

The influence of medical history on restorative procedure failure rates following dental rehabilitation

Man Wai Ng, DDS, MPH Anupama Rao Tate, DMD Howard L. Needleman, DMD George Acs, DMD, MPH

Dr. Ng is director, Pediatric Dentistry Residency Program, and Dr. Tate is director, Satellite Facilities, Children's National Medical Center. Both are assistant professors of pediatrics, George Washington University School of Medicine, Washington, DC; Dr. Needleman is associate dentist-in-chief, Children's Hospital, and professor, Harvard School of Dental Medicine, Boston, Massachusetts; Dr. Acs is chairman, Department of Dentistry, Children's National Medical Center, and associate professor of pediatrics, George Washington University School of Medicine, Washington, DC. Correspond with Dr. Ng at mng@cnmc.org

Abstract

Purpose: This study evaluated the association between patient medical history and the outcomes of restorative procedures performed under general anesthesia.

Methods: The dental records of patients who had dental rehabilitation under general anesthesia at Children's Hospital in Boston (1990-1992) and Children's National Medical Center in Washington, DC (1994-1998) were examined. Data regarding restorative outcomes and the association between patient medical history and restorative failures were assessed using chi-square tests with correction for continuity. T-tests were performed on parametric data.

Results: Significantly higher stainless steel crown failure rates were found in young patients diagnosed with developmental disabilities when compared to patients without such disabilities ($p < 0.025$, $\chi^2 = 5.50$). However, there was no difference in the failure rates of SSCs in young patients with significant medical histories compared to patients without significant medical histories. Regarding amalgam and composite restorations, there were no differences in failure rates among patients with and without significant medical histories, including developmental disabilities.

Conclusions: SSC failures were higher in young children with developmental disabilities compared to children without these disabilities. (*Pediatr Dent* 23:487-490, 2001)

Many treatment modalities exist for managing young children in need of comprehensive restorative and surgical dental treatment. Treatment must often be performed under general anesthesia in the operating room for the patient who is either very young or has special needs. The decision for performing dental treatment under general anesthesia is based upon age, ability to cooperate in a normal setting, medical status and extent of treatment required.¹

General anesthesia allows treatment to be rendered under optimal conditions, theoretically ensuring ideal outcomes. However, the cost of general anesthesia is a significant consideration that adds between \$1,000 to \$6,000 to the cost of dental care.² Outcomes for these children are of particular interest because the increased risk of incremental decay has been confirmed to exist in children with high initial rates of decay.³ Yet, despite the high risk for new and recurrent decay in children

following dental treatment under general anesthesia, few children return for follow-up after treatment.⁴⁻⁶

Very few studies have investigated the outcomes of treatment rendered during dental rehabilitation under general anesthesia. Eidelman⁵ reported that the quality of treatment performed under general anesthesia was better than the quality of treatment performed under conscious sedation. On the other hand, the authors of a recent study found that a group of children with early childhood caries (ECC) who were treated under general anesthesia demonstrated significantly higher caries rates than a control group who were initially caries-free.⁷ They concluded that a more aggressive approach may be warranted for children with ECC who require treatment under general anesthesia. In other studies, stainless steel crown restorations were reported to be significantly more successful than amalgam or composite restorations for patients who were treated under general anesthesia.^{6,8} Most studies examining the outcomes of treatment rendered under general anesthesia did not discriminate by patient medical history. There has been no published study investigating a relationship between patient medical history and the outcomes of restorations performed under general anesthesia.

The aim of this study was to evaluate whether patient medical history and developmental disability influenced the outcomes of restorative procedures performed under general anesthesia.

Methods

Dental records of patients who underwent comprehensive dental treatment under general anesthesia at Children's Hospital in Boston, MA and at Children's National Medical Center in Washington, DC were reviewed. The Boston patients had dental rehabilitations between 1990 and 1992. The DC patients had dental rehabilitations between 1994 and 1998. In both Boston and DC, pediatric dental residents in advanced educational programs performed the dental treatment in the operating room while under the direct supervision of an attending faculty member. In both studies, only records of patients who returned for follow-up at least six months after their rehabilitations were evaluated.

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Table 1. Full Primary Dentition Patients: A Comparison of Medical Conditions by Study Location

Medical history*	n	%	n	%
Healthy (non-contributory)	68	68	65	61
Significant medical history (Total)	32	32	41	39
Cardiac disease	4	4	9	9
Respiratory disease	11	11	3	3
Cleft lip and palate	2	2	2	2
Syndrome	2	2	4	4
HIV	2	2	2	7
Hematology/oncology	3	3	5	5
Dentinogenesis imperfecta	0	0	6	6
Neurological disorder	5	5	5	5
Other	2	2	0	0
Developmental disability	8	8	12	11

*Total sample size of patients n=206; Boston n=100; DC n=106. Patients may present with multiple medical conditions.

