Recurrence of Early Childhood Caries after Comprehensive Treatment with General Anesthesia and Follow-up:

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ABSTRACT

Purpose: Children diagnosed with early childhood caries (ECC) receive comprehensive treatment using general anesthesia at the Women and Children's Hospital of Buffalo. The purpose of this study was to determine the likelihood of new caries, and if attendance at immediate follow-up can prevent relapse.
Methods: All patients with ECC who had been scheduled for treatment using general anesthesia in the year 2000 were reviewed. The study population was limited to those who had received at least one examination within the 6- to 24-month postoperative period.
Results: Of 448 patients with ECC, 193 children satisfied the study criteria. Their ages ranged from 19 to 60 months (mean 41 months). There were 76 (39%) children who had returned for their immediate follow-up appointment. Within 2 years, 103 (53%) children had developed new lesions. The children who had failed to attend their immediate follow-up appointment were more likely to relapse, particularly in the primary dentition.
Conclusions: Despite the aggressive treatment of ECC, more than half the patients have new caries lesions within 2 years. The patients who fail to attend their immediate follow-up appointment may be more likely to experience a relapse. (J Dent Child 2006;73:25-30)

KEYWORDS: EARLY CHILDHOOD CARIES, CARIES RECURRENCE, GENERAL ANESTHESIA, FOLLOW-UP

A particularly insidious form of dental caries can affect the primary dentition of infants, toddlers, and preschool children.[1] It begins soon after tooth eruption, affects smooth surfaces, and progresses rapidly. These children are then predisposed to future caries in both their primary and permanent dentition.[2-5] This condition may also affect the child's growth rate, body weight, and ability to thrive.[6] More specifically, the presence of one or more decayed, missing or filled primary tooth surfaces in a child 71 months (5 years and 11 months) or younger, has been defined as 'early childhood caries' (ECC).[7]

ECC affects children throughout the world.[8] Its prevalence differs among populations, but it is particularly common in socio-economically disadvantaged groups, irrespective of race, ethnicity, or culture.[9] Many of the economically disadvantaged children in Western New York receive their dental treatment at the Women and Children's Hospital of Buffalo. Accordingly, many of these preschool children are diagnosed with ECC.

Due to the pernicious nature of this condition, immediate and definitive treatment has been advocated to prevent further tooth destruction and to promote overall health.[10] An aggressive treatment plan has been recommended to halt the disease process and to reduce the remaining number of tooth surfaces susceptible to future caries. This includes alternative restorative materials, fluoride applications, oral hygiene instruction and dietary counseling to prevent future caries. Full crown coverage is desirable to protect susceptible tooth surfaces from caries, particularly stainless steel crowns that are less likely to require subsequent replacement.[11-13]

The complexity of these comprehensive treatment plans necessitates the utilization of advanced behavior manage-

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ment techniques. Some children may be managed with immobilization and conscious sedation, but the limited cooperative capacity of preschool children and the extent of the procedures usually warrants the use of general anesthesia.[14] Furthermore, general anesthesia can provide better operative conditions and an economically viable alternative for some.[15] These treatments can render an immediate improvement in their oral health and quality of life.[16, 17] Accordingly, many of the children with ECC treated at the Women and Children's Hospital of Buffalo are managed aggressively using general anesthesia and follow-up care.

Despite aggressive rehabilitation and prevention, these children are likely to experience a recurrence of caries.[3-5, 18, 19] A recent study on a cohort of 79 children with ECC treated aggressively under general anesthesia, found that of the 57 that returned at 6 months, 37% had developed new caries lesions.[5] They found that placement of stainless steel crowns and the reduction of surfaces at risk did not appear to have reduced the risk of a relapse. A recent retrospective study of 292 children treated similarly found that of the 95% that returned, 55% had developed new caries within 2 to 4 years.[4] An earlier retrospective analysis of 42 patients found that 79% had a recurrence of caries within 2 years compared to 29% in 31 initially caries-free controls.[19] The ECC patients were significantly more likely to develop new lesions, to develop smooth surface lesions, and 17% required re-treatment with general anesthesia within 2 years.

Therefore, to prevent a recurrence of caries, regular postoperative follow-up examinations, prophylaxis, oral hygiene instruction and dietary counseling are recommended. However, previous studies found that only 26 to 29% of children who were treated for ECC with general anesthesia actually returned for follow-up care[20, 21], and even an additional pre-operative consultation failed to increase their attendance at the 6-month recall.[22]

The purpose of this study was to determine the likelihood of a recurrence of ECC within the 6-24 month postoperative period following comprehensive treatment by general anesthesia, and to determine if the children who attend their immediate postoperative follow-up appointment are less likely to relapse.

