Survival Rates of Full Coronal Restorations in Primary Maxillary Incisors

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Abstract

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Purpose: The purpose of this study was to compare the survival rates of zirconia crowns (ZC) with that of resin strip crowns (RSC) on primary maxillary incisors of children diagnosed with ECC with a minimum follow-up period of 12 months in a university pediatric dental clinic.

Methods: Inclusion/exclusion criteria included primary maxillary incisors that received a RSC or ZC in children (24 to 60 months of age) under general anesthesia (N=587). For this longitudinal study, data collection included demographics, baseline dmft, date of crown placement, age of patient at crown placement, tooth number(s) treated, tooth type, and restoration type. Variables collected at follow-up appointments included appointment dates, survival of crown or category of failure, and secondary treatments completed for restoration failures. Descriptive statistics were calculated for all variables while Kaplan-Meier survival curves were used to summarize success of each crown type. Unadjusted and adjusted hazard

ratios (HR) from Cox Proportional Hazard Regression with robust standard errors were used to compare survival rates for variables of interest ($P<0.05$).

Results: The overall survival rates for RSCs at 12-, 24-, and 36-months were 98 percent, 89 percent, and 81 percent, respectively. The overall survival rates for ZCs at 12-, 24-, and 36-months were 93 percent, 81 percent, and 72 percent, respectively. Both RSCs and ZCs placed on teeth in patients between 49 and 60 months of age were associated with higher survival probabilities than when placed in children of younger age groups.

Conclusion: Both RSCs and ZCs exhibited clinically acceptable survival rates at 12-, 24-, and 36-months post-treatment. Acceptable patient behavior and adequate isolation are important for long-term success of RSCs.

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DEDICATION

This project is dedicated to my parents, my wife, and my son. To my parents, thank you for your love, support, and encouragement throughout my educational and professional career. To my wife, Sarah, and my son, Ben, thank you for your love and support, and for all of the sacrifices you have made to take this incredible journey through residency in Seattle with me.

Chapter 1. INTRODUCTION

In young children, Early Childhood Caries (ECC) remains a highly prevalent disease with rapid progression causing advancing disease, pain, or infection and often requires prompt definitive treatment.[1,2] In severe stages of this disease, advanced behavior guidance techniques, such as sedation or general anesthesia (GA), are indicated due to the patient's stage of cognitive development and diminished cooperative ability. Specifically, GA provides optimal conditions for safe, efficient, and effective dental care by eliminating a patient's anxiety and response to pain and reducing any untoward movement or reaction during dental treatment.

Children with ECC have a high risk for developing new and recurrent caries, even after treatment under GA.[3] Because of this, an aggressive restorative approach, which includes full-coronal restoration of caries-affected primary teeth, is often indicated.[4] While stainless steel crowns (SSCs) have long been the gold standard in full-coronal restoration of primary molars with multi-surface lesions, aesthetic demands are being met with a variety of options in full-coronal restoration of primary anterior teeth, including resin strip crowns (RSCs) and pre-fabricated zirconia crowns (ZCs).

RSCs have been utilized for restoration of primary teeth since the mid-1980s, and, as recently as 2010, were reported to be the first choice among a majority of pediatric dentists for full-coronal restoration of primary maxillary incisors.[5] They are favored for their excellent aesthetics and their reparability. Additionally, the availability of multiple sizes of crown forms and shades of composite makes RSCs a good restorative for cases with anterior crowding. Despite these clear advantages, placement of RSCs is extremely technique-sensitive. Preparation for RSCs must remove enough tooth structure for adequate material thickness while leaving sufficient structure for bonding and retention of the crown. In addition, restoration placement

requires a clean, dry field. Moisture and hemorrhage contamination can affect bonding or have an adverse impact on aesthetics. Previous studies have shown 2- to 3-year survival rates of approximately 80 percent for RSCs, though retention rates have been proven to be lower for children with high caries risk.[6]

Zirconia has been successfully used for single unit crowns in adult dentistry for over a decade, favored over porcelain-fused-to-metal for its material strength and more natural-looking appearance.[7] Shortly after its introduction to adult dentistry, its clinical benefits were applied to pediatric dentistry, when the first commercially available ZC for primary teeth was introduced in 2010. ZCs have been gaining popularity among pediatric dentists ever since. They over excellent aesthetics, and due to their favorable mechanical characteristics, ZCs fracture less than RSCs. Like pre-veneered SSCs, ZCs are adhered to teeth with a luting cement, and depending on the cement used, are more tolerant to moisture contaminated environments and less technique-sensitive than RSCs.[8] The aggressive preparation and passive fit required compared to RSC placement, though, and the inability to crimp ZCs for tight marginal adaptation might have adverse effects on their clinical success. Additionally, few longitudinal studies have been done to assess the extent of attrition to primary teeth opposing ZCs.

