RANDOMIZED CONTROL TRIAL

Clinical Comparison of Three Esthetic Full-Coverage Restorations in Primary Maxillary Incisors at 12 Months

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Abstract: ***Purpose:*** *The purpose of this study was to compare the 12-month clinical outcomes of primary maxillary incisors restored with composite strip crowns (CSCs), NuSmile preveneered stainless steel crowns (PVSSCs), and NuSmile zirconia crowns (ZCs).* ***Methods:*** *A total of 135 teeth in 49 two- to four-year-olds with early childhood caries were randomly assigned to crown groups. Demographic and tooth-related variables at baseline and 12 months were assessed by calibrated examiners. Fisher's exact or chi-square tests were used to test associations (P<0.05). Parental satisfaction of crown esthetics was evaluated by questionnaire.* ***Results:*** *Children were, on average, 3.4 years old, female (55 percent), and had a mean decayed, missing, and filled primary teeth (dmft) index score of 10.6. At 12 months, crown retention was significantly lower for CSCs versus PVSSCs or ZCs (79 percent, 100 percent, and 95 percent, respectively; P=0.002). Partial and complete loss of material was significantly higher in CSCs than PVSSCs or ZCs (29 percent, 11 percent, and zero percent, respectively; P<0.001). CSCs presented with increased marginal discrepancies and color change (P<0.001). Most parents were very satisfied (87 percent); those dissatisfied were concerned with the color of CSCs and PVSSCs (63 percent versus 37 percent; P=0.005).* ***Conclusions:*** *Composite strip crowns showed significantly reduced clinical success in retention, durability, marginal adaptation, and color compared to preveneered stainless steel crowns or zirconia crowns. Parental esthetic satisfaction was highest for NuSmile ZCs.* *(Pediatr Dent 2020;42(5):367-72) Received February 28, 2020 | Last Revision July 9, 2020 | Accepted July 16, 2020*

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Early childhood caries (**ECC**) is highly prevalent in 18- to 36-month-old children, who tend to be uncooperative for restorative treatment due to their lack of cognitive skills.[1,2] For this age group, definitive treatment is most typically achieved via stabilization, sedation, or general anesthesia, and clinical failure could pose a problem for replacement.[3] Increased public awareness of esthetics has resulted in greater parental requests for tooth-colored restorations.[4] There are many full-coverage tooth-colored restorative options for primary incisors, each with strengths and weaknesses.

Composite strip crowns (**CSCs**) have long been favored as an esthetic option for restoring primary incisors, with the benefits of multiple shade selections, ability to fit in crowded dentitions, and ease of repair.[2] Despite widespread use, CSCs are technique sensitive and have difficulty controlling for hemorrhage and saliva.[5] Preveneered stainless steel crowns (**PVSSCs**) are bonded with composite or thermoplastic resin on the roughened or meshwork facial surfaces. Compared to CSCs, PVSSCs are less sensitive to hemorrhage or saliva affecting the resistance, retention, or color of the crown, and less chair time is needed.[6,7] Difficulties include greater tooth reduction, compromised ability to fit in crowded dentitions, and fracture of the inflexible resin veneer.[7-9] Zirconia crowns (**ZCs**) have proven to be successful in adult dentistry for many years, as measured by durability, strength, bio-compatibility, and color stability.[10] These crowns are made of high-grade monolithic zirconia ceramic and require nearly twice the force to fracture compared with PVSSCs.[10,11] Zirconia crowns have recently been shown to be clinically acceptable at 36 months follow-up in 24- to 60-month-olds.[12] Benefits include excellent esthetics and no components that could fracture or debond from the crown.[13] Difficulties include preparing the tooth to fit the crown (due to an inability to crimp the crown margins for mechanical retention)[2] and compromised ability to fit in crowded dentitions.[14] There is insufficient controlled, long-term prospective clinical data to suggest an ideal anterior restorative material.[2] One recent randomized controlled trial compared CSCs, PVSSCs and ZCs placed with basic behavior guidance and physical restraint.[15] ZCs were found to have better esthetics, retention, and gingival health at six months follow-up.[15]

The purpose of this randomized controlled trial was to compare the 12-month clinical outcomes and parental satisfaction of composite strip crowns, preveneered stainless steel crowns, and zirconia crowns for carious primary maxillary incisors in healthy children with early childhood caries who received treatment under general anesthesia.

