

Reasons for Repeat Dental Treatment Under General Anesthesia for the Healthy Child

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Abstract

Purpose: This study investigated reasons a healthy child may need repeat dental treatment under general anesthesia (GA).

Methods: Experimental subjects were 23 healthy children who received dental treatment under GA twice; controls were 23 healthy children requiring a single dental treatment session under GA. Records review determined demographics, intraoperative information, diagnosis, and treatment provided. Parents of 11 subjects and 9 controls completed a questionnaire and were interviewed.

Results: Many factors differed between subject and control children. Common characteristics of children requiring repeat care under GA (subjects) were: (1) 100% percent caries involvement of maxillary central incisors at time of initial treatment; (2) majority of central incisors were nonrestorable; (3) still using nursing bottle at the time of GA; (4) child responsible for brushing own teeth; (5) poor cooperation in the medical and dental setting; (6) difficult personality as described by parent; (7) dysfunctional social situation; and (8) lack of follow-up dental care. Stainless steel crowns were the most successful restoration placed.

Conclusions: A number of predictors were found to help identify high-risk children. Best outcomes following dental rehabilitation under GA may result from aggressive treatment of caries, active follow-up, and education of parents. (*Pediatr Dent.* 2003;25:546-552)

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Several studies have described the clinical characteristics of healthy and medically complex pediatric patients requiring dental treatment under general anesthesia (GA).¹⁻¹⁰ In a study of 300 pediatric patients treated under GA, rampant caries was the most common indication for treatment under GA, followed by behavior management problems.¹ These findings were duplicated in a report describing the clinical features of 933 patients of varying ages who received dental care under GA.³

Caries recurrence and outcomes of treatment provided under GA have been the focus of multiple reports.^{4,9-13} Berkowitz et al, found that over 50% of children treated under GA presented with caries, requiring further treatment at 6-month recall.⁹ Several investigators have reported that certain children eventually return for further treatment under GA.^{1,4,6-8,10,11,14} Almeida and coauthors found that 17%

of children with early childhood caries treated under GA required further treatment under GA within 2 years.¹⁰ In a study by Worthen and Mueller,¹¹ 20% of patients treated under GA before eruption of primary second molars required additional dental treatment under GA within 38 months of initial treatment.

Both Seale¹⁵ and Mueller¹⁶ emphasized the associated costs and risks associated with general anesthesia and advocated considering GA costs/risks when formulating treatment plans. Tate et al, reported stainless steel crowns (SSCs) to be the most successful restoration for pediatric patients treated under GA.¹³

During the time period of this study, 234 children received more than 1 session of dental treatment under GA at Children's Hospital & Regional Medical Center (CH) in Seattle, Wash. Most of these patients had either developmental

disabilities or complex medical conditions. The patient's mental or physical condition has been reported to be the third most common reason for dental treatment under GA.^{2,3}

The repeater children who were medically healthy and had no developmental disabilities were the focus of this report. The purpose was to investigate reasons a healthy child may need a second session of dental treatment under GA; it included both an evaluation of factors not examined in previous reports and outcome measures of treatment provided. Patient characteristics including age, dietary and hygiene habits, behavior, initial dental condition, treatment variables, and parent attitudes were analyzed to identify healthy children at risk for requiring repeated sessions of dental rehabilitation under GA, and for this study.

Methods

This Institutional Review Board (IRB)-approved study had 2 parts:

1. a chart review of patients receiving dental treatment under GA at CH;
2. an interview and questionnaire directed to their caregivers.

For the purposes of this study, "healthy" children were defined as those patients classified by the attending anesthesiologist as ASA I or II¹⁷ at the time of surgery and having no developmental delays or disabilities. Records review identified 23 patients with noncontributory medical histories who had received 2 sessions of dental treatment under GA between January 1990 and March 2000. These were labeled subjects. Controls were 23 healthy patients requiring a single GA visit for dental treatment at CH. Controls were frequency matched by age, gender, ethnicity, payment method, and date of first dental treatment under GA. All controls were patients of an outpatient clinic affiliated with CH.