METHODS

COMPREHENSIVE TREATMENT USING GENERAL ANESTHESIA

Many children with ECC present for dental treatment at the Department of Pediatric Dentistry in the Women and Children's Hospital of Buffalo, in Buffalo, New York. Their treatment begins with a complete dental examination, cleaning, fluoride application, oral hygiene instruction and dietary counseling. Treatment options are reviewed with the child's parent or legal guardian, and a treatment plan is formulated. Some of these children are then treated in the dental chair using only local anesthesia, which may be supplemented with nitrous oxide and oral sedation. However, many of the children are not amenable to these routine techniques because of the complexity of their treatment needs and their limited cooperative ability. These children are scheduled for a single session of comprehensive treatment using general anesthesia, and the dental procedures are performed by either an attending pediatric dentist or by a pediatric dental resident under the supervision of an attending pediatric dentist. An aggressive treatment approach is followed which includes oral hygiene instruction, dietary counseling and postoperative instructions for follow-up care.

POSTOPERATIVE CARE

Following the single session of treatment with general anesthesia, children are scheduled for immediate 2-week follow-up appointments, and ongoing 6-monthly recall visits. At the immediate follow-up appointments, the children are examined, and oral hygiene instruction and dietary counseling are reinforced. At the subsequent recall appointments, examinations and radiographs (when feasible) are used to detect new caries lesions and restorative failures. A recurrence of caries is defined as a new lesion on a previously untreated tooth or tooth surface. Recurrent caries at the margins of existing restorations are included in restorative failures. Cleanings, fluoride applications, oral hygiene instructions, and dietary counseling are also provided.

In addition to the scheduled follow-up and recall appointments, patients may walk-in for an unscheduled emergency visit. Many children who fail to attend their scheduled follow-up and recall appointments appear for an unscheduled emergency visit. At these emergency visits, examinations and radiographs are used to detect new caries lesions and restorative failures.

CASE SELECTION FOR STUDY POPULATION

A list of all of the patients with ECC scheduled for general anesthesia at the Women and Children's Hospital of Buffalo in the year 2000, was obtained (Table 1). These were limited to children who were otherwise healthy and who were less than 61 months (5 years and 1 month) of age at the time of their treatment. Of these 448 children, many had failed to return to the Children's Hospital at any time during the 6 to 24 month postoperative period. Many of these children had returned to other dental practices and clinics for ongoing follow-up and treatment. Some of the children had failed to return for any postoperative visit and a few had failed to return for any visit after their immediate follow-up appointment. Some children had only returned after hours for an unscheduled visit to the Children's Hospital Emergency Department, where their dental examinations were limited to the management of their acute condition. Additionally, there were a few children who had failed to come for their scheduled treatment appointment.

The remaining 193 patients made up the study population. All of these patients had attended at least one 6-month recall appointment or appeared for an emergency visit within the 6 to 24 month postoperative period. The demographic characteristics of the study population were compared with the group of all scheduled cases to verify their similarity (Table 1).

Table 1. Age Characteristics of All Scheduled Patients and the Study Population

Case Attributes	All Scheduled Patients (N=448)	Study Population (N=193)
Age Range (Months)	18.7-60.9	18.7-60.9
Age Range (Years)	1.56-5.08	1.56-5.08
Mean Age (Months)	41.0±10.9	39.7±10.9

STATISTICAL ANALYSIS

The frequency of attendance at immediate follow-up appointments and the frequency of a recurrence of caries are nominal data. These were presumed to be independent, since they were neither paired, nor matched. The null hypothesis was that there was no association between attendance at follow-up and the recurrence of caries. To test this hypothesis the actual frequencies were compared with their expected frequency, by using the chi-squared test.

RESULTS

ATTENDANCE FOR POSTOPERATIVE CARE

A review of the records for the 193 patients in the study population revealed that only 76 children (39.4%) had returned for their scheduled immediate 2-week follow-up appointment (Table 2). More than 60% of the children had failed to attend their immediate follow-up appointment for an examination, and for the reinforcement of oral hygiene and dietary counseling.

However, 167 children or nearly 90% had attended at least one of the scheduled 6-monthly recall appointments for examination, cleaning and counseling. Additionally, 122 children or nearly two-thirds of the study population had appeared for an unscheduled walk-in emergency visit in response to the loss of a restoration or a painful sensation.