While past studies have shown that both RSC and ZC crown types are clinically acceptable and have high parental satisfaction ratings, to our knowledge, only one prospective study (six-month follow-up) comparing aesthetic full-coronal restorations on primary maxillary incisors has been published.[9] The purpose of this study is was to compare the survival rates of ZCs with that of RSCs on primary maxillary incisors of children diagnosed with ECC, with a minimum follow-up period of 12 months in a university pediatric dental clinic.

Chapter 2. METHODS

2.1 STUDY POPULATION

This project was approved by the University of Washington Human Subjects Review Board (STUDY00001516). Children between the ages of 24- and 60-months who were treated under GA at the University of Washington Center for Pediatric Dentistry (UWCPD) in Seattle, Washington, USA between 2012 and 2015 were included in this longitudinal study. The initial database consisted of 1115 electronic dental records of active and inactivated patients from the UWCPD. Eligibility for this study included children a) with at least one full-coronal restoration placed on a previously-unrestored primary maxillary incisor, and b) with at least 12 months of follow-up after dental treatment under GA. One hundred and eighty-eight subjects satisfied the inclusion and exclusion criteria (Figure 1: Flowchart of Data Collection).

2.2 INTERVENTION

All treatment was completed either by a pediatric dental attending faculty member or a pediatric dental resident under the supervision of a calibrated pediatric dental attending faculty member. Under GA, all crowns were placed following manufacturers' instructions. Briefly, for RSCs, after crown preparation and caries excavation, strip crown forms (Nowak Dental Supplies; Success Essentials Space Maintainers Laboratory) were fitted under rubber dam isolation. A gel-etching agent (3M ESPE Scotchbond Universal) and resin-based composite restorative material (3M ESPE Filtek Supreme Ultra) were used according to manufacturer's instructions. For ZCs, briefly, teeth were prepared according to manufacturer's instructions, removing all caries. A ZC

(NuSmile Zirconia; EZ-Pedo) was fitted and cemented using a resin luting cement (NuSmile BioCem; 3M ESPE RelyX Luting Plus).

2.3 DATA COLLECTION

For this study, initial crown placement was defined as the date of treatment under GA as recorded in the patient's electronic dental record. We followed each primary maxillary incisor receiving either a RSC or ZC through restoration failure, survival of the restoration through the patient's most recent follow-up appointment, or natural exfoliation of the restored tooth. Because our university pediatric dental clinic is a referral site for the community, selected subjects were required to have 12 months of follow-up appointments at the UWCPD in order to minimize selection bias by including patients whose treatment under GA was at the UWCPD and whose follow-up appointments were at another dental clinic in the community. Five hundred and seventy-eight primary maxillary incisors treated with full-coronal restorations in a total of 188 patients who reported for a minimum follow-up period of 12 months were included in this study.

2.4 DEMOGRAPHIC VARIABLES

The following demographic variables were extracted from the patient electronic dental records: child's date of birth, gender, and insurance status. Age was calculated as the date of initial crown placement minus the child's date of birth and categorized as follows: a) 24-36 months, b) 37-48 months, and c) 49-60 months. Insurance status was categorized as a) Medicaid, b) Private Insurance and Self-Pay, or c) Not specified.

2.5 DENTAL VARIABLES

The following dental variables were extracted from the patient dental electronic records: number of decayed, missing, or filled teeth in the primary dentition (dmft) at initial crown placement; date of initial crown placement; tooth number treated with crown (#D, #E, #F, and/or #G); type of tooth treated with crown (central incisor or lateral incisor); the number of, and dates of follow-up appointments at the UWCPD. Initial dmft was categorized into four groups: a) 1-4, b) 5-8, c) 9-12, and d) 13 or more.

2.6 DEFINITIONS OF DENTAL PROCEDURES AT FOLLOW-UP

The type and date of full-coronal restoration treatment outcomes were recorded at each follow-up appointment. Related variables were categorized as follows:

2.6.1 *Extraction*

The dental record indicated that the treated tooth was extracted, due to either clinical evidence of apical periodontitis or traumatic dental injury. The date of the extraction was recorded as indicated in the patient chart.