Records review

Medical and dental charts were reviewed. Demographic information collected included: (1) date of GA; (2) patient age; (3) gender and ethnicity; and (4) payment method. Intraoperative data included ASA classification and provider details. Diagnosis and treatment information included: (1) indication(s) for GA; (2) teeth present; and (3) treatment. Each subject's dental chart was analyzed for the time period between the first and second procedure under GA; data was gathered for an equivalent time period for controls beginning from the date of treatment under GA. The following information was recorded: (1) date and nature of appointment(s); (2) teeth present; (3) failing restoration(s); (4) new caries; and (5) treatment.

Questionnaire and interview

The parents/guardians of subjects and controls were contacted with a letter introducing the project; they returned a postcard indicating willingness to participate. Consent was obtained after an explanation of the study and an opportunity for questions. Current addresses were identified for 16 subjects (70%), and 11 agreed to participate (69%). Control caregivers were

sought only to frequency-match these 11 subject caregivers; 9 participated. Interviews were conducted in a private setting at CH or in the caregiver's home.

Caregiver questionnaires consisted of 22 items including age, education level, ethnicity, family size and composition, caregiver's dental history, and caregiver's dental anxiety assessed using Corah's Dental Anxiety Scale.¹⁸ Caregivers were interviewed after questionnaire completion. The interview involved a series of questions relating to the child's dental and medical history, behavior in general life and health care settings, oral hygiene, and dietary habits. Open-ended questions encouraged participants to use their own words to describe attitudes about dental treatment under GA and changes in diet and/or oral hygiene practices after the child's initial dental treatment under anesthesia.

Data analysis

Descriptive statistics were calculated for all variables, and frequencies were compared between subject and control groups using chi-square analyses.

The primary teeth were grouped into 9 tooth types: (1) maxillary second molars; (2) maxillary first molars; (3) maxillary canines; (4) maxillary laterals; (5) maxillary centrals; (6) mandibular second molars; (7) mandibular first molars; (8) mandibular canines; and (9) mandibular incisors. The Mann-Whitney nonparametric test was used to compare the number of teeth and type of teeth present between groups.

Success was determined for each tooth type. An erupted, unrestored tooth present at the first GA was defined as a success if the tooth did not have caries and was not restored or extracted prior to or during the second GA for subjects or at the end of an equivalent time interval for controls (Time 2). A restoration placed at the first GA was considered a success if it did not have to be replaced due to structural breakdown, pulpal or dentoalveolar infection, or new or recurrent caries. Sealants were considered successful if the tooth did not develop caries requiring treatment by Time 2. Teeth present, unerupted, or previously extracted, type and number of procedures performed, and number of successes was recorded for each tooth group. The frequencies of various treatment procedures were compared between groups using the chi-square test and Fisher exact test. A two-tailed significance level of 0.05 was used for all statistical tests.

The interviews were audiotaped and transcribed. Comments were analyzed by the authors to provide a better understanding of the caregiver's perception of the child's behavior in health care and general life settings, importance of preventive care, and attitude towards dental treatment under GA.

Results

Patients were prominently male (65%; 30/46). The mean age at first GA treatment was 2.6 years for subjects (range=1.5-5.8 years) and 2.7 years for controls (range=1.4-5.7 years; $P=.61$). Mean age of subjects at the second GA

Table 1. Treatment Provided at First GA

	Subjects			Controls		
	Present	Restored	Extracted	Present	Restored	Extracted
	N	N	N	N	N	N
Maxillary second molars	28	8 (29%)	0 (0%)	32	19 (59%)	0 (0%)
Maxillary first molars	46	35 (76%)	0 (0%)	46	32 (70%)	5 (11%)
Maxillary canines	46	13 (28%)	0 (0%)	46	11 (24%)	0 (0%)
Maxillary laterals	43	16 (37%)	19 (44%)	44	23 (52%)	15 (11%)
Maxillary centrals	42	10 (24%)	32 (76%)	42	19 (45%)	14 (33%)
Mandibular second molars	32	7 (22%)	0 (0%)	32	15 (47%)	2 (6%)
Mandibular first molars	46	25 (54%)	1 (2%)	46	30 (65%)	2 (4%)
Mandibular canines	46	7 (15%)	0 (0%)	46	3 (1%)	0 (0%)
Mandibular incisors	90	6 (7%)	3 (3%)	92	3 (1%)	1 (1%)
Totals	419	127 (30%)	55 (13%)	426	155 (36%)	39 (9%)

was 4.7 years (range=2.1-7.5 years). The mean time interval between first and second GA was 2.1 years (range=0.5-4.3 years). Ninety-five percent of the patients were classified as ASA I. Two subjects were ASA II, one with mild aortic stenosis and the other with a history of urinary tract reflux. Two controls with mild asthma were classified as ASA II. Patient ethnicity was 52% white/non-Hispanic, 30% African American, 9% white/Hispanic, and 9% Asian; 17% of subjects and controls required foreign language interpreters (8/46).