Methods

Study design. The Human Subjects Review Board, University of Washington, Seattle, Wash., USA (STUDY-00003980) approved this single-center, single-blinded, randomized controlled clinical trial. Clinical outcomes and parental satisfaction

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at 12 months were evaluated. The design of this study followed the guidelines published by the Consolidated Standards of Reporting Trials (CONSORT). Before enrollment, all study procedures were explained to every child's parent or guardian and written consent was obtained.

Sample selection. Patients were recruited from a university pediatric dental clinic between 2015 and 2017. The criteria utilized for inclusion were healthy patients (ASA I) no older than five years old in need of at least one preformed crown on the anterior primary teeth and undergoing general anesthesia for dental treatment. The criteria for exclusion were medically compromising conditions, teeth with anterior crowding, teeth with loss of more than one-half the clinical crown following tooth preparation, teeth expected to exfoliate or be extracted within one year, and class III occlusion. Ninety-seven children (299 teeth) were assessed for eligibility, and 76 children (220 teeth) fulfilled the aforementioned criteria, as shown in Figure 1. The most frequent reasons for exclusion were extensive caries warranting extraction or teeth near exfoliation.

Study procedures: randomization and sample power calculation. All teeth in a single patient were randomly allocated to receive one type of restoration: CSCs (Space Maintainers Laboratory, Chatsworth, Calif., USA); PVSSCs (NuSmile Signature Crowns, NuSmile, Houston, Texas, USA); and ZCs (NuSmile ZR Crowns, NuSmile). The randomization sequence was created using Stata 12.0 software (StataCorp, College Station, Texas) using random block sizes, which were known only to the study statistician. A post hoc sample power calculation was completed using R-project statistical software (version 3.6.1.). The power of the sample of 135 teeth, with an observed difference of retention rates for two of the groups (0.69 vs. 0.95), was 0.89, with an alpha of 0.05.

Study procedures: calibration. Four pediatric dentists were calibrated on tooth preparation and crown placement of PVSSCs and ZCs via online training as well as hands-on training with extracted or typodont teeth and in vivo cases completed under general anesthesia. Initial calibration for PVSSCs and ZCs was led by a pediatric dentist supplied by NuSmile who trained all four operators. Pictures were taken of all tooth preparations and immediately following crown cementation, of which a minimum was reviewed by the clinical research lead (to ensure that each operator maintained calibration for the course of the study). The four experienced clinicians performed CSC preparation and placement according to the standard of care at the university pediatric dental clinic, and calibration was led by the same clinical research lead.

Study procedures: operative procedures. Comprehensive examinations (including radiographs) were performed, followed by the placement of a rubber dam. Hemorrhage was controlled via rubber dam, cotton pressure, and local anesthetic where necessary. Briefly, for CSCs, a feather-edge margin was created supragingivally or at the gingival level. A gel etching agent (Ultra-Etch, Ultradent Products, South Jordon, Utah USA) was applied for 15 seconds and rinsed off followed by the application of a bonding agent (Scotchbond Universal, 3M ESPE, St. Paul, Minn., USA), according to manufacturer's directions. The celluloid crowns were filled with the appropriate shade of composite (Filtek Supreme, 3M) and seated with gentle, even, pressure, allowing excess to exit freely. Composite finishing burs or abrasive discs were used to adjust and polish both the crown and margin.

For NuSmile PVSSCs and ZCs, a feather-edge margin was created approximately one to two mm subgingivally. Occlusal

