10 years' experience, after performing basic behavior guidance. Before filling out the surveys, the patients and their parents were informed about the study aims and procedures, and their written consent was obtained.

Methods

At the first appointment, a detailed medical and dental history was obtained, and intraoral and radiographic examinations were conducted. Then, the treatment was planned accordingly. The patient was categorized according to the ASA classification system, and an anesthesiologist was consulted to exclude any medical complications to GA or IVS (ASA II or above, the presence of congenital heart disease or gastroesophageal reflux and anticipated difficult airway). An appointment was scheduled within 1 month for the operative procedures. The oral and dental examinations and the surveys were carried out by the same pediatric dentist at the first appointment and the postoperative visit, which was scheduled for 1 month after the dental treatment.

The IVS and GA protocol were in accordance with the instructions released by the Sedation and Anesthesia Committee of American Academy of Pediatric Dentistry.[13] Following the treatment planning, GA or IVS was proposed to the patient depending on the operation duration. An anesthesiologist performed the techniques in a hospital setting. Children with specific physical characteristics, such as overweight, retrognathic mandible, and large tonsils (Brodsky's Scale 3 and 4), were treated under GA rather than IVS.

The patients were divided into two groups according to the treatment protocol applied:

1. GA group: 49 patients, 17 females and 32 males, needing many dental operations. GA was performed with mask induction before the IV route. An experienced anesthesiologist performed the procedure for all patients. Induction was first demonstrated on the pediatric dentist as Tell-Show-Do (without gas)
2. IVS group: 50 patients, 19 females and 31 males, whose dental operations could be completed in a short time (maximum 30 min) with a minimal requirement of using an air turbine system (a maximum of six simple restorations). The IV route was performed on hand and introduced as a "butterfly button." The IV procedure was considered "deep sedation," as the border between moderate and deep sedation can easily change. We used 0.1 mg/kg midazolam for all participants in this group.

In our university, the physical conditions limit per oral premedication procedures because an additional, quiet, equipped room with experienced staff is needed to monitor the patient. Thus, the patients were not premedicated owing to safety-related issues and the increased risk of drug combinations. For both groups, the patients and/or their legal guardians were asked to complete the Turkish version of the ECOHIS scale 1 month before and 1 month after the operation. The scale was administered each time by the same pediatric dentist.

The first ECOHIS section, the child impact section, evaluates the child's symptoms such as tooth pain; functions such as eating, drinking, pronunciation, and school attendance; psychological factors such as sleep and behavior disorders; and the child's confidence and social life. The second ECOHIS section, the family impact section, evaluates the parents' intangible experiences such as sadness and guilt, as well as material influences such as expenses for the child's dental treatment. Responses are rated on a 5-point scale of "never" (0), "hardly ever" (1), "occasionally" (2), "often" (3), and "very often" (4). The total score range is 0–52; higher scores indicate poor oral and dental health. The adults' score range is 0–16 and the children's score range is 0–36.

For the dental fear and anxiety evaluation, the patients were further divided into two subgroups based on age. Each child's behavior was recorded by the same pediatric dentist who had performed the surveys. The 3–5-year-olds were assessed using the FBS and the VPT. The FBS divides the child's behavior into four categories, ranging from "definitely positive" to "definitely negative."[14] The VPT features a picture card consisting of eight frames, each of which contains one image of an anxious child and one image of a nonanxious child; the card was shown to children 1 month before and 1 month after the operation. All images were shown according to their sorted numbers and children were asked to identify which image felt most familiar. Selection of the anxious figure was recorded as 1 point, and selection of the nonanxious figure was recorded as 0 points. The possible score range was 0–8.