The method of payment was similar for the subjects' and controls' first GA ($P=.74$): for subjects, Medicaid=87%, self pay=9%, and private insurance=4%, for controls, Medicaid=96% and private insurance=4%. At the time of subjects' second GA, method of payment was Medicaid=91%, self-pay=4%, and private insurance=4%.

At the initial dental appointment, subjects were significantly less cooperative than control children for examination and radiographs: only 44% of subjects were examined in the dental chair, 75% of controls sat in the dental chair for examination ($P=.036$), no subjects cooperated for radiographs, and 40% of controls had radiographs ($P=.0015$). Overall, 45% of subjects and 22% of controls responded negatively in the dental setting, as described by chart notes at initial examination ($P=.12$).

Treatment at first GA

Treatment was provided by an attending dentist with no resident for 74% of subjects and 78% of controls ($P=.73$). No significant differences were found between groups for the number and type of teeth present or erupted ($P>.05$). The type of treatment within the 9 tooth groups was significantly different only for maxillary central incisors. All subjects (100%) received treatment for the central incisors vs only 76% of the controls ($P=.049$). Significantly more subjects (76%) had 1 or more central incisors extracted than

controls (38%; $P=.013$). Treatment type tended to be different between groups for maxillary first molars and mandibular second molars. No subjects had maxillary first molars extracted, 17% of controls had a maxillary first molar extracted ($P=.11$). Mandibular second molars were treated with fewer SSCs in subjects (4%) than in controls (26%; $P=.096$). Treatment details are presented in Table 1.

All patients were advised to return for a postoperative appointment 2 weeks after treatment under GA. Seven percent of subjects (2/23) and 43% of controls (10/23) returned for a postoperative appointment ($P=.0072$).

Treatment at second GA and Time 2

The proportion of teeth requiring treatment significantly differed for all tooth types at the subjects' second GA and controls' Time 2. Subjects developed caries in 39% of previously untreated or unerupted teeth (84/218). At Time 2, controls had developed caries in only 2% of previously untreated or unerupted teeth (4/227; Table 2). Success of restorations placed at the first GA differed between subjects and controls for all tooth types (Tables 3 and 4). At the second GA/Time 2, only 59% of composite crowns placed on anterior teeth of subjects were successful, in contrast to 100% success in controls (Table 3). Success of SSCs was similar in both groups, while amalgams and sealants were markedly less successful in subjects (Table 4).

Caregiver questionnaire and interview

Most respondents were mothers (64% subjects and 100% controls; $P=.094$). Remaining respondents included a father, 2 aunts, and a foster parent. The GA(s) and dental care considered in this study had been provided within 3 years for children of 9 subject caregivers and 7 controls. Education of subject caregivers was: (1) some high school (3/11); (2) high school graduate (2/11); (3) college (6/11). Control parents' education was high school graduate (2/9) and college (7/9; $P=.24$). More subjects than controls

Table 2. New Caries in Previously Unerupted or Untreated Primary Teeth at Time of Second GA or Time 2

Category	Subjects				Controls			
	Previously no tx	Previously unerupted	Total	New caries	Previously no tx	Previously unerupted	Total	New caries
	N	N	N	N	N	N	N	N
Maxillary second molars	6	15	21	16 (76%)	5	12	17	0 (0%)
Maxillary first molars	7	0	7	3 (43%)	6	0	6	0 (0%)
Maxillary canines	33	0	33	16 (49%)	35	0	35	1 (3%)
Maxillary laterals	8	0	8	6 (75%)	6	0	6	0 (0%)
Maxillary centrals	0	0	0	0 (0%)	9	0	9	0 (0%)
Mandibular second molars	8	13	21	19 (91%)	1	12	13	0 (0%)
Mandibular first molars	8	0	8	5 (63%)	10	0	10	1 (10%)
Mandibular canines	39	0	39	13 (33%)	43	0	43	2 (5%)
Mandibular incisors	81	0	81	6 (7%)	88	0	88	0 (0%)
Totals	190	28	218	84 (39%)	203	24	227	4 (2%)