2.6.2 *Treated Tooth Remains with Complete Loss of Crown*

The dental record indicated that the patient presented to the follow-up appointment with a complete loss of the crown on the treated tooth. The date of the follow-up appointment was recorded as indicated in the patient chart.

2.6.3 *Treated Tooth Remains with Significant Material Loss*

The dental record indicated that a portion of the crown remained on the treated tooth, but that significant crown material had been lost, and a secondary procedure would be needed to repair to replace the crown prior to the tooth's natural exfoliation.

2.6.4 *Treated Tooth Remains with Crown Intact*

The dental record indicated that the treated tooth remained with the crown intact or with minimal material loss and still serviceable.

2.6.5 *Treated Tooth Exfoliated Naturally*

The dental record indicated that the treated tooth had exfoliated naturally since the previously scheduled appointment. The date of the most recent follow-up appointment prior to exfoliation was recorded as the date of last follow-up.

2.7 DEFINITION OF TREATMENT SUCCESS

In order to assess the effectiveness of each crown type, we defined success as primary maxillary incisors treated with RSCs or ZCs that did not require a secondary procedure through preservation of the treated tooth to the last follow-up appointment or through natural exfoliation of the treated tooth.

2.8 DEFINITION OF TREATMENT FAILURE

Because the goal of full-coronal restoration of a primary maxillary incisor is to remove all caries and restore the tooth's original form and function for preservation through natural exfoliation, we

defined failure as any secondary procedure of a treated tooth prior to natural exfoliation. Specifically, secondary procedures were defined as replacement of a RSC or ZC after complete loss of crown, crown repair or replacement after significant material loss or recurrent caries, or extraction of the treated tooth due to evidence of apical periodontitis or trauma prior to natural exfoliation.

2.9 DATA ANALYSIS

Data were captured using REDCap Software Version 7.2.2 (Vanderbilt University) and then imported into Stata 14.0 (College Station, Texas) for analysis. Descriptive statistics were calculated for all variables. Kaplan-Meier curves were calculated for overall treatment success and to determine the survival rate for overall treatment success and to determine the survival rate for each variable. Unadjusted and adjusted Hazard Ratios (HR) from Cox Proportional Hazard Regression with robust standard errors were used to compare the survival rates for variables of interest. Adjustments were made for age of patient at the date of crown placement, the gender of the patient, the patient's insurance status, initial dmft score, and the tooth type treated with the crown. An adjustment was made for multiple teeth restored within a single patient using a Generalized Estimating Equations model to correlate a single patient's teeth. The significance level was established at 5 percent.

Chapter 3. RESULTS

3.1 DESCRIPTIVE STATISTICS

A total of 578 primary maxillary incisors in 188 patients were included in this study. Patients treated ranged in age from 24 months to 59 months, with an average age of 42.1 months.

Medicaid was the most commonly billed insurance (76%) for patients included in this study. A small majority of the incisors treated were in female patients (53%), and nearly half of the teeth (46%) were in patients with an initial dmft score of 13 or greater. Fifty-five percent of the teeth treated were central incisors, while 45 percent were lateral incisors. A vast majority of the incisors were treated with RSCs (84%), while only 16 percent were treated with ZCs.

The earliest recording of crown placement was in January 2012 and the last in November 2015. For the study population, the length of follow-up period ranged from 12 months to 53 months, with an average period of 28 months. The number of follow-up appointments ranged from one to 17, with an average number of 4.8 follow-up appointments per patient (Table 1).

3.2 SURVIVAL ANALYSIS

The overall survival rates for RSCs at 12-, 24-, and 36-months were 98 percent, 89 percent, and 81 percent, respectively. The overall survival rates for ZCs at 12-, 24-, and 36-months were 93 percent, 81 percent, and 72 percent, respectively (Table 2). Associations between demographic and dental variables are summarized in Tables 3a, 3b, and 3c. Age at the time of crown placement was found to be associated with tooth survival; specifically, between the ages of 49 and 60 months ($p=0.01$). Kaplan-Meier survival estimates are shown in Figure 2 and Table 2.

3.3 FAILURE ANALYSIS

The most frequent cause of failure in RSCs was reported as complete loss of crown (31%), followed by trauma (20%) and apical periodontitis (20%). In ZCs, the most frequent cause of failure was reported as apical periodontitis (48%), followed by complete loss of crown (26%) and trauma (22%). ZCs sustained no failures due to recurrent caries or partial crown fracture,

while partial crown fractures accounted for 15 percent and recurrent caries accounted for 14 percent of RSC failures.

