

Future caries susceptibility in children with Early Childhood Caries following treatment under general anesthesia

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Abstract

Purpose: The purpose of this study was to assess the susceptibility of children to the future development of caries following comprehensive treatment for early childhood caries (ECC) under general anesthesia.

Methods: The patients selected for this retrospective study were identified by analyzing dental records of children receiving treatment at the Franciscan Children's Hospital & Rehabilitation Center, Boston, MA (FCH & RC). In total, 4,143 records were reviewed. Of these, ECC was diagnosed in 42 patients before their admission to the operating room. Thirty-one control children were selected randomly from the dental records reviewed at FCH & RC. The control group was initially caries-free. The caries status of the children diagnosed with ECC was evaluated and compared with the control group. Children in both groups were seen for recall at intervals of six to nine months over a two-year period. The carious lesions were recorded in two categories; new smooth surface caries (NSSC) and new pit and fissure caries (NPF).C).

Results: Thirty-three of 42 (79%) ECC children compared to nine of 31 (29%) control children had detectable carious lesions at subsequent recall visits. Children with ECC demonstrated a mean number of 3.2 ± 3.3 new carious lesions compared to a mean of only 0.8 ± 1.6 carious lesions in the control group. These differences were statistically significant ($t_{71} = 3.8$; $P < 0.001$). In addition, of the 42 patients treated for ECC under general anesthesia, seven (17%) required retreatment under general anesthesia within two years following their initial full-mouth rehabilitation. The prevalence of NSSC in the ECC group was significantly higher than the control group ($t_{71} = 3.5$; $P < 0.001$).

Conclusions: Despite increased preventive measures implemented for children who experienced ECC, this study concluded that this group of children is still highly predisposed to greater caries incidence in later years. These findings strongly suggest that more aggressive preventive therapies may be required to prevent the future development of carious lesions in children who experienced ECC. (*Pediatr Dent* 22:302-306, 2000)

Early childhood caries (ECC) is the term now recommended by the Centers for Disease Control and Prevention to describe a unique pattern of carious lesions in infants, toddlers, and preschool children. Although the prevalence of dental caries in infants and young children has decreased considerably in recent years, it continues to affect many children in the general population. Previous investigations have focused on the etiologic factors associated with the development of ECC. However, while the general etiology of ECC appears similar to that of other types of caries, its predisposing factors are still unclear.¹ The biology of ECC may be modified by factors unique to young children: the implantation of cariogenic bacteria, immaturity of the host defense systems and behavioral patterns associated with feeding and oral hygiene in early childhood.¹ ECC is known to be characterized microbiologically by dense oral populations of mutans streptococci (MS).² Scientific evidence strongly suggests that the development of ECC occurs in three stages. The first stage is characterized by the primary infection of the oral cavity with MS. The second stage is characterized by the accumulation of these organisms to pathogenic levels as a consequence of frequent and prolonged exposure to cariogenic substrates. And finally, a rapid demineralization and cavitation of enamel occurs resulting in rampant dental caries.³ Burt *et al*⁴ demonstrated that colonization by MS is stable over time. Over a two-year period, levels of MS were fairly stable; high levels of infection tended to stay high and were associated with subsequent development of caries. On the other hand, none of the teeth with undetectable levels of MS developed caries. This indicates that children with ECC are highly susceptible to the development of caries in later years when compared to caries-free children.

Most patients receive dental care under routine conditions in a conventional office environment. However, there are circumstances that make an alternative method of treatment necessary.⁵ Patient behavior, age, and the extent of restorative treatment required are major determinants in selecting the mode of treatment.⁶ Contemporary clinical management of ECC is often accomplished using general anesthesia.⁷ Several

investigators have reported the susceptibility of children with ECC to future caries development following comprehensive treatment under general anesthesia.^{7,8} Children with ECC receiving ongoing comprehensive dental care are more susceptible to lesions of proximal surfaces of primary molars than are children initially caries-free.⁸ Susceptibility of children with ECC to further lesions is of potential clinical importance. Continued caries risk is associated with “unfavorable” eating patterns, marginal fluoride exposure, and unsupervised daily tooth brushing.⁹ Therapeutic approaches to minimize risk for relapse must also address the control of etiologic risk factors.⁷

The purpose of this study is to assess the susceptibility of children to the future development of caries following comprehensive treatment for ECC.