RECURRENCE OF EARLY CHILDHOOD CARIES

Following the comprehensive treatment of ECC using general anesthesia, over half the children (53.4%) had developed new caries lesions within the 6 to 24 month postoperative period (Table 3). A little less than half of the children (46.6%) had new caries in only the primary dentition. Another 12% had new caries in only the permanent teeth, and 5% had new caries lesions which involved both the primary and permanent teeth.

New caries lesions were less likely in the children that had attended their immediate 2-week follow-up appointment (19.7%) than in those who failed to attend (33.7%) (Figure 1). However, this association between the development of new caries and the failure to attend follow-up, was not statistically significant (P>0.05); yet, the association between failure to attend follow-up and the development of new caries was more evident in the primary dentition. The children who attended their follow-up appointment were less likely to have developed new caries lesions in their primary teeth (15.0%), than those who failed to attend (31.6%). This association was also not statistically significant, but a trend was evident (P=0.057).

DISCUSSION

ECC occurs throughout the general population and is particularly prevalent in economically disadvantaged groups. Indigent children from the inner city of Buffalo and from the surrounding rural areas in Western New York and Northwest Pennsylvania receive treatment at the Department of Pediatric Dentistry in the Women and Children's Hospital of Buffalo. Many of these children are diagnosed with ECC and this study found that there were 448 cases which had been scheduled for general anesthesia in the year 2000 alone. These numbers attest to the public health costs of this condition, in addition to its impact on oral and systemic health and wellbeing. A recent study in Iowa found that less than 2% of under 6-year-olds who received dental services through Medicaid accounted for 25% of all the dental expenses in the group.[23] However, despite these costs and the seriousness of treatment, follow-up is low and a relapse is likely.[3] Therefore, the purpose of this study was to determine if attendance at an immediate postoperative follow-up appointment reduced the likelihood of a recurrence in caries.

For the purposes of detecting a recurrence of caries in this retrospective analysis, the study population was limited to the patient records for which at least one examination had been performed in the following 6 to 24 month postoperative period. These 193 patients accounted for almost half (43.1%) of all the patients with ECC which had been scheduled for general anesthesia in the year 2000. Furthermore, the demographic characteristics of the study population were very similar to the total case load. Therefore it is reasonable to assume that the study population is representative of the larger population of patients with ECC who are treated by general anesthesia at the Women and Children's Hospital of Buffalo during daily sessions.

These patients were found to resemble other study populations in their poor compliance with follow-up. A review of all of the scheduled patients showed that there were at least 50 children who failed to return for any scheduled or unscheduled postoperative visits, and at least another 15 who attended the immediate follow-up and then failed to show thereafter. These numbers would have been even higher if the records from other dental practices and clinics were available for inclusion. Within the 193 patients for which additional recall data were available, only a little over one third of the children (39.4%) attended their immediate follow-up appointment. The over 60% who failed to attend did attend at least one scheduled recall appointment or an unscheduled walk-in emergency visit during the following 6 to 24 month period of this study. This was a requirement for the inclusion of the case in the study population. In actuality, the failure rate for attendance at the immediate follow-up appointment may have been even higher if the other records were included.

Table 2. Patient Attendance at Scheduled and Unscheduled Follow-up, Emergency and Recall Appointments

Scheduled and Unscheduled Appointments	Patient Attendance (N=193)	Percent
Immediate Postoperative 2-Week Follow-up Visit	76	39.4
Unscheduled Walk-in Emergency Visits	122	63.2
Scheduled 6-Monthly Recall Visits	167	86.5

However, since at least one examination was necessary in the 6- to 24-month postoperative period for the detection of new caries lesions, these patients were excluded from the analyses. Similarly, Primosch et al[22] found that only 46% of the children returned for their immediate postoperative follow-up appointment. This figure was higher than the 39% who returned in our study, but their follow-up was scheduled 1 week postoperatively, and it is possible that this immediacy was beneficial for attendance. Primosch et al also found that the scheduling of an additional intervening pre-operative consultation increased immediate follow-up to 60% attendance. Thereafter, their recall decreased to 31-42% attendance at 6 months. Similarly, earlier studies found that there was as little as 26-29% attendance at the later recall appointments.[20, 21]

In our study it was discovered that despite poor attendance at the immediate follow-up appointment, a large proportion of the children were seen on recall (86.5%) or during a walk-in emergency (63.2%). This outcome was partly due to the study design as already mentioned. However, even if the additional patients who failed to attend recall or emergency visits were included, there would have still been a nearly half to two-thirds attendance at emergency and recall visits respectively. This contrasts with the previous studies which limited their assessments to the earlier recall period. Although these children were inconsistent in their attendance at the scheduled immediate follow-up and ongoing 6-monthly recall appointments, many of them did attend at least one scheduled or unscheduled visit in the 6 to 24 month postoperative period. This demonstrates the importance of the continuation with regular and periodic recalls and the availability of unscheduled visits, since it is likely that they will utilize these services, albeit inconsistently. Therefore, the establishment of a dental home may ensure regular and ongoing access to these services.[10]