Chapter 4. DISCUSSION

Our study demonstrated lower survival rates for ZCs at 12 months (93%), 24 months (81%), and 36 months (72%) compared to survival rates of RSCs over the same follow-up periods (98%, 89%, and 81%, respectively). This differs from the results observed in a previous survival analysis comparing ZCs to RSCs, which showed retention of ZCs (100%) to be superior to retention of RSCs (71%) after a six-month follow-up.[9] We attribute this difference to the behavior management techniques used in each study. In Walia's study, RSCs were placed using only behavior management techniques and physical restraints, which resulted in uncooperative patient behaviors and inability to maintain a non-contaminated field during crown placement. In our study, RSCs were placed under rubber dam isolation in patients under GA, which resulted in a higher survival rate at 36-months than observed in Walia's study at 6-months. This finding supports the technique-sensitivity of RSC placement and demonstrates that RSC survival is directly related to the behavior of the child and the isolation achieved during crown placement. Survival rates for ZCs in our study are consistent with one previous study that assessed 12- and 24-month follow-up of severely decayed primary maxillary incisors treated with glass ionomer posts and ZCs.[10] No other published studies were identified that assessed the survival rate of ZCs in primary anterior teeth.

Interestingly, apical periodontitis accounted for nearly half (48%) of the reported ZC failures, while it accounted for only 20 percent of RSC failures. One plausible explanation for this may be a pulpal response to the aggressive preparation required for ZC restoration compared

to the relatively minimal preparation required for RSC restoration. Clark's in vitro study found that preparation of anterior incisors for ZCs required removal of over twice as much tooth structure as anterior SSC preparation, suggesting that there was a greater potential for mechanical pulpal exposure in ZC preparation than in a more conservative preparation.[11] Additionally, previous studies have reported pulpal necrosis of 15 to 25 percent of permanent teeth prepared for full-coverage crowns, attributing the response to thermal injury in absence of adequate water spray, excessive pressure applied to the dentin, or mechanical damage to odontoblasts in preparation of dentin approximating the pulp chamber.[12] No equivalent published studies of primary teeth were identified.

Lastly, our study included 48 teeth that were treated with either a pulpotomy or pulpectomy prior to restoration with a crown. Forty-five teeth were treated with RSCs, and three were treated with ZCs. Of the 45 teeth to receive pulpal treatment and RSCs, 21 (46%) resulted in failure. Only five of these teeth (24%), all treated with pulpectomies, were classified as failure due to clinical or radiographic presentation of apical periodontitis in a follow-up appointment. This is consistent with failure rates of pulpectomies of anterior primary teeth treated under general anesthesia observed in Amin's retrospective cohort study.[13] No pulpally-treated teeth restored with ZCs in our study resulted in failure. While our sample size was small, one plausible explanation is that aggressive ZC preparation resulting in mechanical exposure and treated with pulpectomy may be less prone to secondary inflammatory response than carious exposure and treated with pulpectomy. No studies were identified to support this hypothesis.

There were several limitations in the present study. All treatment was completed in a university pediatric dental clinic, and care was administered by diverse providers. While crown placement procedures were calibrated, follow-up appointments were uncalibrated and completed

by either pediatric dental residents or dental students overseen by pediatric dental residents and attending faculty. Chart notes from follow-up appointments were inconsistent, and radiographs were infrequently available. For this reason, radiographs were only used to estimate the date of natural exfoliation when it was not clearly registered in the patient's dental chart. Additionally, p-values calculated for overall treatment success could not be adjusted for multiple teeth within a single patient, so these values may contain bias.

Chapter 5. CONCLUSION

Survival rates of primary maxillary incisors restored with RSCs or ZCs were compared in this longitudinal study. Both RSCs and ZCs exhibited clinically acceptable survival rates at 12-, 24-, and 36-months post-treatment. Predictably, crowns placed on teeth in patients between 49 and 60 months of age had higher survival probability than crowns placed in children of younger age groups.

5.1 CONFLICT OF INTEREST

The authors have no conflicts of interest.

