Clinical outcomes for Early Childhood Caries (ECC): the influence of salivary mutans streptococci levels


ABSTRACT. Aim To assess the relationship between clinical outcomes for children treated for Early Childhood Caries (ECC) and salivary mutans streptococci (MS) levels. Study design and methods The study cohort consisted of 79 children (42 males, 37 females) treated for ECC, aged from 2.3 to 7.3 years at time of entry. Whole non-stimulated saliva samples were obtained from each subject prior to dental surgery and at 6 mths post dental surgery, by saturating a cotton swab in the saliva pooled in the floor of the mouth. Samples were placed into PBS on ice and processed within 2 hours. Samples were sonicated, serially diluted and plated onto MSB and SBA agar plates, then incubated 48 hours anaerobically; SBA plates were incubated an additional 24 hours aerobically. The MS level in each sample was expressed as a percentage of the total cultivable flora. The cohort was evaluated for new caries lesions at 6 months post dental surgery. Relapse was defined as the presence of new smooth surface caries lesions. Statistics Comparisons between Relapse (R) and Non-Relapse (NR) groups with respect to mutans streptococci levels were performed using Wilcoxon tests. Within group comparisons were performed using Wilcoxon signed-rank tests. Results 57 children (72%) returned for the 6 months examination and 21 of these subjects (37%) relapsed. No statistically significant difference in median salivary MS levels existed between the R (0.20%) and NR (0.033%) groups at baseline (p=0.647) or at 6 months post dental surgery (R=0.03%; NR=0.01%; p=0.273). A statistically significant difference between baseline and 6 months post dental surgery was noted in the median salivary MS level within the R group (p=0.0007) and within the NR group (P<0.0001). Conclusions The relapse rate (37%) was high and rapid for children treated for ECC. Dental surgery resulted in a statistically significant reduction in salivary MS reservoirs for children treated for ECC. However, this did not translate into acceptable clinical outcomes.

KEYWORDS: Mutans streptococci, Early Childhood Caries, Clinical outcomes.

Introduction
Early Childhood Caries (ECC) is a particularly virulent form of dental caries characterized by an overwhelming infectious challenge and cariogenic feeding behaviours [Seow, 1998; De Grauwe et al., 2004]. Results from studies demonstrated that in children with ECC mutans streptococci regularly exceeded 30% of the cultivable plaque flora [Van Houte et al., 1982; Berkowitz et al., 1984; Milnes and Bowden, 1985]. This dense level of dental infection was associated with carious lesions, white spot lesions and sound tooth surfaces near the lesions. Conversely, mutans streptococci typically comprise less than 0.1% of the plaque flora in children with negligible to no caries activity [Loesche, 1986]. These observations, together with other published results [Keyes, 1960; Krasse, 1965; Dreizen and Brown, 1976], clearly illustrate the concept that ECC is an infectious disease and that mutans streptococci are the most likely aetiologic
agents. Accordingly, it is reasonable to speculate that clinical outcomes for children treated for ECC are likely to be influenced by mutans streptococci reservoirs post dental treatment/surgery. On such basis, this research assessed the relationship between salivary mutans streptococci reservoirs and clinical outcomes for children treated for ECC under general anesthesia (GA).

Materials and methods

Study population. This consisted of 79 children consecutively admitted to the Ambulatory Surgical Center of the Strong Memorial Hospital at the University of Rochester Medical Center (URMC) for treatment of ECC utilizing GA. This study cohort consisted of 42 males and 37 females ranging in age from 2.3 to 7.3 years (mean age: 4.2 years) at their time of entry into the study. Ethnicity of the study population was: 2 Native American; 2 Asian; 22 Black (not of Hispanic origin); 4 Hispanic; 27 Caucasian; 22 mixed race. All of the subjects were recipients of New York State Medicaid or Child Health Plus, state financial support programs indicating that they were from families of lower socioeconomic status. All subjects had only primary teeth at the start of the study. The criterion for establishing a diagnosis of ECC was dental caries affecting at least 2 of the 4 maxillary primary incisors and at least 2 of the 4 buccal segments. Dental surgery utilized an aggressive approach such that teeth with necrotic pulps and non-restorable teeth were extracted; single surface lesions that did not compromise cusp integrity were restored with intracoronal restorations; teeth requiring pulp therapy were restored with preformed metal crowns (SSC); teeth having cavities affecting 2 or more surfaces were restored with SSC. A prophylaxis and topical fluoride application were performed after all surfaces were restored with SSC. A prophylaxis and topical fluoride application were performed after all restorative procedures had been completed. All patients received preoperative dietary counseling and oral hygiene instruction. The study protocol was approved by the Research Subjects Review Board of the URMC.

Bacteriologic procedure. Whole non-stimulated saliva samples were obtained from each subject on the day of dental surgery prior to initiating treatment and at 6 months post dental surgery. These samples were obtained by saturating a calcium alginate swab (Fisherbrand) in saliva that pooled in the floor of the mouth [Van Houte et al., 1982]. The swabs were immediately placed in vials containing 1.0 ml of phosphate buffered saline (PBS) and placed on ice. All samples were transported to the laboratory within 2 hours of collection for processing. Samples were sonicated with three 10-seconds bursts (100 watts P.E.P.) with a Braunsonic Model 1510 Sonicator to disperse clumps and initiate dechaining of streptococci. Samples were serially diluted in PBS and plated in duplicate onto MSB agar [Gold et al., 1973] and sheep’s blood agar (SBA; Crane Laboratories) plates using a Spiral Systems, Spiral Plater. The plates were incubated for 48 hours under an atmosphere of 95% N, and 5% CO₂; SBA plates were incubated an additional 24 hours in an aerobic atmosphere. Colony forming units (CFUs) were enumerated using sector counts. MSB plate counts were used to determine the number of mutans streptococci in the sample while SBA plate counts were used to determine the magnitude of the total cultivable flora in the sample. The level of mutans streptococci in each sample was expressed as a percent of the total cultivable flora.