Anxiety in the 6–12-year-olds was assessed using the FBS and the CFSS-DS. The latter features 15 situations related to different aspects of dental treatment, such as dentist, doctor, injections, having somebody examine your mouth, having to open your mouth, having a stranger touch you, having somebody look at you, the dentist drilling, the sight of the dentist drilling, the noise of the dentist drilling, having somebody put instruments in your mouth, choking, need to go the hospital, people in a white uniform, having the dentist clean your teeth. Each item was scored from 1 (not afraid) to 5 (very afraid). Responses were given by the parents 1 month before and 1 month after the operation. The total score range was 15–75. Scores within the range 15–31 indicate a low level of anxiety, 32–38 a medium level of anxiety, and 39 or more a high level of anxiety. A number of extractions and fillings were recorded for all participants.

Data analysis

SPSS for Windows 11.5 software (SPSS Inc., Chicago, IL, USA) was used for the data analysis. The Kolmogorov–Smirnov test was used to check normality of data distribution and Levene's test was used to check the homogeneity of variance. Differences between group means were tested using Student's *t*-test, and differences between group medians were tested using the Mann–Whitney U-test. Within groups, the difference between pre- and postoperation CFSS-DS scores was tested using the dependent *t*-test and the differences in ECOHIS, VPT, and FBS scores were tested using the Wilcoxon-signed-rank test.

Spearman's correlation test was used to evaluate whether there was a statistically significant relationship between pre- and post-operation ECOHIS, VPT, and FBS scores, the number of extracted teeth, and the number of restored teeth. Unless indicated otherwise, 0.05 was set as the significance level. The Bonferroni correction was applied to all possible multiple comparisons to counteract Type I error.

Results

Demographic data and clinical properties

A total of 99 child patients, 36 (36.4%) female and 64 (63.6%) male, were included in the study between September 15, 2014, and February 15, 2015. Patients' ages ranged between 3 and 12 years, with a mean age of 4.91 years (4.9 for the IVS group and 5.2 for the GA group). There was no statistically significant difference in mean age between the groups ($P = 0.452$).

The patients were categorized into four groups: GA1 ($n = 28$) 3–5 years, operated on under GA; GA2 ($n = 21$) 6–12 years, operated on under GA; IVS1 ($n = 27$) 3–5 years, operated on under IVS; and IVS2 ($n = 23$) 6–12 years, operated on under IVS. Cases were distributed evenly; 49 (49.5%) out of 99 patients were treated under GA, and 50 (50.5%) were treated under IVS. Among all patients, 55 (55.6%) were aged 3–5 years and 44 (44.4%) were aged 6–12 years.

In the GA groups, tooth extraction was performed in 45 out of 49 patients (91.8%), and the highest number of tooth extractions for a single patient was 12 (two teeth were extracted on average). In the IVS groups, tooth extraction was performed for 40 out of

50 patients (80%), and the highest number of tooth extractions for a single patient was eight, (two teeth were extracted on average).

In patients treated under GA, 10 teeth were restored on average; in patients treated under IVS, six teeth were restored on average. There was no statistically significant difference in the presence of tooth extractions between the GA groups and the IVS groups ($P = 0.091$). However, the total number of interventions differed significantly between the GA and the IVS groups ($P = 0.007$ and $P < 0.001$, respectively). The GA groups had a significantly greater number of treated teeth than the IVS groups. The descriptive statistics are given in Table 1.

Table 1: Demographic and clinical properties of cases according to groups

Variables	Overall (*n*=49), *n* (%)	Sedation (*n*=50), *n* (%)	*P*
Age (years)	4.9 (3.5-10.5)	5.2 (3.0-11.2)	0.452†
Age groups			
Ages 3-5	28 (57.1)	27 (54.0)	0.753‡
Ages 6-12	21 (42.9)	23 (46.0)	
Gender			
Female	17 (34.7)	19 (38.0)	0.732‡
Male	32 (65.3)	31 (62.0)	
Tooth extraction	45 (91.8)	40 (80.0)	0.161¶
Number of extractions	2 (0-12)	2 (0-8)	0.007†
Number of operated teeth	10 (5-20)	6 (2-12)	<0.001†