These ongoing recall appointments are important because of the propensity for the recurrence of caries in this population. In agreement with previous studies, our study found that many of the children with ECC were susceptible to the development of new caries lesions within the two years following treatment. Despite an aggressive treatment plan that included extractions and full coronal coverage with stainless steel crowns, more than half of the children experienced a recurrence of caries. This recurrence was largely in the primary dentition (46.6%) due to their age, but there were also many cases involving the permanent teeth (11.9%). Furthermore, this relapse was evident despite the scheduling of immediate 2-week follow-up and ongoing 6-monthly recall appointments, and the availability of unscheduled walk-in emergency care.

The incidence of a relapse in our study population (53.4%) was higher than the study by Graves and coworkers (37%),[5] and lower than the study by Almeida et al (79%).[19] However, all of the children in the Almeida et al study were seen at 2-years to determine caries status, whereas all of the children in the Graves et al study and some of the children in our study were seen at only the first 6-month recall. Therefore it is possible that the children who had failed to attend subsequent recall appointments in our study, subsequently developed caries. If all had been examined at 24 months, the recurrence of caries may have been closer to the 79% that was reported by Almeida and colleagues. These figures confirm the likelihood of a relapse in this condition and reinforce the importance of intervention strategies.

The simple strategy of attending the immediate follow-up appointment for postoperative evaluation and for the reinforcement of oral hygiene and dietary counseling appeared to reduce the likelihood of a recurrence of caries, particularly in the primary dentition. Although these differences were not statistically significant, a statistical trend was evident in the primary dentition. If these findings are true, then attendance at immediate follow-up should be emphasized as one of the many interventions in the management of this condition. Alternatively it is possible that the failure to attend immediate follow-up appointments was an indicator of other characteristics associated with an increased risk of susceptibility to caries. Poor compliance with follow-up may be indicative of poor compliance with oral hygiene and dietary practices that are necessary for the prevention of relapse. Accordingly, the children who fail to attend follow-up should be pursued in an effort to reschedule and reinforce their recall appointments in recognition of their susceptibility for a recurrence of caries.

Ultimately, these results and their interpretation are in agreement with the previous studies. Children who are treated for ECC using general anesthesia are unlikely to seek follow-up and are likely to relapse. Additionally, this study found a trend that the children who fail to attend their immediate follow-up appear to be more likely to relapse.

Table 3. Recurrence of Dental Caries in the Primary and Permanent Dentition

New Caries Lesions	Incidence (N=193)	Percent
Either Primary or Permanent Teeth	103	53.4
Only Primary Teeth	90	46.6
Only Secondary Teeth	23	11.9
Both Primary and Secondary Teeth	10	5.2

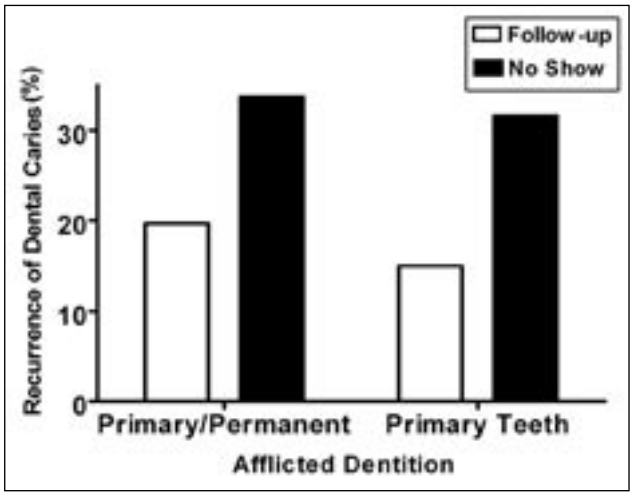

Figure 1. Attendance at follow-up and the recurrence of dental caries. The children who attended their follow-up appointments were less likely to develop new caries lesions (20%) than those who failed to attend (34%). The children who attended follow-up were particularly less likely to have new caries in their primary teeth (15%), compared to those that failed to attend (32%).