Materials and methods

ECC children

The patients selected for this study were identified by analyzing dental records of children receiving treatment at Franciscan Children’s Hospital & Rehabilitation Center, Boston, MA (FCH & RC). As a retrospective study conducted in a teaching program, the children were examined and treated by a number of clinicians.

In total, 4,143 records were reviewed. Of these, 194 patients were treated under general anesthesia, and ECC was diagnosed in 42 patients before their admission to the operating room. ECC was defined as the occurrence of one or more carious lesions involving maxillary anterior teeth of toddlers (1 to 2 years) and preschool children (2 to 5 years). Extent of restorative treatment required was a major determinant in selecting the children for treatment under general anesthesia. All children included in this study had unremarkable medical histories. Almost all of the children had full-mouth rehabilitation within 3 to 4 weeks of their initial visit to the hospital.

Control children

A control group was selected randomly from the dental records reviewed at FCH & RC. Thirty-one control children were selected. All children in this group were similar in age to the ECC subjects at the time of their initial visit to the hospital. The control group had unremarkable medical histories. At the time of their first visit to the hospital, none of the control group had any filled surfaces, active carious lesions or missing teeth.

Demographics

In total, 42 children with a diagnosis of ECC were selected for the study group. The subjects ranged in age from 1.9 to 4.9 years (mean age 3.1) at the time of their initial visit to the hospital. The group consisted of 23 males and 19 females (Table 1). There were 31 control children similar in age to the ECC children at the time of their initial visit to the hospital. This group consisted of 17 male and 14 female children varying in age from 1.11–4.9 years (mean age 3.0).

Prevalence of carious lesions at future recall visits

Children in both groups were seen for recall at intervals of six to nine months over a two-year period. The caries status of the study sample diagnosed with ECC was evaluated and compared with the control group. Bitewing radiographs were used to diagnose proximal caries in all children included in this study. The number of new carious lesions was recorded from each dental record. The carious lesions were recorded in two categories; new smooth surface caries (NSSC) and new pit and fissure caries (NPFC).

Statistical analysis

Unpaired *t*-tests were performed using a 0.05 significance level to determine if significant differences existed between the two groups. Descriptive statistics were calculated for the data from the two groups and used to interpret the data.

Results

Prevalence of carious lesions at future recall visits

All children diagnosed with ECC receiving treatment at FCH & RC were given a more intensive preventive regimen. Dietary counseling with parents was provided. Oral hygiene instructions were given to parents, encouraging the use of toothbrushing with fluoridated dentifrices and daily flossing. Furthermore, general dental education and regular recall was encouraged. After comprehensive oral rehabilitation, all the ECC group returned for a one-week follow-up visit, and preventive dental care was reinforced at that visit and at each subsequent recall visit.

The caries incidence in the children of the study group was compared to that of the control children during the two-year period following their initial visit to the hospital. Thirty-three of 42 (79%) ECC children compared to nine of 31 (29%) control children had detectable carious lesions at subsequent recall visits. By 24 months, children with ECC demonstrated a mean number of 3.2 ± 3.3 new carious lesions compared to a mean of only 0.8 ± 1.6 carious lesions in the control group. These differences were statistically significant ($t_{71} = 3.8$; $P < 0.001$).

The mean time elapsed between oral rehabilitation under general anesthesia of children diagnosed with ECC and the detection of new caries at a recall visit in the two-year period was 17.7 months.

Of the 42 patients treated for ECC under general anesthesia, seven (17%) required retreatment under general anesthesia within two years following their initial full-mouth rehabilitation.