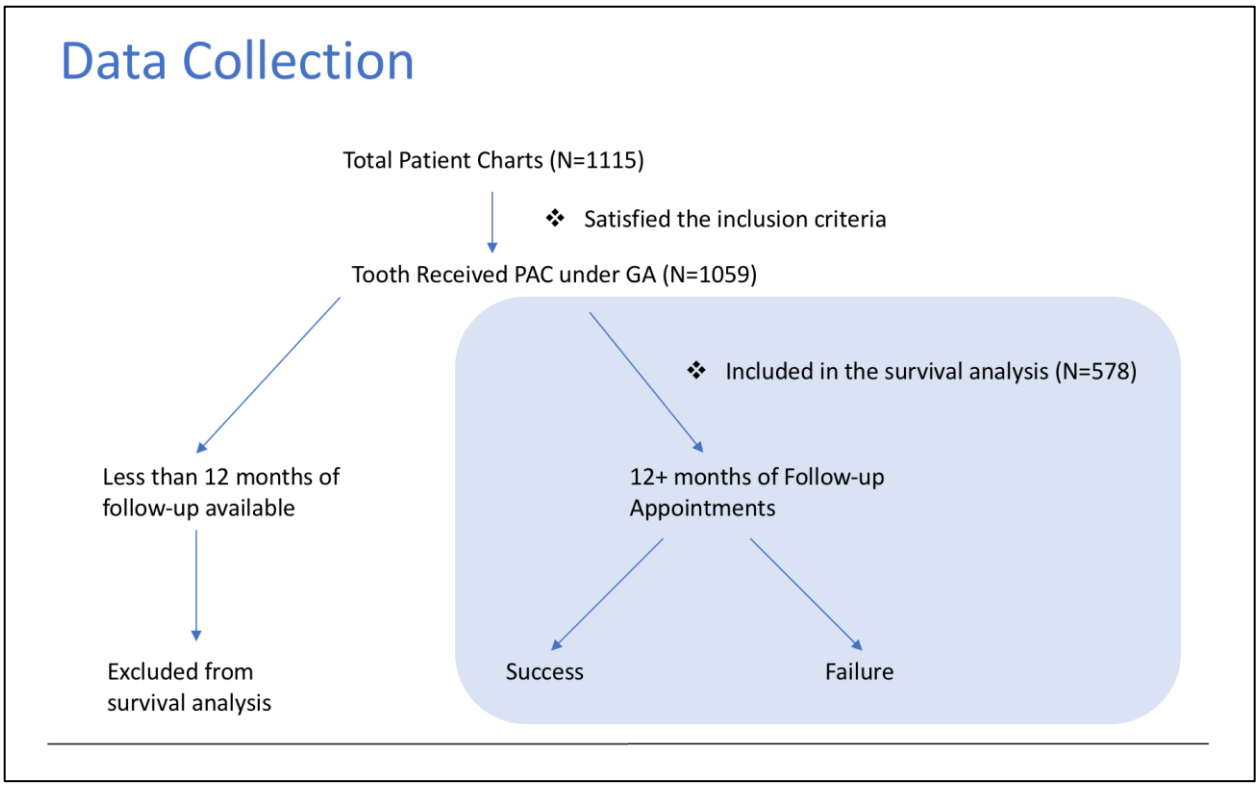

Figure 1: Flowchart of Data Collection

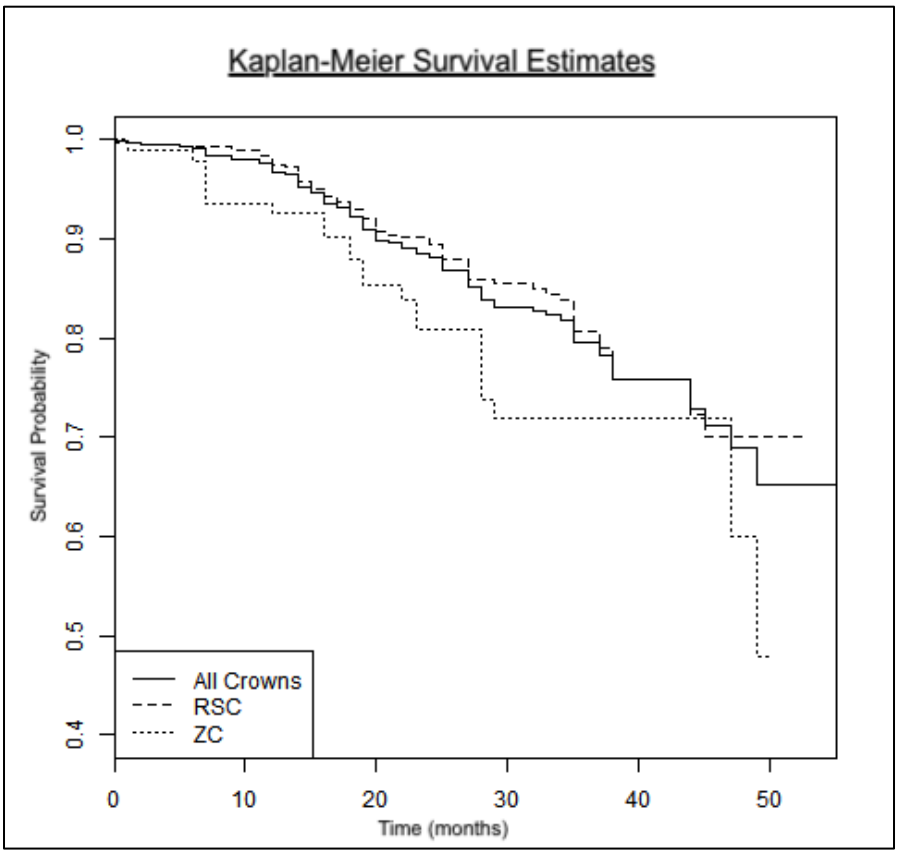

Figure 2: Kaplan-Meier Curves by Crown Type

Table 1	DEMOGRAPHIC AND DENTAL VARIABLES OF PRIMARY ANTERIOR CROWNS (PAC) OF THE TREATED STUDY POPULATION			
	PAC Type			
	RSC (N=484)	ZC (N=94)	Total (N=578)	Overall Robust Wald p-value
Age at PAC Placement				
24-36 months	178 (37%)	28 (30%)	206 (36%)	0.91
37-48 months	170 (35%)	50 (53%)	220 (38%)	
49-60 months	136 (28%)	16 (17%)	152 (26%)	
Gender				
Male	225 (46%)	49 (52%)	274 (47%)	0.89
Female	259 (54%)	45 (48%)	304 (53%)	
Insurance Status				
Medicaid	365 (75%)	72 (77%)	437 (76%)	0.99
Self-Pay and PPO[a]	113 (23%)	22 (23%)	135 (23%)	
Missing	6 (1%)	0 (0%)	6 (1%)	
dmft at PAC Placement				
1-4	7 (1%)	0 (0%)	7 (1%)	0.96[b]
5-8	82 (17%)	17 (18%)	99 (17%)	
9-12	165 (34%)	43 (46%)	208 (36%)	
13+	230 (48%)	34 (36%)	264 (46%)	
Tooth Location of PAC				
Central Incisor	268 (55%)	52 (55%)	320 (55%)	> 0.99
Lateral Incisor	216 (45%)	42 (45%)	258 (45%)	

[a] Self Pay and PPO insurances grouped together due to small number of individual groups

[b] 1-4 dmft at PAC Placement category omitted from p-value calculation due to small sample size

