

A comparison of restorations for children with early childhood caries treated under general anesthesia or conscious sedation

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Abstract

Purpose: *There is no data in the dental literature concerning the quality of the restorations performed in young children with early childhood caries (ECC) under sedation as compared with those treated under general anesthesia (GA). The aim of this study was to compare the quality of restorations and recurrent caries in 65 children with ECC who had dental treatment under GA or sedation.*

Methods: *Thirty-four children, mean age 34.4 months were treated under GA and 31 children with a mean age of 37.2 months were treated under sedation and re-examined 6-24 months after completion of treatment. The quality of the restorations was evaluated using a modified Cvar & Ryge index.⁷*

Results: *Fifty-nine percent of children treated under GA required further dental treatment compared to 74% of children treated under sedation. The majority of the required treatment was due to new caries: 57% in the GA group and 60% in the sedation group. A total of 248 restorations were evaluated for the GA group, with a 94% success rate for marginal adaptation, 92% success for anatomic form, and 97% had no secondary caries. In the sedation group, out of 224 restorations, 78% demonstrated perfect marginal adaptation, 79% showed adequate anatomic form, and 90% had no secondary caries. Successful marginal adaptation was found in 90% of strip crowns placed under GA, compared to 63% of those placed under sedation.*

Conclusion: *It is concluded that the outcome of treatments related to quality of the restorations performed under GA is better for all parameters examined. (Pediatr Dent 22:33-37, 2000)*

Early childhood caries (ECC), or baby bottle tooth decay (BBTD), is a unique form of rampant caries that develops in the primary dentition soon after the eruption of the first teeth. Many authors reported that the condition is initiated and exacerbated by prolonged use of sweet drinks in a nursing bottle, particularly night feeding or during day naps.¹

Dental treatment of ECC often requires general anesthesia (GA) or sedation because the very young are unable to cope with the procedures. However, a sedated child is not always cooperative enough to ensure optimal conditions to perform the restorative procedures, particularly bonded composite restorations that are extremely technique-sensitive. On the other hand, dental treatment under GA has optimal conditions for the restorative procedures but adds between \$1,000-\$6,000 to the cost of dental care.²

There is little data in the literature concerning the quality of the restorations performed in young children with ECC that were treated under sedation or GA. The existing data deals with the outcomes of treatments under GA. Legault et al.³ reported that 38% of children treated under GA required further dental treatment after 15 months. In a more recent report on 80 children that received comprehensive dental care under GA and were followed for at least two years, only 8.75% of patients required retreatment.⁴

The purpose of this retrospective study was to compare the quality of the restorations and the presence of secondary caries in children treated for ECC under general anesthesia or under oral sedation.

Methods

Out of 120 complete records of children who were treated in the Pediatric Dentistry clinic of the Hebrew University-Hadassah School of Dental Medicine between 1995-1997, only 65 were reviewed for our study. These 65 children were those whose parents agreed to attend our clinic for recall examination following a telephone conversation. The remaining parents could not be contacted due to disconnected phones or changed addresses, or refused to participate in the study.

The diagnosis of ECC was made when at least two affected maxillary primary incisors (irrespective of severity of the lesions) and a history of bottle feeding were confirmed from the dental records.⁵ Signed informed consent was obtained from the parents following approval of the study by the Human Use Committee. From the 65 children that were summoned for recall, 34 were treated under GA, their mean age at the time of the post treatment examination was 49±11 months, and the mean time lapse after treatment was 13.5±5.2 months. The group treated by sedation (Hydroxyzine 3.7 mg/kg and nitrous oxide 40-50%) included 31 children, with a mean age of 55±10.6 months at the time of the post treatment examination, and a mean time lapse after treatment of 15.6±6.03 months. All treatments were performed by second- and third-year-graduate students under the supervision of a senior, board-certified pediatric dentist. Routine preventive sessions were scheduled for all patients and families as follows: for children scheduled for GA, at the initial visit and in the one-week-follow-up visit. Also, the parents received oral hygiene instructions at the end of the operation. For children scheduled for treatment under sedation, oral hygiene therapy

Marginal Adaptation:	
A -	The restoration adapts closely to the tooth, an explorer does not catch, and no crevice is visible;
B -	The explorer catches, and there is visible evidence of a crevice which the explorer will penetrate. However, neither dentine nor the base is visible;
C -	The explorer penetrates into a crevice that is of such depth that dentine or base is exposed. The restoration is fractured, mobile, or missing.
Anatomic Form:	
A -	The restoration is continuous with existing anatomic form;
B -	The restoration is discontinuous with existing anatomic form, but the missing material is not sufficient to expose dentine or base;
C -	Sufficient material is lost to expose dentine or base.
Secondary Caries:	
A -	Restoration is caries free;
B -	Secondary caries is detected.