†Mann–Whitney U-test, ‡Pearson's Chi-square test, ¶Continuity corrected Chi-square test. Statistical significance is expressed with bold

Evaluation of early childhood oral health impact scale scores

Initial scores for both anxiety and quality of life were similar among the groups. Table 2 shows the interaction of ECOHIS scores with pharmacological behavior management techniques and age. Regarding the effect of pharmacological technique on quality of life, ECOHIS scores significantly decreased in both GA and IVS groups after the operation ($P < 0.001$ for both). Although the IVS group showed a slightly greater decrease in ECOHIS scores, this difference was not statistically significant ($P = 0.897$) [Table 3].

Regarding age differences, there was no statistically significant difference in ECOHIS score changes between the GA1 and GA2 groups ($P = 0.160$) or between the IVS1 and IVS2 groups ($P = 0.974$). Gender, number of extractions, and number of restored teeth did not have any effect on ECOHIS scores.

Evaluation of dental anxiety

There was a statistically significant decrease in VPT scores in the GA1 group ($P = 0.003$). This shows that anxiety decreased after the operation in 3–5-year-olds who had their dental treatment under GA. In contrast, the amount of change in VPT scores in the GA2 group was not statistically significant ($P = 0.095$): there

Table 2: Clinical evaluation of pre- and postoperation scales for 3-5, 6-12 age groups and total sample

Variables	Procedure	Age Range	Mean±SD		*P*
			Preoperative	Postoperative	
ECOHIS	GA	3-5 years	15.1±6.7	6.14±4.8	<0.001†,§
		6-12 years	13.04±5.8	7.3±6.7	0.013†,§
		Total	14.2±6.4	6.7±5.7	<0.001‡
	Sed	3-5 years	12.2±8.9	4.8±5.5	<0.001†,§
		6-12 years	14.5±8.9	5.5±5	<0.001†,§
		Total	13.2±8.9	5.17±5.3	<0.001‡
VPT	GA	3-5 years	4.1±2.5	5.7±2	0.003†,§
	Sedation		5.1±2.2	5.8±1.9	0.095†,§
CFSS-DS	GA	6-12 years	39.7±11.0	32.3±8.6	0.006†,Ω
	Sedation		36.5±9.9	27.3±9.5	<0.001†,Ω
FRANKL	GA	3-5 years	1.7±0.7	3.2±0.8	<0.001†,§
		6-12 years	2.09±0.8	3.5±0.6	<0.001†,§
		Total	1.9±0.8	3.3±0.74	<0.001‡
	Sedation	3-5 years	1.8±0.5	3.1±0.9	<0.001†,§
		6-12 years	2.3±0.8	3.4±3.4	<0.001†,§
		Total	2.06±0.7	3.3±0.85	<0.001‡

†Pre- and post-operative evaluation in the GA and sedation groups $P<0.0125$ was accepted statistically significant after the Bonferroni correction; ‡Pre- and post-operative evaluation in the GA and sedation groups $P<0.025$ was accepted statistically significant due to Bonferroni correction; significant values are in bold; §Wilcoxon signed-rank test; ΩDependent *t*-test. ECHOIS=Early Childhood Oral Health Impact Scale; VPT=Venham Picture Test; CFSS-DS=Children's Fear Survey Schedule-Dental Subscale; FRANKL=Frankle Behaviour Scale; SD=Standard deviation; GA=General anesthesia

Table 3: Comparison of pre- and post-operation score changes between general anesthesia and sedation groups

Variables	Age Range	Mean±SD		*P*
		GA	Sedation	
ECOHIS	Ages 3-5	−9±7.8	−7±8.6	0.453#
	Ages 6-12	−5.6±8.6	−9±9.2	0.254#
	Total	−7.5±8.3	−8.1±8.8	0.897#
VPT	Ages 3-5	1.6±2.5	0.7±2.3	0.218#
CFSS	Ages 6-12	−7.4±11	−9.2±10.7	0.576Δ
FRANKL	Ages 3-5	1.6±0.7	1.2±0.9	0.670#
	Ages 6-12	1.4±0.9	1.1±0.8	0.254#
	Total	1.4±0.8	1.2±0.9	0.264#