Table 2	KAPLAN-MEIER SURVIVAL ESTIMATES FOR PACs AT 12-, 24-, AND 36-MONTHS POST-TREATMENT			
	RSC	**ZC**	**All Crowns**	**log-rank p-value**
Survival Period				
12 Months	98%	93%	97%	0.010
24 Months	89%	81%	88%	0.015
Months	81%	72%	79%	0.059

Table 3a	UNADJUSTED AND ADJUSTED HAZARD RATIOS (HR) FROM COX PROPORTIONAL HAZARD REGRESSION WITH ROBUST STANDARD ERRORS FOR ALL PRIMARY ANTERIOR CROWN TYPES (PACs)					
	Unadjusted Model			Adjusted Model*		
	HR	95% CI	p-value	HR	95% CI	p-value
Age at PAC Placement						
24-36 months	ref			ref		
37-48 months	0.99	(0.56, 1.77)	0.98	0.84	(0.45, 1.58)	0.59
49-60 months	0.4	(0.18, 0.91)	0.03	0.33	(0.14, 0.79)	0.01
Gender						
Male	ref			ref		
Female	1.13	(0.66, 1.92)	0.65	1.1	(0.64, 1.89)	0.72
Insurance Status						
Medicaid	ref			ref		
Self-Pay and PPO	1.28	(0.69, 2.36)	0.44	1.27	(0.68, 2.37)	0.46
dmft at PAC Placement						
1-4	ref			ref		
5-8	0.58	(0.08, 4.27)	0.59	0.66	(0.08, 5.48)	0.7
9-12	0.52	(0.07, 3.78)	0.52	0.67	(0.08, 5.51)	0.71
13+	0.67	(0.09, 4.84)	0.69	1.01	(0.13, 7.78)	0.99
Tooth Location of PAC						
Central Incisor	ref			ref		
Lateral Incisor	0.95	(0.62, 1.46)	0.83	0.92	(0.60, 1.42)	0.72