Table 2. Full Primary Dentition Patients: Procedure Failure Rates

Procedure	n	% Failure
Amalgam	558	22*
Stainless steel crown	778	8*
Composite	332	29*
Composite strip crown	63	51*

*P<0.001

For all dental records, the following information was collected: demographic data, information on patient medical history, the date of the dental rehabilitation, the types of procedures performed and information regarding restoration failures. Failure was defined as a restoration needing to be replaced due to structural breakdown (fracture or dislodgment of the restoration), pulpal or dentoalveolar infection associated with the

restored tooth or recurrent decay. For stainless steel crowns, perforation by wear-through was considered to be a failure with or without the need for replacement. Failure could have occurred any time between the date of the dental rehabilitation and the last documented return visit. Intact restorations without new caries at the time of follow-up were considered to be successful.

From recorded medical histories completed by parents, patients were grouped into one of two categories: as healthy or having a significant medical history. Patients were also grouped into one of two additional categories: as having a developmental disability or no developmental disability. Patients who were free of systemic disease were classified as healthy. Patients were considered to have a significant medical history if one or more of the following conditions was present: a classified developmental disability, asthma requiring chronic medication, bleeding disorders, cancer, cleft lip/palate, diabetes, endocrine disturbance, gastrointestinal/liver disease, heart disease requiring medication, HIV infection, kidney disease, seizure disorder, sickle cell disease or any syndrome. Patients were classified as having a developmental disability if one or more of the following

conditions was present: autism, cerebral palsy, emotional disability, learning disability or mental retardation. As such, developmental disability is a subcategory of significant medical history.

A subgroup of dental records was reviewed to examine the association between patient medical history and the failure rates of restorative procedures performed for patients in the full primary dentition. All patients in the subgroup returned for at least one follow-up appointment six months after their dental rehabilitations.

All of the data were recorded and evaluated using SAS JMP statistics program (SAS Institute, North Carolina), and t-tests were performed to compare the mean age of patients in the Boston and DC subgroups. The association between patient medical history and failure rates of restorative procedures was assessed using chi-square tests with corrections for continuity.

Results

A total of 504 patient records (231 from Boston, 273 from DC) were reviewed. From the entire group of patient records that were reviewed, 105 Boston records and 136 DC records satisfied the condition of patient follow-up of at least six months after rehabilitation. These comprised 45% of Boston records (N=231) and 50% of DC records (N=273). The mean age at the time of the dental rehabilitation was 43 months for the Boston patients with a range of 17 to 86 months. The mean age for the DC patients was 58 months, with a range of 23 to 274 months. There was no significant difference in the satisfaction of inclusionary criteria based upon service site.

A subgroup of patient records was then reviewed to examine the association between patient medical history and the failure rate of restorative procedure performed for patients in the full primary dentition.

Full primary dentition patients who returned for follow-up

Characteristics

One hundred Boston and 106 DC dental records formed the FPD subgroup. The patients within this subgroup were 66 months of age or younger at the time of their dental rehabilitation; 51% of the Boston subgroup and 59% of the DC subgroup were male (NS). The patient mean age was 41 months for the Boston subgroup and 44 months for the DC subgroup (NS).

Table 1 summarizes the medical conditions of Boston and DC subgroups. The percentage of patients who had significant medical histories and the percentage of patients who had developmental disabilities were similar at both sites.

Failure rates of restorative procedures

Table 2 presents the restorative procedures performed and their failure rates for the combined Boston and DC groups. Stainless steel crown restorations had the lowest failure rates. Compared to SSC failure rates, amalgam restoration failure rates were significantly higher ($p<0.001$, $\chi^2=57.31$), while the highest failure rates were found in the composite restorations ($p<0.001$, $\chi^2=81.92$) and composite strip crown restorations ($p<0.001$, $\chi^2=103.39$).

Restorative procedures failure by categories of medical history

Table 3 presents the failure rates of restorative procedures by categories of medical history. A slightly greater percentage of patients with significant medical histories had SSC failures compared with healthy patients (NS). However, while the failure rate of SSC restorations performed on patients without developmental disabilities was 7%, the SSC failure rate for patients with developmental disabilities was 16%. This difference in failure rates was statistically significant ($p < 0.025$, $\chi^2 = 5.50$).

Regarding amalgam and composite failures, no significant differences in incidence were found for patients with significant medical histories or developmental disabilities compared to patients without such conditions. Comparisons of differences in failure rates of Boston and DC patients by medical history for procedures performed were not found to be statistically significant.

Discussion

Since many of the patients who require dental rehabilitation under general anesthesia have significant medical histories including developmental disabilities, the influence of patient medical history on the failure rates of restorative procedures for primary teeth was examined. Similarities in medical history between the Boston and DC patients in the full primary dentition (FPD) allowed the subgroups to be consolidated for the purpose of evaluating for an association between patient medical history and restorative procedure outcomes.