Table 3. Success in Anterior Teeth at Time of Second GA or Time 2

	Subjects			Controls		
	1 surface composite	Multisurface composite	Composite crown	1 surface composite	Multisurface composite	Composite crown
	N	N	N	N	N	N
Maxillary						
Canine	3/7 (43%)	2/3 (67%)	0/3 (0%)	6/8 (75%)	1/1 (100%)	2/2 (100%)
Lateral	0/1 (0%)	1/1 (100%)	11/14 (79%)	1/1 (100%)	1/1 (100%)	21/21 (100%)
Central	0 (0%)	0/2 (0%)	5/8 (63%)	1/1 (100%)	0 (0%)	18/18 (100%)
Mandibular						
Canine	1/6 (17%)	1/1 (100%)	0 (0%)	3/3 (100%)	0 (0%)	0 (0%)
Incisors	2/2 (100%)	1/2 (50%)	0/2 (0%)	1/1 (100%)	2/2 (100%)	0 (0%)
Totals	6/16 (38%)	5/9 (55%)	16/27 (59%)	12/14 (86%)	4/4 (100%)	41/41 (100%)

(45% vs 11%) were living in 2-parent families, and 2 subjects were not living with either parent ($P=.16$).

By caregiver report, a greater number of subjects (46%) than controls (11%) reacted poorly to injections in the medical setting ($P=.16$). Forty-six percent of subjects and 33% of controls were perceived by their caregiver as having a difficult temperament ($P=.67$).

At the time of first GA, more subjects (63%) than controls (22%) were bottle-fed with fluids other than water at nap or bedtime ($P=.092$). All controls had an adult brushing their teeth; 45% of subject caregivers reported that their child's teeth were either not brushed or were brushed by the child alone ($P=.038$). More subjects (45%) than controls (11%) brushed less than once a day ($P=.16$).

After treatment under GA, 45% of subjects and 11% of controls continued to use the bottle with fluids other than water at nap or bedtime ($P=.16$). Teeth were brushed

more often for both subjects (72%) and controls (44%). An adult brushed for 100% of subjects and 89% of controls ($P=.45$). Most subject (64%) and control (67%) caregivers did not change frequency or types of snacks given to their child. Caregivers were uniformly satisfied and agreed GA was the best treatment choice for their child.

One of the topics eliciting markedly different responses from subject vs control caregivers during the interviews was the use of the nursing bottle. One subject's parent said, "We had a real tough time trying to get him off it (the bottle); it was his security blanket. He always knew it would be there (and that it) wouldn't leave him. I just got tired of fighting over it. He'd get upset and I always swore I'd never watch my kids upset...so I just didn't want to fight it any more." This is in contrast to one parent of a control: "The dentist told me 'you need to stop the bottle, right now, today'. It was not easy, but I stopped it."

Table 4. Success in Posterior Teeth at Time of Second GA or Time 2

	Subjects				Controls			
	Sealant	Amalgam/ composite	SSC	Pulp+SSC	Sealant	Amalgam/ composite	SSC	Pulp+SSC
	N	N	N	N	N	N	N	N
Maxillary								
First molar	1/11 (9%)	2/5 (40%)	12/13 (92%)	8/10 (80%)	3/3 (100%)	5/5 (100%)	25/25	1/2 (50%)
Second molar	1/14 (7%)	0/3 (0%)	2/3 (67%)	0 (0%)	7/8 (88%)	11/11 (100%)	6/6	1/2 (50%)
Mandibular								
First molar	2/12 (17%)	3/13 (23%)	9/9 (100%)	2/2 (100%)	5/5 (100%)	13/14 (93%)	14/14	2/2 (100%)
Second molar	3/17 (12%)	2/5 (40%)	2/2 (100%)	0 (0%)	12/14 (86%)	7/7 (100%)	7/7	1/1 (100%)
Totals	7/54 (13%)	7/26 (27%)	25/27 (93%)	10/12 (83%)	27/30 (90%)	36/37 (97%)	52/52	5/7 (71%)

Another discussion topic with definite differences was family issues. A parent of a subject stated, "Well he'd been through a lot...he has a lot of anger built up from his father, who pulled a gun on him and put it to his head, things like that. So I thought that by him having that trauma in his life that it could have been the onset of him building up all this anger." A parent of a control child reported, "I tried to get everyone to stop giving him pop and candy. I tried to stop letting his grandfather give him Pepsi. He would give (child's name) Pepsi when he was a baby in the bottle."