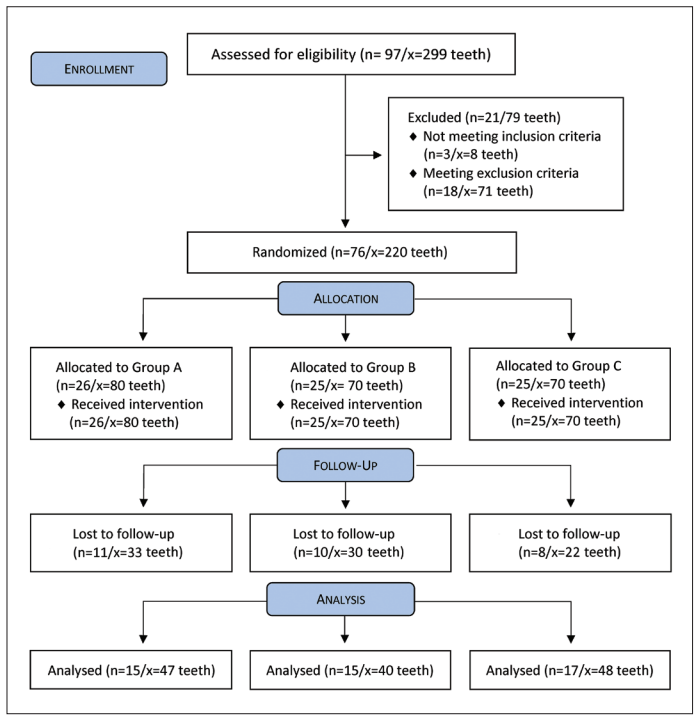

Figure 1. Flow diagram of available, eligible, and randomized children, including reasons for loss of follow-up (Group A equals preveneered stainless steel crowns, Group B equals zirconia crowns, Group C equals composite strip crowns).

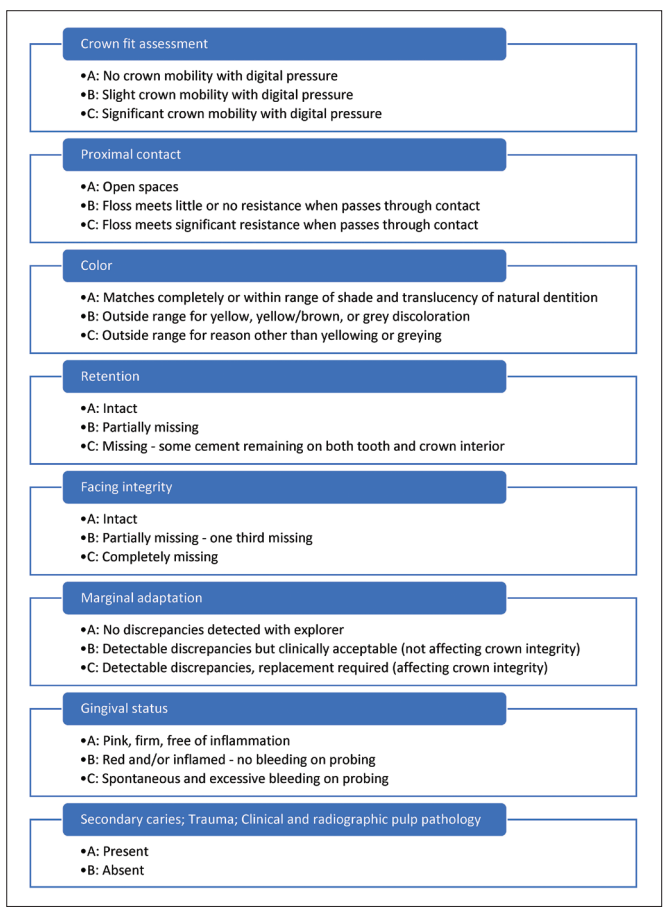

Figure 2. Clinical variables and associated grading system.

contact in centric and excursive functions was assessed before cementation. For ZCs, NuSmile Try-In Crowns were used to test the fit and avoid saliva or blood contamination of the intaglio surface. PVSSCs were cemented with glass ionomer cement (Ketac, 3M ESPE), according to the manufacturer's directions. ZCs were cemented with resin-modified glass ionomer cement (BioCem, NuSmile), according to the manufacturer's directions. Briefly, crowns were tac-cured, excess cement was removed, and then crowns were fully cured.

All patients were provided with standard postoperative instructions, including oral hygiene directions and avoidance of sticky foods to prevent debonding of the crowns. Postoperative follow-up examinations were performed after two weeks.