Table 1: Demographic data of subjects in study

	<i>ECC</i>	<i>Control</i>
Total	42	31
Male	23 (55%)	17 (55%)
Female	19 (45%)	14 (45%)
Mean age at initial visit (years)		
Mean \pm SD	3.0 ± 0.8	3.0 ± 0.8
Range	1.9 – 4.9	1.11 – 4.9

Patterns of carious lesions at future recall visits

Figure 1 illustrates the different patterns of carious lesions that emerged from the study. In the ECC group, 25 of 42 (60%) subjects were diagnosed with at least one NSSC lesion compared to only four of 31 (13%) subjects in the control group. The prevalence of NSSC in the ECC group (mean of 1.9 ± 2.3) was significantly higher than the control group (mean of 0.3 ± 0.9) ($t_{71} = 3.5$; $P < 0.001$). Eight of 31 (26%) subjects in the control group were diagnosed with at least one NPFC lesion compared to 17 of 42 (40%) subjects in the ECC group. The difference in the development of NPFC in the ECC group (mean of 1.0 ± 1.9) was not statistically significant when compared to the development of NPFC in the control group (mean of 0.5 ± 0.90) ($t_{71} = 1.6$; $P > 0.1$). A greater percentage of children initially diagnosed with ECC were more likely to develop subsequent NSSC lesions. In contrast, children initially caries-free tended to develop a greater percentage of NPFC versus NSSC lesions at future recall visits.

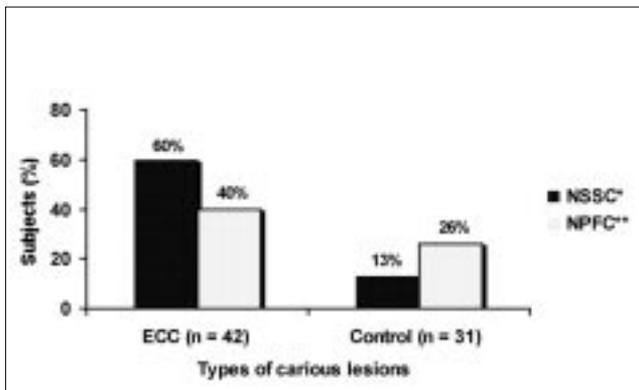


Fig 1. Relationship of different patterns of dental caries in a two-year period. The difference of NSSC lesions among the two groups is statistically significant ($t_{71} = 3.5$; $P < 0.001$).
 NSSC* (new smooth surface caries)
 NPFC** (new pit and fissure caries)

Association of recall visits and future caries development

All subjects included in the study returned for a recall visit within 24 months. By the end of 12 months, 19 of 42 (45%) ECC children had not yet returned for a recall visit. Of the 19 children who had not returned, four (17%) eventually required retreatment under general anesthesia. The remaining three (16%) ECC children requiring retreatment under general anesthesia had returned for a recall visit by the end of 12 months. There was no relationship between subjects who required retreatment under general anesthesia and immediacy or frequency of recall visits. By the end of 12 months, those members of the ECC group who had not returned for a recall visit showed a mean number of 2.6 ± 2.7 new carious lesions when compared to a mean of 3.6 ± 3.7 new carious lesions in the group who had returned for a recall visit. These differences were not statistically significant ($t_{40} = -1$; $P > 0.1$) (Table 2).

By the end of 24 months, a number of members of the ECC group ($N = 9$) had returned only for a single recall visit, while other members ($N = 17$) had returned for two recall visits or three ($N = 16$) regular recall visits. However, an analysis of variance showed no significant effect of the frequency of recall visits on the development of new carious lesions ($F = 1.603$; $P = 0.214$).

Table 2. The Relationship Between Recall Visits and Future Caries Development for ECC Children

	Recall by 12 months	No recall by 12 months
Total caries Mean \pm SD	3.6 ± 3.7	2.6 ± 2.7
Percent of patients that returned to the Operating Room	16%	17%

The association of recall visits and future caries development was not statistically significant ($t_{40} = -1$; $P > 0.1$).

Discussion

The results of this and many other studies suggest that ECC can be a predictor of future caries development. After two years, 33 of 42 (79%) children diagnosed with ECC had additional caries diagnosed following initial comprehensive treatment compared to only nine of 31 (29%) children that were initially caries-free. This confirms findings of Slavos *et al.*¹⁰ in which ECC children continued to develop significantly greater mean numbers of carious lesions in follow-up visits compared to a control group.