Table 3b	UNADJUSTED AND ADJUSTED HAZARD RATIOS (HR) FROM COX PROPORTIONAL HAZARD REGRESSION WITH ROBUST STANDARD ERRORS FOR RESIN STRIP CROWNS (RSCs)					
	Unadjusted Model			Adjusted Model*		
	HR	95% CI	p-value	HR	95% CI	p-value
Age at RSC Placement						
24-36 months	ref			ref		
37-48 months	0.63	(0.30, 1.32)	0.22	0.49	(0.23, 1.06)	0.07
49-60 months	0.44	(0.20, 0.99)	0.046	0.34	(0.15, 0.80)	0.01
Gender						
Male	ref			ref		
Female	0.85	(0.48, 1.53)	0.59	0.83	(0.47, 1.47)	0.52
Insurance Status						
Medicaid	ref			ref		
Self-Pay and PPO	1.29	(0.64, 2.60)	0.48	1.3	(0.65, 2.60)	0.46
dmft at RSC Placement						
1-4	ref			ref		
5-8	0.64	(0.08, 5.07)	0.67	0.46	(0.07, 3.08)	0.42
9-12	0.46	(0.06, 3.63)	0.46	0.42	(0.07, 2.67)	0.36
13+	0.63	(0.08, 4.90)	0.66	0.75	(0.13, 4.53)	0.76
Tooth Location of RSC						
Central Incisor	ref			ref		
Lateral Incisor	0.96	(0.57, 1.61)	0.87	0.92	(0.54, 1.56)	0.76

Table 3c	UNADJUSTED AND ADJUSTED HAZARD RATIOS (HR) FROM COX PROPORTIONAL HAZARD REGRESSION WITH ROBUST STANDARD ERRORS FOR ZIRCONIA CROWNS (ZCs)					
	Unadjusted Model			Adjusted Model*		
	HR	95% CI	p-value	HR	95% CI	p-value
Age at ZC Placement						
24-36 months	ref			ref		
37-60 months[a]	2.26	(0.46, 10.96)	0.31	2.66	(0.65, 10.96)	0.17
Gender						
Male	ref			ref		
Female	3.2	(0.91, 11.29)	0.07	4.84	(1.22, 19.21)	0.02
Insurance Status						
Medicaid	ref			ref		
Self-Pay and PPO	1.17	(0.38, 3.58)	0.78	0.94	(0.30, 2.94)	0.92
dmft at ZC Placement						
1-8[b]	ref			ref		
9-12	2.21	(0.42, 11.69)	0.35	3.79	(0.68, 20.99)	0.13
13+	2.92	(0.59, 14.53)	0.19	2.92	(0.62, 13.68)	0.17
Tooth Location of ZC						
Central Incisor	ref			ref		
Lateral Incisor	0.97	(0.51, 1.87)	0.94	0.83	(0.41, 1.69)	0.61

[a] Age at ZC placement groups 37-48 and 49-60 were combined due to small size of individual groups

[b] dmft groups 1-4 and 5-8 were combined due to small size of individual groups

Table 4	DEMOGRAPHIC AND DENTAL VARIABLES OF FAILED PRIMARY ANTERIOR CROWNS (PAC) IN THE STUDY POPULATION			
	PAC Failures			
	RSC (N=71)	ZC (N=23)	Total (N=94)	Overall Robust Wald p-value
Length of Follow-up				
12-23 months	16 (23%)	12 (52%)	28 (30%)	0.98
24-35 months	27 (38%)	2 (9%)	29 (31%)	
36+ months	28 (39%)	9 (39%)	37 (39%)	
Number of Months between Placement and Failure				
0-12 months	12 (17%)	7 (30.5%)	19 (20%)	0.97
13-24 months	31 (44%)	9 (39%)	40 (43%)	
25-36 months	28 (39%)	7 (30.5%)	35 (37%)	
Failure by Gender				
Male	35 (49%)	6 (26%)	41 (44%)	0.89
Female	36 (51%)	17 (74%)	53 (56%)	
Failure by Age of Patient at Crown Placement				
24-36 months	42 (59%)	5 (22%)	47 (50%)	0.90[b]
37-48 months	19 (27%)	18 (78%)	37 (39%)	
49-60 months	10 (14%)	0 (0%)	10 (11%)	
Failure by Initial dmft				
1-4	2 (3%)	0 (0%)	2 (2%)	0.99[c]
5-8	17 (24%)	2 (9%)	19 (20%)	
9-12	21 (29%)	9 (39%)	30 (32%)	
13+	31 (44%)	12 (52%)	43 (46%)	
Failure by Insurance Type				
Medicaid	53 (75%)	17 (74%)	70 (74%)	> 0.99
Self-Pay and PPO[a]	18 (25%)	6 (26%)	24 (26%)	