Data collection. Demographic and dental variables collected at the time of crown placement included the child's age, gender, decayed, missing, and filled primary teeth (**dmft**) score, parental insurance status, and primary anterior crown (**PAC**) location (central or lateral incisor). The initial dmft score was categorized into three groups: Group A (less than or equal to nine); Group B (10 to 13); and Group C (greater than 13). The four pediatric dentists performed clinical and radiographic assessments at three-, six- (data not shown), and 12-month visits following the guidelines at the university pediatric dental clinic. Crowns were photographed at baseline and again at recall visits when possible to aid in clinical assessments.

The crown variables assessed were as follows: crown fit assessment, proximal contact, color, retention, facing integrity, marginal adaptation, and gingival status. Failures were recorded according to the presence of secondary caries as detected visually, trauma as recalled by parents (yes/no), and pulp pathology as detected clinically and radiographically. An evaluation rating system was created similar to the U.S. Public Health Service (USPHS) Ryge Criteria, 16 with scores for each variable (Figure 2).

Parental satisfaction was assessed using a questionnaire with a four-point Likert-type scale that asked parents to rate the overall appearance of their child's teeth as very satisfied, somewhat satisfied, somewhat dissatisfied, and very dissatisfied. Characteristics assessed were shape, color, alignment, spacing between teeth, crowding of teeth, and/or a speckled/spotted/streaky/irregular/blotchy appearance.

Data analysis. All data were entered into REDCap and imported into Stata 15.1 software (StataCorp) for analysis. Descriptive statistics (means, standard deviations, counts, and percentages) were calculated. Fisher's exact or chi-square tests were used to test associations between PAC type and variables of interest. Missing data were excluded from all tests of association ($P<0.05$). The tooth was the unit of analysis; although the study was randomized at the patient level, all analysis was performed at the tooth level since the outcome of interest was failure of the restoration.

Results

Sample characteristics. Forty-seven children (135 teeth) were enrolled in the study at baseline: 47 teeth were restored with PVSSCs, 40 teeth with ZCs, and 48 teeth with CSCs (Figure 1). At baseline, the children were, on average, 3.4±0.8 (standard deviation) years old, with a mean dmft score of 10.6±4.0. The majority of children were female (55 percent), had Medicaid (83 percent), and had a dmft score of 10 or more (59 percent; Table 1). Although the children were randomized to groups, gender, insurance type, and dmft at PAC placement were significantly different among the three PAC types (Table 1).

Clinical outcomes. There was a significant difference between PAC types for color, retention, facing integrity, and marginal adaptation, as shown in Table 2. For all these clinical outcomes, CSCs presented with the lowest clinical success rate. At baseline, all PVSSCs, ZCs, and CSCs matched within the range of shade and translucency of the natural dentition. At 12 months, PVSSCs and ZCs matched for almost all crowns placed, while less than half of the CSCs placed did (100 percent and 98 percent versus 44 percent, $P<0.001$). PVSSCs and ZCs were completely or almost completely retained, while only 79 percent of CSCs were retained ($P=0.002$). ZCs had the highest success rate for facial veneer integrity at 98 percent, while 89 percent of PVSSCs and 69 percent of CSCs remained intact ($P<0.001$). At 12 months, almost all PVSSCs and ZCs presented without detectable marginal discrepancies compared to only 69 percent of CSCs ($P<0.001$) and compared to baseline where 90 percent of CSCs did ($P<0.01$). Overall, three teeth (all with CSCs) required retreatment due to inadequate marginal adaptation.

Trauma was found to be significantly different among PAC types ($P<0.001$), where PVSSCs were the only crown type with a reported history of trauma (Figure 3). Of note, only 50 teeth (37 percent) had radiographs taken at the 12-month follow-up, primarily due to a lack of patient cooperation and occasional parental refusal and clinical judgment determining the necessity. There was no known pulp pathology detected clinically and with radiographs (no pathosis apparent in pulpal and periapical tissues). No pulp therapy was required during treatment or following crown placement.