When discussing child behavior, parent responses were more alike. A parent of a subject noted, "She has had ...a stubborn streak...where she knows exactly what she wants and she's not going to change her mind. It's just like with the dentist...you know I'm not going to like it...she made up her mind before she even knew it." A similar comment was made by the parent of a control patient: "Once she started walking, she thought she was an adult...she did what she wanted so we had hard times. She was a very active child that...did what she wanted."

Discussion

This project grew out of the frustration of the hospital dental team treating a small group of healthy patients who required multiple sessions of dental treatment under GA. During the time period of this study, 2,014 children received dental care under GA and 234 patients received more than 1 session of dental treatment under GA. The 23 repeater children who were medically healthy and had no developmental disabilities were the focus of this study. Although the overall percentage (23/2,014, 1%) of healthy repeaters was low compared with the 3% to 20% rate reported by others,^{1,4,7,8,10,11,14} these patients consumed significant time, financial, and professional resources.

Dental caries has been defined as a "biosocial" infectious disease in which many factors lead to the development of demineralization.¹⁹ The research design attempted to match each repeater with a control/nonrepeater to assess multiple patient, parent, and treatment variables that could be re-

sponsible for the good and poor outcomes. Controlling patient age was considered of primary importance due to timing and sequence of tooth eruption; subject and control ages were matched within 9 months. Due to difficulty of matching based upon these criteria, date of first procedure under GA differed by as much as 12 months between subject and matched control.

After frequency-matching subjects and controls by age, gender, ethnicity, language spoken in the home, payer, and date of first GA, the subjects required more treatment at the time of the first GA than controls. One hundred percent of subjects' central incisors needed treatment, and the majority (76%) required extraction. In contrast, 76% of controls' central incisors required treatment and fewer of those were extracted (38%). Other patient characteristics found to differ between the groups at the time of the first GA were detected by the caregiver questionnaires and interviews. More subjects used the bottle with fluids other than water at nap or bedtime, fewer subjects had their teeth brushed by an adult, and subject's teeth were brushed less frequently than the controls.

The majority of the patients had multiple indications for GA. The most frequent indication in both groups was extensive caries with an inability to cooperate in the dental clinic. This parallels other studies showing rampant caries as the most common reason for GA and behavior management problems as the second most common.^{1,3} Most studies of young patients receiving care under GA show no gender predilection.^{1-3,5} A disproportionate number of repeaters were boys, and the mean age of repeaters at second GA was 4.7 years. This may reflect the fact that boys mature psychologically at a slower rate and have not acquired the skills to cope with in-office dental treatment.

Arnup and coauthors found that uncooperative pediatric dental patients are a heterogeneous group. Lack of cooperation has been linked to dental and general fears, temperament, behavioral characteristics, and verbal intelligence.²⁰ In this study, subjects and controls differed in behavior as assessed by the parents and cooperation at the

initial dental appointment. Subjects were viewed by their parents as having more difficult temperaments than controls, and many more subjects reacted poorly to injections in the medical setting. Initial behavior in the dental setting was better in controls, more were examined in the dental chair and had radiographs preoperatively.

Both subjects and controls were at high risk for future caries. Children with early childhood caries who received ongoing comprehensive dental care were found to be more susceptible to lesions of proximal surfaces of primary molars than caries lesion-free children.²¹ The subjects developed new caries in previously unerupted or untreated teeth at an extremely high rate (39%) compared to the controls (2%). Caries rate is influenced by susceptibility and flora of the host, diet, and daily hygiene habits. After treatment under GA, the caregivers of subjects reported to be more involved with their child's brushing yet did not change frequency or type of snacks given to the child; almost half the subjects continued allowing bottle use with fluids other than water at nighttime.