Failure by Type				
Apical Periodontitis	14 (20%)	11 (48%)	25 (26%)	0.99[d]
Complete Loss of Crown	22 (31%)	6 (26%)	28 (30%)	
Recurrent Caries	10 (14%)	0 (0%)	10 (11%)	
Partial Crown Fracture	11 (15%)	0 (0%)	11 (12%)	
Trauma	14 (20%)	5 (22%)	19 (20%)	
Missing	0 (0%)	1 (4%)	1 (1%)	
Tooth Location of PAC				
Central Incisor	39 (55%)	13 (57%)	52 (55%)	0.97
Lateral Incisor	32 (45%)	10 (43%)	42 (45%)	
Failure by Pulp Treatment				
No pulp treatment	50 (70%)	23 (100%)	73 (78%)	N/A[e]
Pulpotomy	2 (3%)	0 (0%)	2 (2%)	
Pulpectomy	19 (27%)	0 (0%)	19 (20%)	

[a] Self Pay and PPO insurances grouped together due to small number of individual groups

[b] Age group 49-60 months omitted from p-value calculation

[c] Initial dmft group 1-4 omitted from p-value calculation

[d] Failure Type groups Recurrent Caries and Significant Loss of Material omitted from p-value calculation

[e] p-value could not be calculated

BIBLIOGRAPHY

[1] Waggoner WF. Restoring primary anterior teeth: updated for 2014. Pediatric Dentistry 2015; 37: 163-170.

[2] American Academy of Pediatric Dentistry. Behavior guidance for the pediatric dental patient. Pediatric Dentistry 2017; 39: 246-259.

[3] Almeida AG, Roseman M, Sheff M, Huntington N, Hughes CV. Future caries susceptibility in children with early childhood caries following treatment under general anesthesia. Pediatric Dentistry 2000; 22: 302-306.

[4] Tate AR, Hg MW, Needleman H, Acs G. Failure rates of restorative procedures following dental rehabilitation under general anesthesia. Pediatric Dentistry 2002; 24: 69-71.

[5] Oueis H, Atwan S, Pajitas B, Casamassimo PS. Use of anterior veneered stainless steel crowns by pediatric dentists. Pediatric Dentistry 2010; 32: 413-416.

[6] Ram D, Fuks AB. Clinical performance of resin-bonded composite strip crowns in primary incisors: a retrospective study. International Journal of Pediatric Dentistry 2006; 16: 49-54.

[7] Zarone F, Russo S, Sorrentino R. From porcelain-fused-to-metal to zirconia: clinical and experimental considerations. Dental Materials 2010; 27: 83-96.

[8] Holsinger DM, Wells MH, Scarbecz M, Donaldson M. Clinical evaluation and parental satisfaction with pediatric zirconia anterior crowns. Pediatric Dentistry 2016; 38: 192-197.

[9] Walia T, Salami AA, Bashiri R, Hamoodi OM, Rashid F. A randomised controlled trial of three aesthetic full-coronal restorations in primary maxillary teeth. European Journal of Paediatric Dentistry 2014; 15: 113-118.

[10] Shahawy O, O'Connell AC. Successful restoration of severely mutilated primary incisors using a novel method to retain zirconia crowns – two year results. Journal of Clinical Pediatric Dentistry 2016; 40: 425-430.

[11] Clark L, Wells MH, Harris EF, Lou J. Comparison of amount of primary tooth reduction required for anterior and posterior zirconia and stainless steel crowns. Pediatric Dentistry 2016; 38: 42-46.

[12] Sukapattee M, Wanachantararak S, Sirimaharaj V, Vongsavan N, Matthews B. Effect of full crown preparation on pulpal blood flow in man. Archives of Oral Biology 2016; 70: 111-116.

[13] Amin M, Nouri M, Hulland S, El Salhy M, Azarpazhooh A. Success rates of treatments provided for early childhood caries under general anesthesia: a retrospective cohort study. Pediatric Dentistry 2016; 38: 317-324.