Table 1. DEMOGRAPHIC AND DENTAL VARIABLES OF PRIMARY ANTERIOR CROWNS (PAC) OF THE TREATED STUDY POPULATION

	PAC type				
	Total (N=135) N (%)	CSC* (N=48) N (%)	PVSSC* (N=47) N (%)	ZC* (N=40) N (%)	*P*-value†
Age at baseline (months)					**0.53**
34-36	43 (32)	16 (33)	12 (26)	15 (38)	
37-48	92 (68)	32 (67)	35 (74)	25 (62)	
Gender					**0.004**
Male	61 (45)	24 (50)	12 (26)	25 (63)	
Female	74 (55)	24 (50)	35 (74)	15 (37)	
Insurance status					**0.01**
Medicaid	112 (83)	34 (71)	43 (91)	35 (88)	
Private insurance	23 (17)	14 (29)	4 (9)	5 (12)	
dmft* at PAC placement					**0.001**
≤ 9	56 (41)	14 (29)	19 (40)	23 (58)	
10-13	48 (36)	14 (29)	22 (47)	12 (30)	
>13	31 (23)	20 (42)	6 (13)	5 (12)	
Tooth location of PAC					**0.82**
Maxillary central incisor	72 (53)	25 (52)	24 (51)	23 (58)	
Maxillary lateral incisor	63 (47)	23 (48)	23 (49)	17 (42)	

* CSC=composite strip crown; PVSSC=preveneered stainless steel crown; ZC=zirconia crown; dmft=decayed, missing, and filled primary teeth.

† Chi-square test.

Table 2. CLINICAL OUTCOMES OF PRIMARY ANTERIOR CROWNS AT 12 MONTHS

	Primary anterior crown type				
	Total	CSC*	PVSSC*	ZC*	
	N=135	N=48	N=47	N=40	
	N (%)	N (%)	N (%)	N (%)	*P*-value †
Crown fit assessment					**0.12**
A: No mobility with digital pressure	119 (88)	43 (90)	41 (87)	35 (88)	
B: Slight mobility with digital pressure	10 (7)	1 (2)	6 (13)	3 (8)	
C: Significant mobility with digital pressure	4 (3)	3 (6)	0 (0)	1 (3)	
Missing	2 (2)	1 (2)	0 (0)	1 (3)	
Proximal contact					
A: Open spaces	119 (88)	41 (85)	41 (87)	37 (93)	0.57‡
B: Floss meets little or no resistance when passes through contact	12 (9)	4 (8)	6 (13)	2 (5)	0.44‡
C: Floss meets significant resistance when passes through contact	1 (1)	1 (2)	0 (0)	0 (0)	0.10‡
Color					**<0.001**
A: Matches completely or within range of shade and translucency	107 (79)	21 (44)	47 (100)	39 (98)	
B: Outside range for yellow, yellow/brown, or grey discoloration	23 (17)	23 (48)	0 (0)	0 (0)	
C: Outside range for reason other than yellowing or graying	3 (2)	3 (6)	0 (0)	0 (0)	
Missing	2 (2)	1 (2)	0 (0)	1 (3)	
Retention					**0.002**
A: Intact	123 (91)	38 (79)	47 (100)	38 (95)	
B: Partially missing	7 (5)	6 (13)	0 (0)	1 (3)	
C: Missing-some cement remaining on both tooth and crown interior	3 (2)	3 (6)	0 (0)	0 (0)	
Missing	2 (2)	1 (2)	0 (0)	1 (3)	
Facing integrity					**<0.001**
A: Intact	114 (84)	33 (69)	42 (89)	39 (98)	
B: Partially missing-one third missing	16 (12)	11 (23)	5 (11)	0 (0)	
C: Completely missing	3 (2)	3 (6)	0 (0)	0 (0)	
Missing	2 (2)	1 (2)	0 (0)	1 (3)	
Marginal adaptation					<0.001
A: No discrepancies detected with explorer	116 (86)	33 (69)	46 (98)	37 (93)	
B: Detectable discrepancies but clinically acceptable	14 (10)	11 (23)	1 (2)	2 (5)	
C: Detectable discrepancies, replacement required	3 (2)	3 (6)	0 (0)	0 (0)	
Missing	2 (2)	1 (2)	0 (0)	1 (3)	
Gingival status					0.05§
A: Pink, firm, free of inflammation	96 (71)	27 (56)	36 (77)	33 (83)	
B: Red and/or inflamed; no bleeding on probing	34 (25)	17 (35)	11 (23)	6 (15)	
C: Spontaneous and excessive bleeding on probing	1 (1)	1 (2)	0 (0)	0 (0)	
Missing	4 (3)	3 (6)	0 (0)	1 (3)	