Fig 1. Cvar and Ryge index.

and instructions were provided in the first and last appointments. Parents of both groups were instructed to have follow-up visits every six months after the treatment.

Child behaviors throughout the treatment were routinely recorded in the files according to Frankl's categories.⁶ The Frankl categories that were recorded during the operative procedures and the restorations of the sedation group were included, not those recorded during the local anesthesia or the rubber dam placement. For the purpose of analyses, the behavioral records were dichotomized as follows: "positive" behavior (categories 3 and 4); and "negative" behavior (categories 1 and 2).

All children were examined by the same dentist (SF), in a dental chair with a dental mirror and a probe. A group of 10 children, not included in this study, were examined by the evaluator under the supervision of the senior authors, to test the validity of the evaluating criteria. The examiner was not blind as to who was in the GA vs. the sedation group. The quality of the restorations was assessed using a modified Cvar and Ryge index (Fig 1).⁷ In this study, "success" represented category A in the index, "questionable" represented category B, and "failure" represented category C for marginal adaptation and anatomical form.

Statistical analysis

Chi-square test was performed to assess the variables characterizing the clinical success of the restorations, and the distribution of the types of procedures in the GA and the sedation groups (with bonferoni correction). Student t-test was used to assess the means and standard deviations of the percents of the successful restorations per child in both groups. Fisher exact test was used to study the percent of failure of restorations per child in the sedation group by Frankl's categories of behavior.

Results

The type of restorations placed under the two treatment modalities is presented in Table 1. While the number and percentage of composite-sealant restorations and strip crowns is comparable in the two groups, the number and percentage of stainless steel crowns, and composite fillings was greater in the GA group ($P<0.05$).

Since all stainless steel crowns were found successful in both GA and sedation groups, clinical variables of quality of restorations excluded stainless steel crowns and secondary caries in both groups, as summarized in Table 2. In the 34 children treated under general anesthesia, a total of 248 restorations were evaluated. The vast majority (94%) were successful (category A), and only 8 restorations failed with defective margins. In the sedation group, 224 restorations were evaluated, among which 78% showed good marginal adaptation and 14 restorations had open margins (category C). Anatomic form was successful in 92% of the restorations in the GA group compared to 79% in the sedation group. Secondary caries was diagnosed in 7 teeth in the GA group, and in 22 teeth in the sedation group.

Generally, 59% of the children who were treated under GA required further treatment, compared to 74% of the sedation group. Most of the treatment was for new carious lesions and not for secondary caries or defective restorations (57% for the GA group and 60% for the sedation group).

A separate analysis for the clinical performance of the strip crowns is summarized in Table 3. Successful marginal adaptation was found in 90% of the strip crowns placed under GA, and in 63% of those placed under sedation. Successful anatomic form was more frequent in teeth restored under GA (86%) than under sedation (65%); these differences were statistically significant ($P<0.05$). The absence of secondary caries was not significantly different between the two groups. The percentage of fully retained sealants was 81% for GA, compared to 54% for those placed under sedation. This difference was not significant ($P=0.07$).

Table 4 summarizes the percentage of successful restorations per child. Marginal adaptation and anatomic form were more frequently diagnosed as successful in the children treated under GA (97% and 95%, respectively) compared to children treated under sedation (79% and 76%, respectively). Absence of secondary caries was more frequently found in children

Table 1. The Distribution of the Types of Procedures in the GA and the Sedation Groups

	GA		Sedation		P*	Total	
	N	%	N	%		N	%
Amalgam	18	6	25	10		43	7
CS	85	26	83	33		168	29
SSC	77	24	31	12	0.0004	108	19
SC	59	18	48	19		107	18
Composite	65	20	29	11	0.0007	94	16
Sealant	21	7	39	15	0.0005	60	10
Total	325		255			580	

CS=Composite sealant, SSC=Stainless steel crown, SC=Strip crown.
* Chi-square with Bonferoni correction.