Parents control a child's diet and oral hygiene; they schedule and transport the child to dental appointments. Parental dental indifference has been correlated with a child's DMS rate.²² In this sample, the caregivers of subjects had less formal education than control caregivers; this is consistent with a recent study where authors found lower caries in children having at least 1 parent with a university education.¹⁹ All patients receiving treatment under GA are encouraged to return 2 to 3 weeks following surgery for a postoperative appointment. The appointment is used for examination, reinforcement of hygiene and dietary practices, to address parent concerns, and to set a positive tone for future recall dental visits. In a report by Roberts, 26% of patients received preventive therapy after GA. Once treatment was completed, parents did not recognize the need for ongoing care and failed to keep appointments for preventive therapy.²³ Berkowitz et al, reported that 29% of children treated for nursing caries under GA returned for scheduled follow-up visits.⁹ Only 7% of the subjects in this study returned for a postoperative appointment vs 43% of controls. The higher proportion of controls returning for the follow-up visit may indicate their caregivers were more interested in preventive dental care.

The authors were struck during the interview and home visits with the dysfunctional family situation of many of the subjects. While such impressions cannot be quantified, there were differences between the home situations of many subjects compared to controls. Oral hygiene and diet control are understandably low priorities in a chaotic or dangerous home situation.

Appreciation of the multifactorial nature of dental caries is important when developing a treatment approach; child, parent, and dentist all influence the outcome. The child will not voluntarily alter diet or improve oral hygiene habits; the responsibility for these necessary changes rest with the caregiver. A parent that fails to bring a child in

for follow-up appointments may be indicating dental indifference. It may be of value to actively pursue these caregivers and promote a preventive agenda emphasizing termination of nursing habits, use of fluoride, increased tooth-brushing by the parent, and regular professional dental recalls. Limited funding and resources currently exist for this type of dental social work. Kanellis et al, emphasized the cost to state Medicaid programs when treatment is provided under GA in hospitals for young children with extensive caries.²⁴ Aggressive preventive measures for high-risk children may be less costly than repeated treatment under GA.

The dentist spends only a small amount of time with the child and has limited influence with both child and caregiver but can influence the treatment outcome by choice of restorative material. SSCs are the most reliable restoration and composite restorations are less durable. In this study, at the time of the second general anesthesia visit, the subjects developed caries in 39% of previously untreated or unerupted teeth. Both the successful outcome of SSCs and the subjects' high caries recurrence rate support the view that the operating room is not the place for conservative dentistry.

In this study, success was determined for each tooth type. Success of SSCs in teeth without pulpotomy was 93% for subjects and 100% for controls. When a SSC was combined with pulpotomy, the success for subjects was 83% contrasted, with 71% for controls. All pulpotomy failures occurred in maxillary teeth, which may reflect the difficulty of radiographic diagnosis of maxillary molar furcation areas or the small number of pulpotomies performed in mandibular molars in this sample. Success of other restorations was much lower in subjects than controls: molar single surface amalgams/composites=27% vs 97%; incisor composite strip crowns=59% vs 100%. These findings are comparable to those reported in a review of restorative procedures for 504 children treated under GA.¹³ Seale noted that the advantages of SSCs for patients treated under GA include full coverage, superior durability, and longevity; the use of SSCs could be expected to decrease the frequency of children being re-exposed to GA with its associated costs and risks.¹⁵

Llodra concluded that sealants are less effective in high-risk children.²⁵ Bravo found higher sealant success in patients with a low dft score.²⁶ Sealants in this study were placed under rubber dam isolation without an intermediate bonding step. Sealant success in the subjects was a dismal 13%, but an encouraging 90% in the controls. The high rate of success in the controls was unexpected due to the high initial dft score.

A small sample size and time elapsed between treatment and caregiver interviews and questionnaires limit this study. Prospective studies following a larger group of patients and parents from the time of GA would be beneficial. Investigation of oral flora and dental caries experience of both children requiring dental care under GA and their primary caretakers could further enhance our understanding of risk factors.

Conclusions

1. Patient factors found to be associated with the need for a second session of dental treatment under general anesthesia were:
 - a. 100% involvement of maxillary central incisors at time of initial GA;
 - b. continued use of the bottle at the time of the GA;
 - c. poor cooperation in the medical/dental setting;
 - d. difficult personality as described by parent.
2. Parent factors found to be associated with recurrent caries were:
 - a. adult not brushing the child's teeth;
 - b. dysfunctional social situation;
 - c. failure to return for postoperative dental appointment after initial treatment.
3. Strategies for improved success with high-caries risk patients include:
 - a. aggressive treatment of caries;
 - b. active postoperative follow-up and education of caregivers.

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