Relapse evaluation. The study population was evaluated for new caries lesions at 6 months post dental surgery. Caries status was evaluated by 2 clinical examiners (RJB and IC). One examiner (RJB) was trained and calibrated by one of the authors (RB) who had extensive experience in caries clinical trials. The second examiner (IC) was trained and calibrated by the first examiner (RJB). Relapse was defined as the presence of one or more new smooth surface caries lesion(s) affecting any primary teeth. A surface was declared as having smooth surface caries per the criteria of Radike [1972] with the exception that white spot lesions were not penetrated with an explorer. No opportunity was provided for performing repeated evaluations on the same subjects and thus no quantitative assessment of reliability was calculated. However, both prior to and during the course of this investigation, the 2 examiners engaged in extensive discussions concerning the use of the Radike scoring system. The subjects were scheduled for the 6 months follow-up visit via telephone by the study coordinator and given a $30 volunteer fee to enhance compliance with follow-up.

Statistical analyses. Comparisons between Relapse (R) and Non-Relapse (NR) groups with respect to percentage of mutans streptococci were performed using Wilcoxon tests. Within group comparisons of changes in salivary mutans streptococci levels between baseline and 6 months post dental surgery were performed using Wilcoxon signed-rank tests. A level of significance of 0.05 was employed in all statistical tests.
**Results**

Of the 79 subjects enrolled in the study, 57 (72%) returned for the 6 months follow-up exam; 21 (37%) of these returning patients relapsed. Pre and post treatment median salivary mutans streptococci levels are presented in Table 1. No statistically significant difference in median salivary mutans streptococci levels existed between the NR (0.33%) and R (0.20%) groups at baseline (p=0.647) or at 6 months post dental surgery (NR=0.01%; R=0.03%; p=0.273). With respect to within group changes between baseline and 6 months post dental surgery, a statistically significant difference was noted in the median salivary mutans streptococci levels within the R group (p=0.0007) and within the NR group (p<0.0001).

**Discussion**

Few studies have evaluated the effect of dental surgery and dietary counseling on salivary mutans streptococci levels in the setting of ECC. One study by Twetman et al. [1999] found a statistically significant reduction in oral mutants streptococci populations from baseline to 6 months post dental surgery in children (2.5-6.0 years of age; mean age 4.4 years) with severe dental caries treated under GA. Likewise, the present study found a statistically significant reduction in salivary mutants streptococci reservoirs from baseline to 6 months post dental surgery in both the Relapse (0.20% to 0.03%) and Non-Relapse (0.33% to 0.01%) groups. Collectively, these 2 studies have indicated that dental surgery has an impact on oral mutants streptococci reservoirs in the setting of young children with severe dental caries receiving dental care under GA.

Saliva harbours 10^8 bacterial cells per ml [Gibbon and Van Houte, 1978]. On this basis, it can be extrapolated that the study cohort harboured baseline and 6 months post dental surgery salivary mutans streptococci levels of 10^5 and 10^4 cells per ml respectively. Although a log decrease (10^5 to 10^4) was statistically significant, 10^4 mutans streptococci cells per ml of saliva posed a caries risk [Wright et al., 1992]. Hence, the observed relapse rate of 37% is biologically plausible based on the bacteriologic findings.

The observed relapse rate in this prospective study was 37%. An earlier report [Berkowitz et al., 1997] from our group, which assessed relapse through retrospective chart review, found that 52% of our study cohort had new smooth surface caries lesions within 4-6 months post dental surgery. Similarly, Eidelman et al. [2000], in a retrospective chart review, reported that 57% of their study cohort who were treated under GA or sedation required treatment for new caries lesions within 6-24 months post dental surgery. Another retrospective study [Almeida et al., 2000] of 42 children with ECC treated under GA at the Franciscan Children’s Hospital and Rehabilitation Center in Boston (USA) reported that 45% relapsed by the end of 12 months post dental surgery. Sheehy et al. [1994], utilizing a telephone survey, found that 23% of children treated for ECC under GA required restorations or extractions following initial dental surgery.

Given the morbidity and cost associated with treatment of relapse (for example GA, sedation, physical restraint), these reports indicate that present approaches to treatment with dental extractions, restorative dentistry and current preventive regimens result in unacceptable relapse rates. New treatment strategies (e.g. chemotherapeutic, behavioural) need to be developed which address the aetiological factors associated with relapse, if improvements in clinical outcomes are to be realized.

**Table 1** - Median pre dental surgery and 6 months post dental surgery salivary mutans streptococci levels for the Relapse (R) and Non-Relapse (NR) groups of children treated for early childhood caries (ECC) under general anaesthesia.

<table>
<thead>
<tr>
<th>Group (N)</th>
<th>Median salivary mutans streptococci levels</th>
<th>Pre-dental surgery</th>
<th>Post-dental surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>NR (36)</td>
<td></td>
<td>0.33% (A)</td>
<td>0.01% (B)</td>
</tr>
<tr>
<td>R (21)</td>
<td></td>
<td>0.20% (C)</td>
<td>0.03% (D)</td>
</tr>
</tbody>
</table>

p values: A v. C = 0.647, B v. D = 0.273, A v. B < 0.0001, C v. D = 0.0007
Conclusions
The relapse rate (37%) was high and rapid for children treated for ECC under GA. Dental surgery resulted in a statistically significant reduction in salivary MS reservoirs for children treated for ECC. However, this did not translate into acceptable clinical outcomes.

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References