Table 2. Clinical Variables of Quality of Restorations and Secondary Caries (Excluding Stainless Steel Crowns) in Children Treated by General Anesthesia or Sedation

	GA		Sedation		X ²	DF	P
	N	%	N	%			
Marginal Adaptation							
Success	234	94	175	78			
Questionable	6	3	35	16			
Failure	8	3	14	6	30.305	2	0.00000
Total	248	100	224	100			
Anatomic Form							
Success	229	92	177	79			
Questionable	14	6	31	14			
Failure	5	2	16	7	18.227	2	0.0001
Total	248	100	224	100			
Secondary Caries							
No	241	97	202	90			
Yes	7	3	22	10	10.091	2	0.0015
Total	248	100	224	100			

treated under GA (98% vs. 86%). In children treated under general anesthesia, 59% required further treatment, compared to 74% of children treated under sedation. These differences were statistically significant ($P < 0.05$, Student t-test).

With regard to children's behavior in the sedation group, 12 children presented "negative" behavior (Frankl 1 and 2), while 19 demonstrated "positive" behavior (Frankl 3 and 4).

Table 5 summarizes the quality of restorations and secondary caries in the sedation group according to Frankl's categories of behavior per tooth. In all clinical parameters, success was more prevalent in the teeth of the patients presenting "positive" behavior. The differences in the scores between both the

"positive" and "negative" behavior groups were statistically significant for anatomic form ($P = 0.049$), and for secondary caries ($P = 0.03$).

Table 6 shows the means and SD of the percent of failure of restorations in the sedation group by Frankl's behavioral scale per child. It can be seen that failure of restorations was more prevalent among children exhibiting "negative" behavior. The differences were not statistically significant.

Discussion

The results of this study demonstrate that the distribution of restorations placed in the children treated under GA and chil-

Table 3. Clinical Success of Strip Crowns on Maxillary Incisors

	GA		Sedation		X ²	DF	P
	N	%	N	%			
Marginal Adaptation							
Success	52	90	30	63			
Questionable	2	3	7	14			
Failure	4	7	11	23	11.107	2	0.0038
Total	58	100	48	100			
Anatomic Form							
Success	50	86	31	65			
Questionable	5	9	5	10			
Failure	3	5	12	25	8.993	2	0.0111
Total	58	100	48	100			
Secondary Caries							
No	56	97	43	90	2.067	1	NS
Yes	2	3	5	10			
Total	58		48	100			

Table 4. Percents of Successful Restorations per Child

	GA (N=34)		Sedation (N=31)		P*
	Mean	SD	Mean	SD	
Marginal adaptation	97	7	79	28	0.000
Anatomical form	95	8	76	32	0.000
No secondary caries	98	4	86	28	0.02

* Student t-test.

dren treated under sedation were similar, except for stainless steel crowns, and composite fillings, which were more frequently performed in the GA group. The more prevalent use of stainless steel crowns under GA may be explained by the more extensive caries in those children often leading to pulp treatments, or the more radical decision on the part of the operator while performing the treatment under GA. Thus, in extensive and borderline cavities, the decision towards stainless steel crowns that will be less likely to require retreatment may be more prominent.⁸ All stainless steel crowns were found successful in both GA and sedation groups. Therefore, all teeth covered with stainless steel crowns were not at risk for anatomic changes, marginal adaptation defects, or secondary caries. For that reason, stainless steel crowns were excluded from Table 2. This finding is also in accordance with the findings of Messer and Levering,⁸ who concluded that crowns placed in 4-year-olds and younger show a success rate which is approximately twice that of class II amalgams. The more sealants being placed under sedation, may suggest efforts to prevent further caries and possible retreatment even on occlusal surfaces of primary teeth that otherwise would not have been candidates for sealants.

Secondary caries was more frequently found in restorations, which were placed in the sedation group. This finding is not surprising, since the behavior of children under GA is uniform, children do not move; while under sedation there is a wide

range of possible behaviors from children being completely asleep to children being awake and hysterical.^{9,10} The success of treatment was correlated with the sedation appointments, and for all clinical parameters, success was more prevalent among patients exhibiting "positive" behavior.

A separate analysis was performed for strip crowns, since this procedure is extremely technique-sensitive and its outcome is mainly based on dentine bonding procedures. All parameters

were significantly better for the group treated under GA, 90% for marginal adaptation and 86% for anatomic form, compared to 63% and 65% respectively for the sedation group. Similar results were found for complete retention of sealants, although the difference was not statistically significant ($P=0.07$).