In comparison between general anesthesia and sedation groups in terms of changes, results were accepted as statistically significant for $P<0.025$. #Mann–Whitney U-test, ΔStudent's *t*-test; ECHOIS=Early Childhood Oral Health Impact Scale; VPT=Venham Picture Test; CFSS-DS=Children's Fear Survey Schedule-Dental Subscale; FRANKL=Frankle Behaviour Scale; SD=Standard deviation; GA=General anesthesia

was no statistically significant difference in pre- and postoperative dental anxiety in 3–5-year-olds who had their dental treatment under IVS.

CFSS-DS scores decreased significantly in the IVS1 and IVS2 groups ($P = 0.006$ and $P < 0.001$, respectively). However, the decrease in anxiety was not statistically different for the two methods ($P = 0.576$). That is, anxiety decreased significantly in 6–12-year-olds when the operation was performed under GA and when it was performed under IVS [Table 2]. For all groups, gender did not significantly affect dental anxiety ($P < 0.005$).

Regarding age differences, there was no statistically significant difference between the GA1 and GA2 groups in FBS score changes ($P = 0.160$). However, there was a greater positive change in FBS scores for the 6–12-year-olds. ECOHIS, VPT, and CFSS-DS scores were not affected by the number of extractions or the number of treated teeth ($P > 0.05$). However, there was a statistically significant correlation between the number of restored teeth and FBS scores ($P = 0.034$). As the number of restored teeth increased, FBS scores increased. The number of extractions was not significantly related to FBS scores ($P > 0.05$).

Discussion

High caries prevalence is a very common problem and a serious community health issue in Turkey.[15-17] In 1988, caries prevalence in 6-year-old children was reported to be 84% and decayed, missing, and filled teeth scores was 4.4. Caries prevalence in 5-year-old children was reported to be 70% and 69.8% in 2004 and 2010, respectively.[15,17] These data show that many children need restorative treatment. However, in the pediatric population, anxiety may lead to treatment refusal and in turn long-term deterioration of oral health.[1] Although there is an awareness of this negative effect, parents, and health providers have substantial concerns about pharmacological behavior management techniques.

In the present study, there were no significant associations between gender and changes in postoperative anxiety (VPT, CFSS-DS, and FBS scores) for any of the four groups. This is in accord with the previous studies indicating that dental anxiety is not associated with gender.[18-20] However, in the present study, this finding may be related to the uneven distribution of male and female patients (64% male and 36% female). Thus, further studies that include an equal number of male and female participants are needed to draw firm conclusions. The effect of gender on dental anxiety is controversial in the dental literature. Many researchers have asserted that gender has no impact on dental anxiety.[18,21,22] In contrast, some researchers have reported that dental anxiety is higher in females,[23,24] whereas others have found that anxiety is higher in males.[25] Two studies conducted in Turkey have similarly produced conflicting data.[19,20] Sarı *et al*.[20] have emphasized that the measurement method could affect the results of studies on dental anxiety.

Cantekin *et al*.[4] measured dental anxiety level using the CFSS-DS before and after GA in 311 children aged 4–6 years. They used the FIS and the CFSS-DS because of the very young age of the children in the study. They reported a significant increase in dental anxiety after dental operations under GA and a significant relationship between the increase in the number of tooth extractions and CFSS-DS scores. In contrast, in the present study, ECOHIS, VPT, CFSS-DS, and FBS scores were not affected by the presence of tooth extractions or the number of tooth extractions performed. In addition, there was no statistically significant relationship between the number of restored teeth and ECOHIS, VPT, and CFSS-DS scores. However, there was a statistically significant relationship between the number of restored teeth and FBS scores; dental behavior changed positively as the number of restored teeth increased. This might be because the necessity of treatment for multiple teeth increased children's awareness of the treatment need and prompted them to think "I don't need treatment anymore" following the operation. Children who attend dental visits thinking that "there is no need for the dentist to perform any operations" might demonstrate lower anxiety. In addition, it may be that children attending control visits had sufficient sleep and no pain; thus, FBS scores might have been positively affected.