Parental satisfaction. Most parents (87 percent) were very satisfied with the overall appearance of the crowns and did not complete the remainder of the questionnaire regarding which crown characteristics were dissatisfying. Of the 23 parents dissatisfied with the appearance of the crowns, 19 (83 percent) were dissatisfied with color, of whom 63 percent were concerned with the color of CSCs and 37 percent with PVSSCs (P=0.005). The remaining four (17 percent) dissatisfied parents were concerned with the shape and alignment of ZCs (P=0.007).

Discussion

The purpose of this randomized controlled trial was to compare the 12-month clinical outcomes of CSCs, PVSSCs, and ZCs for carious primary maxillary incisors in healthy children with ECC who received treatment under general anesthesia. The results of this study showed that CSCs had overall reduced clinical success regarding color, retention, facing integrity, and marginal adaptation.

Color. This study found that CSCs were most likely to present with color outside the range of shade and translucency of the tooth, presenting with yellow, brown, or grey discoloration when compared with PVSSCs and ZCs at 12 months. While CSCs present with the benefit of multiple shades to choose from, accounting for a relatively good initial match to the tooth structure, the plaque and stain retentiveness of resin may contribute to low color stability.[17] Regarding PVSSCs, several authors reported difficult color matching and color instability, attributed to minimal shade options (light and extra light) and the accumulation of yellow staining.[2,4,9] Meanwhile, the benefit of ZCs is a highly polished surface preventing staining and plaque accumulation from affecting the color. A study evaluating endodontically treated teeth restored with ZCs over 30 months found that none of the crowns had discolored.[17] Optimal color matching to tooth structure is possible due to a moderate level of translucency that results in a naturally appearing restoration.[4,17]

Facing integrity and retention. Facing integrity was found to be highest for ZCs followed by PVSSCs and CSCs. This is consistent with a recent randomized controlled trial where six of 36 CSCs were completely lost and two had loss of material, two PVSSCs had loss of material, and no loss of restoration or material occurred with ZCs.[15]

* CSC=composite strip crown; PVSSC=preveneered stainless steel crown; ZC=zirconia crown; missing values excluded; N values do not sum to totals.

† Fisher's exact test.

‡ Multiple *P*-values, as more than one option was permitted due to more than one proximal contact per crown.

§ Not significant at the 0.05 level.

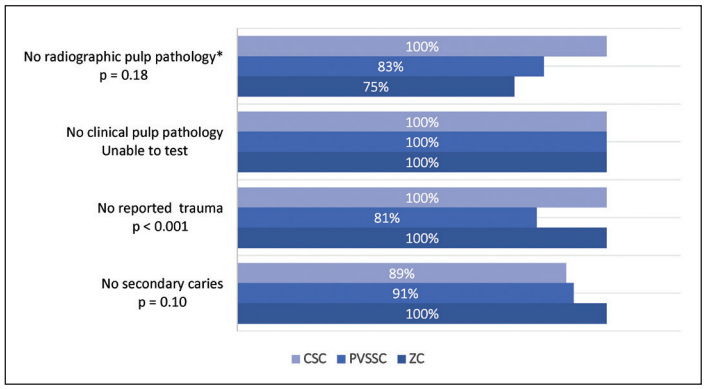

Figure 3. Clinical and radiographic successes of primary anterior crowns at 12 months (associations tested using Fisher's exact test).

* Radiographs obtained for 50 teeth (37 percent).

CSC= composite strip crown; PVSSC= preveneered stainless steel crown; ZC= zirconia crown.