This study found that among FPD patients, SSC restorations had significantly lower failure rates than amalgam and composite restorations. Other studies reporting on outcomes of procedures performed in the routine dental setting have supported the superior durability of SSC restorations.^{6,9-12} However, patients diagnosed with developmental disabilities had significantly higher SSC failure rates compared with patients without such disabilities.

SSC failures could usually be attributed to either occlusal crown perforation or crown loss as a result of cement wash out. SSC failures may also be due to failures of the associated pulpotomies. In this study, all teeth treated with a pulpotomy were restored with a SSC. The overall failure rate of pulpotomies was very low (only 1% overall out of 208 performed). Among patients with developmental disabilities, none of the 22 pulpotomies performed resulted in failure. As such, pulpotomy failure was not a contributing factor of SSC failures for patients with developmental disabilities. However, the failure rate of pulpotomies was likely under-reported in our study, since patients who required general anesthesia for dental rehabilitation were often uncooperative for intraoral radiographs during their follow-up appointments.

Roberts reported that the major reason for stainless steel crown failures was occlusal wear leading to perforation of the surface.¹² If crown perforation from occlusal wear is a significant

factor leading to crown failures in pediatric patients receiving treatment in the routine office setting, it should not be surprising that higher crown failure rates would be found in patients who are diagnosed with developmental disabilities. Children with cerebral palsy have been reported to have higher levels of tooth wear.¹³ Additionally, children with musculoskeletal problems or severe mental retardation commonly exhibit bruxism.¹⁴

Although patients with developmental disabilities were more likely to have SSC failures compared with patients without these disabilities, no increase in failure rates of amalgam or composite restorations in these patients was noted. However, SSC restorations were found to have a similar rate of failure compared to amalgam and a lower rate of failure compared to composite restorations for patients with developmental disabilities. Therefore, SSC restorations may be the treatment of choice for those patients who require general anesthesia. On the other hand, for patients with developmental disabilities who have less extensive caries, conservative amalgam or composite restorations may be appropriate where bruxism and malocclusion could negatively affect success.

In this study, composite strip crowns placed in FPD patients were found to have the highest failure rates. Relatively few strip crowns were actually performed compared to other restorative procedures. To minimize the possibility of procedure failure, providers likely used very selective patient criteria in deciding on the appropriateness of these restorations for each patient at the time of the dental rehabilitation. In fact, provider discretion was likely the reason that very few strip crowns were placed for patients with significant medical histories and none were placed for patients with developmental disabilities. Yet, despite the aggressive approaches used in high caries risk patients who were not only more likely to exhibit procedure failure rates, but were also more likely to require pharmacological management for additional treatment, more than half of the strip crowns failed.

Many patients who require general anesthesia have significant medical histories or developmental disabilities. Often these patients are on high caloric diets rich in fermentable carbohydrates that may result in an increased risk for caries development. Limitations in the ability to perform oral hygiene may also contribute to an increased caries risk. At the same time, patients with early childhood caries have a greater propensity for development of new and recurrent caries.³ The fact that SSC restorations have been shown to be more durable suggests that these restorations may be a more cost effective

Table 3. Full Primary Dentition Patients: Restorative Procedure Failure Rates by Categories of Medical History

Procedure	Significant medical HX*		Healthy		Developmental disability only		No developmental disability**	
	n	%	n	%	n	%	n	%
Amalgam	178	21	380	23	49	12	509	23
Stainless steel crown	286	9	492	7	71	16†	707	7†
Composite	83	21	249	32	26	23	306	30
Composite strip crown	26	54	37	46	1	0	62	50

*Category includes patients with developmental disabilities **Category includes patients with other significant medical histories as well as healthy patients; † $P < 0.05$; n = procedures

treatment choice for young children with gross caries and who require general anesthesia as an adjunct to treatment.^{6,9-12}

For patients with developmental disabilities, who are more likely to have SSC failures, SSCs are still indicated for teeth with gross decay. For teeth with limited caries present, other restorative materials may be acceptable alternatives. The development of and increasing availability of new and improved dental materials may be useful to reduce restoration failures for children with medical and developmental disabilities who require dental rehabilitation. At the same time, parents and caregivers need to be made aware of the greater risk of restorative failures in their children who have special needs. The dental professional should work with the caregiver of any child requiring dental rehabilitation to formulate an individualized maintenance protocol that could include a more frequent recall regimen.

Conclusions

1. Stainless steel crowns are the most reliable restorations for primary teeth in young patients treated under general anesthesia, while amalgam restorations are significantly less reliable. Composites and composite strip crowns are the least reliable restorations.
2. The failure rates of amalgam and composite restorations are comparable among patients with and without significant medical histories, including developmental disabilities.
3. SSC failures are more likely to be observed among patients with developmental disabilities, but not necessarily among patients with significant medical histories.
4. The failure rate of SSCs among patients with developmental disabilities is comparable to that observed in amalgam restorations.

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