It was found in this study that in children treated under GA, 59% required further treatment, compared to 74% of children treated under sedation. This can be partly explained by the fact that the number of stainless steel crowns was larger (77) in the GA group, compared to 31 in the sedation group. Successful stainless steel crowns decrease the number of surfaces at risk to develop new or secondary carious lesions. Most of the new treatment was for new carious lesions and not for secondary caries or defective restorations, as only 2% of restorations placed under GA had secondary caries. The findings of recent reports,^{4,11,12} are not similar; O'Sullivan⁴ reported only 8.75% of children requiring retreatment, while Berkowitz et al.¹¹ found that 54.2% of children had new smooth surface carious lesions that visibly extended into dentin after four to six months follow-up. Sheehy et al.¹² found that 23% of child patients required further restorative treatment or extractions at follow-up visits in an average of 14 months after treatment under GA. None of the patients required the retreatment to be carried out under GA. This finding is similar in this study. However, while in this study all children had ECC, in the study by Sheehy et al, only 55% had suffered from ECC.

Table 5. Clinical Variables of Quality of Restorations and Secondary Caries in the Children Treated Under Sedation by Frankl's Categories of Behavior

	Frankl 1+2		Frankl 3+4		Total		P*
	N	%	N	%	N	%	
Marginal Adaptation							
Success	78	91	163	96	241	95	
Failure	8	9	6	4	14	5	0.055
Total	86	100	169	100	255	100	
Anatomic Form							
Success	77	90	162	96	239	94	
Failure	9	10	7	4	16	6	0.049
Total	86	100	169	100	255	100	
Secondary Caries							
Yes	12	14	10	6	22	9	
No	74	86	159	94	233	91	0.03
Total	86	100	169	100	255	100	

* Chi-square.

Table 6. Percent of Failure of Restorations in the Sedation Group by Frankl's Behavioral Scale per Child

	Mean	SD	P*
Marginal Adaptation			
Frankl 1+2**	15	26	
Frankl 3+4†	3	7	0.08
Anatomic Form			
Frankl 1+2	23	36	
Frankl 3+4	6	13	0.06
Secondary Caries			
Frankl 1+2	25.0	39	
Frankl 3+4	7.0	16	0.08

*Fisher exact test. **12 children. †19 children.

With regard to patients treated under GA, the need for retreatment rate in this study was higher than in other studies (59% compared to 54%,¹¹ 38%,³ 23%¹²). This difference may originate from the differences in the study populations and/or the time elapsed until the follow-up examination: Only the study by Berkowitz et al.¹¹ was done on children with ECC while the other studies included also medically compromised children or children with management problems. Furthermore, the follow-up examinations in the study by Berkowitz et al. were performed four to six months post treatment.

The relatively high rate of retreatment that was found in this study suggests that early and frequent intervention and therapeutic approaches to minimize the risk for new carious lesions must emphasize the need to control etiologic risk factors.^{1,13} It should be remembered that the treatment under GA and sedation are directed to deal with the results of the disease rather than the cause of the disease. A positive explanation for less new lesions developed in the GA group could be the increased number of crowns placed in this group.

The treatment of early childhood caries is often accomplished using general anesthesia or sedation. Despite the many similar indications for sedation and general anesthesia, very often general anesthesia is the preferred method in treating uncooperative children with extensive decay, rather than multiple sedation visits.¹⁴ A recent report¹⁵ found no difference in the expected future dental behavior or anxiety of children who experience conscious sedation compared to general anesthesia for dental treatment at a young age.

In light of these findings, if future dental behavior is not different for children treated under GA or sedation, then a factor that may influence the decision-making process as to what modality to choose, is the ability to produce better treatment—in other words, treatment outcomes. Since all parameters examined were to some extent less successful for restorations placed under sedation, it is strongly recommended that clinicians should take this factor into consideration, in addition to age, behavior and temperament of the child, the amount and type of treatment required, and the facilities available prior to deciding on general anesthesia or oral sedation.

Conclusions

1. General anesthesia yields better restorations compared to sedation.
2. The need for retreatment is higher in the sedation group, mainly due to new carious lesions.
3. In the sedation group, success of restorations is more prevalent in patients exhibiting "positive" behavior.

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