To the best of our knowledge, there are no studies investigating the relationship between dental anxiety and dental rehabilitation under IVS. In this study, a statistically significant decrease in preoperation CFSS-DS scores was observed in children aged 6–12 years whose dental operations were performed under IVS. However, the decrease in VPT scores in children aged 3–5 years whose dental operations were performed under IVS was not significant. This might be because titration problems and drug metabolism in young children have not been fully described. Another reason might be the absence of premedication before establishing vascular access in children owing to risk-related drug combinations and interactions. In addition, these findings support previous work[26] suggesting that dental anxiety is a part of overall anxiety in children aged 3–6 years; however, how this anxiety is managed remains unclear. These results can also be attributed to lack of cognitive maturity, as children of this age lack a clear perception of real fear. Increasing age leads to an increase in rapport, self-control, and responsibility, and a decrease in anxiety related to being separated from family, physical damage, and new situations.[27] In the present study, FBS scores increased significantly in all groups, and there were no statistically significant differences among groups. The results relating to the 3–5-year-olds indicate that the second hypothesis can be partially accepted.

Some studies have reported a decrease in postoperative ECOHIS scores in dental rehabilitation under GA and an increase in the positive impact of oral health on quality of life.[18,28] One systematic review[29] of the impact of dental treatment performed under GA on oral health-related quality of life reviewed clinical studies published in various scientific journals between 1978 and 2009. The authors concluded that the dental treatment under GA increases the quality of life of both the family and the child, but underlined the difficulties of data comparison because of differences in culture, study design, and the scales used.[29] Thus, they recommended more long-term studies that use a single scale. However, there is no consensus in the literature on the most suitable scale with which to investigate the quality of life-related to oral health.

In the present study, the ECOHIS was administered to children aged 3–12 years. Although this scale has not previously been used with older children, there were no statistically significant differences between the 3–5-year-olds and the 6–12-year-olds in changes in ECOHIS scores. This suggests that this scale can be used with children aged 6–12 years.

The present study has several limitations. First, the cross-sectional design meant that the sample size was small. Furthermore, it was not possible to obtain a representative sample regarding demographic factors such as income and the sociocultural status of the parents or to achieve a better balance of males and females. The private university in which the study was conducted attracts mostly middle-class rather than low- or high-income patients. The most of the low-income patients prefer government hospitals and most of the high-income patients prefer private practice. Another limitation of this study was the lack of objective scaling of childrens' emotions; there is no consensus regarding a validated method for measuring emotional parameters such as dental anxiety and quality of life.

In accord with previous research, the present study demonstrated that dental rehabilitation under GA increased the quality of life-related to oral health. The dental literature lacks data on the effect of IVS on quality of life and a comparison of the effects of IVS and GA on quality of life. Given the limitations of the present study, the data indicate that dental rehabilitation performed under IVS also increased oral health-related quality of life. Thus, our first hypothesis was accepted.

Conclusions

1. This study demonstrated that both GA and IVS had a positive effect on quality of life. In addition, both pharmacological behavior management methods had positive effects on behavior. Thus, both can be used effectively when the dental treatment is crucial, and the child does not cooperate during treatment
2. Regarding the change in dental anxiety in the 6–12-year-olds, there was no statistically significant difference between children undergoing dental operations under GA and those undergoing dental operations under IVS. In children aged 3–5 years whose dental operations were performed under GA, dental anxiety significantly decreased postoperatively. In children aged 3–5 years whose dental operations were performed under IVS, the decrease in dental anxiety was not statistically significant.

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Conflicts of interest

There are no conflicts of interest.

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