CONCLUSIONS

1. Following the aggressive treatment of ECC using general anesthesia, more than half of the children (61%) failed to attend their immediate postoperative follow-up appointment.
2. Almost all of the children (87%) attended at least one 6-monthly recall appointment within 2 years.
3. More than half of the children (53%) developed new caries lesions within 2 years.
4. A trend was found that relapse may be more likely in those that fail to attend immediate follow-up.

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REFERENCES

1. Berkowitz RJ. Causes, treatment and prevention of early childhood caries: a microbiologic perspective. J Can Dent Assoc 2003;69:304-7.
2. Johnsen DC, Gerstenmaier JH, DiSantis TA, Berkowitz RJ. Susceptibility of nursing-caries children to future approximal molar decay. Pediatr Dent 1986;8:168-70.
3. Proceedings of the Conference on Early Childhood Caries. Bethesda, Maryland, USA. October 1997. Community Dent Oral Epidemiol 1998;26:1-119.
4. Drummond BK, Davidson LE, Williams SM, Moffat SM, Ayers KM. Outcomes two, three and four years after comprehensive care under general anaesthesia. N Z Dent J 2004;100:32-7.
5. Graves CE, Berkowitz RJ, Proskin HM, Chase I, Weinstein P, Billings R. Clinical outcomes for early childhood caries: influence of aggressive dental surgery. J Dent Child (Chic) 2004;71:114-7.
6. Acs G, Lodolini G, Kaminsky S, Cisneros GJ. Effect of nursing caries on body weight in a pediatric population. Pediatr Dent 1992;14:302-5.
7. Drury TF, Horowitz AM, Ismail AI, Maertens MP, Rozier RG, Selwitz RH. Diagnosing and reporting early childhood caries for research purposes. A report of a workshop sponsored by the National Institute of Dental and Craniofacial Research, the Health Resources and Services Administration, and the Health Care Financing Administration. J Public Health Dent 1999;59:192-7.
8. Seow WK. Biological mechanisms of early childhood caries. Community Dent Oral Epidemiol 1998;26:8-27.
9. Milnes AR. Description and epidemiology of nursing caries. J Public Health Dent 1996;56:38-50.
10. Oral health policies. American Academy of Pediatric Dentistry. Pediatr Dent 2003;25:11-49.
11. O'Sullivan EA, Curzon ME. The efficacy of comprehensive dental care for children under general anesthesia. Br Dent J 1991;171:56-8.
12. Eidelman E, Faibis S, Peretz B. A comparison of restorations for children with early childhood caries treated under general anesthesia or conscious sedation. Pediatr D*ent* 2000;22:33-7.
13. Tate AR, Ng MW, Needleman HL, Acs G. Failure rates of restorative procedures following dental rehabilitation under general anesthesia. *Pediatr Dent* 2002;24:69-71.
14. Leagault JV, Diner MH, Auger R. Dental treatment of children in a general anaesthesia clinic: review of 300 cases. J Can Dent Assoc 1972;38:221-4.
15. Lee JY, Vann WF, Roberts MW. A cost analysis of treating pediatric dental patients using general anesthesia versus conscious sedation. Pediatr Dent 2000;22:27-32.
16. Acs G, Pretzer S, Foley M, Ng MW. Perceived outcomes and parental satisfaction following dental rehabilitation under general anesthesia. Pediatr Dent 2001;23:419-23.
17. Anderson HK, Drummond BK, Thomson WM. Changes in aspects of children's oral-health-related quality of life following dental treatment under general anaesthesia. Int J Paediatr Dent 2004;14:317-25.
18. Sheller B, Williams BJ, Hays K, Mancl L. Reasons for repeat dental treatment under general anesthesia for the healthy child. Pediatr Dent 2003;25:546-52.
19. Almeida AG, Roseman MM, Sheff M, Huntington N, Hughes CV. Future caries susceptibility in children with early childhood caries following treatment under general anesthesia. Pediatr Dent 2000;22:302-6.

20. Roberts GJ. Caries and the preschool child: treatment of the preschool child in the hospital service. J Dent 1990;18:321-4.
21. Berkowitz RJ, Moss M, Billings RJ, Weinstein P. Clinical outcomes for nursing caries treated using general anesthesia. ASDC J Dent Child 1997;64:210-1, 28.
22. Primosch RE, Balsewich CM, Thomas CW. Outcomes assessment an intervention strategy to improve parental compliance to follow-up evaluations after treatment of early childhood caries using general anesthesia in a Medicaid population. *ASDC J Dent Child* 2001;68:102-8, 80.
23. Kanellis MJ, Damiano PC, Momany ET. Medicaid costs associated with the hospitalization of young children for restorative dental treatment under general anesthesia. *J Public Health Dent* 2000;60:28-32.