In addition to the previous finding, in which 33 (79%) ECC children required subsequent restorative treatment or extractions at recall visits, it is interesting to note that seven of 42 (17%) children from the ECC group required retreatment under general anesthesia within two years following initial full-mouth rehabilitation. Similar findings were confirmed by Legault *et al.*¹¹ and O'Sullivan *et al.*¹² In contrast, the findings of this study differ from those of Sheehy *et al.*⁹ in which it was reported that 10 of 24 ECC children treated under general anesthesia required further restorative treatment or extractions at follow-up visits. However, none of these patients were retreated under general anesthesia. The difference in results of the two studies is most likely due to the number of ECC children included in the study of Sheehy *et al.*⁹ which was relatively small compared to the current study, and the extent of restorative treatment required in follow-up visits.

In this investigation, the mean time elapsed between oral rehabilitation under general anesthesia of children diagnosed with ECC and the detection of new caries at a recall visit over a period of two years was 17.7 months. This confirms the observations of Legault *et al.*¹¹ showing that ECC children treated under general anesthesia required dental treatment within 15.6 months.

The current study also attempted to identify any association between recall visits and future caries development over a two-year period. Surprisingly, there was no relationship between regular recall visits and a lower incidence of future caries development in ECC children. On the other hand, Al-Shalan *et al.*³ concluded that the number of recall visits was highly correlated to a lower incidence of subsequent carious lesion development. By the end of 24 months, all subjects included in this study returned for at least one regular recall visit. There was no significant difference in the mean carious lesions of ECC children who had or had not returned within 12 months for recall visit. In addition, the ECC children who required retreatment under general anesthesia did not differ in the number of recall visits from those children who required only one

visit to the operating room for oral rehabilitation. This fact is of clinical importance. It clearly demonstrates the high susceptibility of ECC children to future caries development. Even routine recall visits and increased dietary counseling do not appear to be successful in preventing the development of new carious lesions. This study supports findings from a recent investigation performed by Tinanoff *et al.*,²⁰ which concluded that dental caries can develop in high caries risk children despite intensive preventive regimens.

Few studies describing ECC patterns on follow-up visits have been performed. A previous investigation compared ECC children with a caries-free group for susceptibility to future proximal molar caries and reported that 53% of ECC children had one or more proximal molar lesions on follow-up compared to 15% for children who were initially caries-free.⁸ ECC starts on surfaces that can be easily assessed by routine toothbrushing.²¹ In addition, pit and fissure caries comprise the majority of caries increment in both fluoridated and nonfluoridated communities.²² Findings from this study confirm that children who experienced ECC continue to demonstrate the typical caries pattern of this disease, usually smooth surfaces. This observation is consistent with the investigation performed by Johnsen *et al.*,⁸ which demonstrates that children who experienced extensive decay in early years of life are at risk for future development of smooth surface carious lesions.

The majority of earlier investigations focused on methods intended to help arrest the process of the disease such as regular recall visits, implementation of dietary counseling, oral hygiene measures, and fluoride supplementation. However, more aggressive restorative approaches in treating ECC children during oral rehabilitation under general anesthesia have never been reported. An important observation arising from this study was that the children requiring retreatment often had more conservative restorative treatment during their first rehabilitation. Due to a high incidence rate of NSSC lesions, a number of ECC children who had sealants or occlusal amalgam restorations performed initially on primary molars required subsequent placement of stainless steel crowns on the same primary molars in their subsequent visit to the operating room. On the other hand, the majority of ECC children who did not develop further carious lesions had more aggressive restorative approaches performed during comprehensive dental treatment. This observation may support a more aggressive approach to full-mouth rehabilitation of ECC children under general anesthesia.

In certain circumstances, the pediatric dentist has to evaluate the preventive interventions that are being performed during oral rehabilitation in ECC children. ECC is attributed to a heavy infection of MS in the oral environment.² In addition, patient compliance to maintain ideal preventive measures are questionable. Perhaps the performance of amalgam restorations with extension for prevention would be more suitable than preventive resin restorations in occlusal surfaces of primary molars. Furthermore, in primary molars with occlusal carious lesions and demineralized smooth surfaces, the placement of stainless steel crowns instead of occlusal restorations would be a more appropriate treatment. Previous studies have investigated the effect of conventional dental restorative treatment on bacteria in saliva. They indicate that restorative dentistry has little impact on oral levels of MS.^{14,17} Gregory *et al.*⁷ investigated the effect of restorative treatment on MS and

IgA antibodies. Numbers of MS decreased slightly from pre- to postrestoration levels in six subjects and increased in five subjects. They concluded that successful restorative treatment does not modify MS levels and suggested the need for additional effective methods in reducing the cariogenic challenge.

Control of the etiologic factor causing ECC may play a major role in the prevention and control of the disease process. Lopez *et al.*¹⁸ reported the effect of topical application of an iodine agent to dental surfaces of children at risk for ECC and concluded that topical antimicrobial therapy significantly reduces the incidence of ECC in high-risk children. A recent study by Achong *et al.*⁹ investigated the effect of chlorhexidine varnish mouthguards on the levels of selected oral microorganisms in pediatric patients. Results from their study suggest that for at least a period of three months, one week of nightly use of the chlorhexidine varnish mouthguard system is effective in reducing the number of MS in caries-active pediatric patients in the primary and mixed dentition. The high incidence of caries in children following comprehensive restorative treatment for Early Childhood Caries documented by this and other studies suggests that studies are urgently needed to determine the optimal preventive regimens, including antimicrobial therapies to modify the course of ECC.

Conclusions

1. Despite increased preventive measures implemented for children who experienced ECC, this group of children is still highly predisposed to greater caries incidence in later years.
2. In addition to nutritional counseling and fluoride therapy, more aggressive antimicrobial therapies may be required to prevent the future development of carious lesions in children who experienced ECC.

Dr. Almeida would like to acknowledge CAPES "Fundacao Coordenacao de Aperfeicoamento de Pessoal de Nivel Superior," a Federal Agency for Postgraduate Education in Brazil, for their generous support of her studies and research efforts while at the Boston University Goldman School of Dental Medicine.

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ABSTRACT OF THE SCIENTIFIC LITERATURE



MUSCLE ACTIVITY WITH THE MANDIBULAR LIP BUMPER

The purpose of this study was to evaluate the effect that a lip bumper has on lip muscle activity and to ascertain whether the muscles adapted to the appliance over a 12 mo. period. 25 patients, consisting of 16 females and 9 males, with a mean age of 13 years 1 mo. (age range = 10 yr. 6mo. to 17 yr. 4 mo.) were studied. The lip bumper was made of 0.045 inch stainless steel wire with no plastic shield. The bumper was tied into the molar tubes and extended 2mm beyond the facial surfaces of the lower incisors at the level of the gingival margin. Electromyographic measurements were made by placing electrodes on the vermilion border of the lips in the midline. Muscle activity was recorded on the day the appliance was placed and again after the appliance had been used for 12 continuous months. Measurements were made with and without the appliance in place. Specifically, recordings were made with the lips closed and at rest, while speaking the words "church", "pop", and "phone" and while swallowing water. The results showed the following. "1) Insertion of the lip bumper led to increased activity during rest and swallowing of the upper and lower lips. The response for the speech exercises was variable." "2) The lower lip musculature did not show any differences between pretreatment and post treatment activity that would indicate muscle adaptation to the lip bumper appliance" during the 12 mo. treatment period.

Comments: The following comments are from the authors, not this reviewer, and suggest possible implication from their study and their recommendations for further study. These are quoted directly from the article. "Lip bumper treatment in the adolescent patient might not result in increased post treatment stability." "It has to be kept in mind that the patients investigated in this study had an age range of 10 to 17 yrs. The muscular response could be different in a younger age group that receives treatment over a longer time period in the transitional dentition. Future research should determine if treatment at earlier ages can permanently alter the soft tissue environment with lip bumper treatment. If adaptation was observed in such a study with this mechanism of physiologic expansion, one may even wish to compare the stability of teeth in these patients with those treated with conventional expansion." JEP

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Muscle activity with the mandibular lip bumper. Drmeddent AK, Nanda RS, Ghosh J J. Am. Assoc. of Ortho. and Dentofacial Orthoped. 117:384-390, 2000.

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