This study demonstrated high retention rates for PVSSCs and ZCs versus CSCs. The retention of CSCs is reduced with more cariously involved surfaces[5,15]; although this study found higher dmft scores in the CSC group, the retention rate is similar to that of numerous studies. The retention rate of CSCs placed with typical behavior guidance or conscious sedation ranges between 80 to 88 percent at 18 to 74 months of follow-up, with failures including partial and complete loss of composite.[5,18,19] One study demonstrated a much lower success rate of 51 percent for composite crowns placed under general anesthesia.[20] Other studies involving composite crowns placed under general anesthesia have demonstrated success rates ranging from 70 to 100 percent, with follow-up times averaging six to 24 months.[3,21,22] PVSSCs have demonstrated retention rates between 99 to 100 percent at an average of 17.5 to 21 months, although approximately one-third of crowns have lost some or all of the veneer.[7,8] In a more recent retrospective study of NuSmile Signature crowns, 12 percent of crowns were found to have partial loss of the facing at six months of follow-up.[9] Similarly, this study found 11 percent of crowns with partial loss of the facing at 12 months of follow-up. The high retention rates of ZCs compare to the existing literature in which, at an average of 20.8 months of follow-up, ZCs were found to have a retention rate of 96 percent.[13]

Marginal discrepancies and gingival health. Although it was not statistically significant, CSCs had a higher rate of gingival inflammation than PVSSCs and ZCs (40 percent versus 23 percent and 15 percent respectively, *P*=0.052). Previous research has shown that the gingival index decreases following placement of ZCs,[14] increases at least mildly around PVSSCs,[7,8] and increases up to two times around CSCs.[18] CSCs lack a factory-polished surface, while both CSCs and PVSSCs have plaque-retentive resin that may contribute to gingival inflammation.[15,] The biocompatibility of ZCs may be attributed to a polished surface minimizing plaque retention, as has been shown with zirconia fixed partial dentures in the permanent dentition.[15] Further, the present study found that CSCs were more likely to present with discrepancies in the crown margin, which may have led to reduced gingival health.

The technique sensitivity of CSCs in bonding, hemorrhage, and moisture control may have contributed to the increased rate of marginal discrepancies, as well as reduced facing integrity and retention in this study. Calibrated operators had greater experience in placing traditional CSCs versus PVSSCs and ZCs, highlighting the technique sensitivity of CSCs and resulting in lower clinical scores. All crowns in this study were placed under optimal conditions with children under general anesthesia, whereas an awake uncooperative child may further outline the challenges of CSC placement.

Clinical and radiographic failures. There was significantly more trauma reported for teeth restored with PVSSCs. This is despite a greater proportion of females receiving PVSSCs (74 percent), as trauma incidence is higher in males.[24] Furthermore, there was no significant increase in clinical or radiographic pathology reported for PVSSCs. PVSSC retention was not affected, as none of the PVSSCs were lost at follow-up. The incidence of facial veneer fractures in this study is consistent with that previously reported, where a large overjet and overbite are suggested as probable causes.[7,8] It is possible, however, that trauma affected facial veneer integrity, as has been previously shown.[9] Trauma was reported more frequently than facial veneer fractures were observed in PVSSCs, suggesting that parents did not recall trauma more than other groups due to the visibility of the metal interface.

Secondary caries rates were not significantly different among groups, despite significantly higher dmft scores in the CSC group. None of the crowns presented with clinical pathology at 12 months. Assessment of radiographic pulpal health was not comprehensive, as 63 percent of crowns did not have new radiographs taken at 12 months. Overall, the literature is lacking on the assessment of clinical and radiographic pathology of PVSSCs and ZCs. One study found that five percent of ZCs developed clinical pathology that resulted in extraction at an average of 21 months of follow-up.[13] Radiographic assessment of CSCs has shown minimal teeth presenting with periapical pathosis, of which few have required endodontic treatment (one to two percent) beyond 18 months of follow-up.[5,18] Radiographic evaluation of CSC margins have shown a nonideal marginal contour in 46 percent of teeth, including overhangs, undercontour, or radiolucencies.[14]

Parental satisfaction. Given increased parental involvement in clinical decision-making, it is important to consider parental opinion of esthetics, durability, and impact on overall health.[4] Parental emphasis on esthetics is further illustrated in that parents prefer treatment to no treatment for primary incisors with dark coronal discoloration.[25] It is no surprise then, that dissatisfied parents were most concerned with the color of crowns, specifically of PVSSCs and CSCs, which is consistent with what has been found previously.[4,7,8,26] Color dissatisfaction of PVSSCs has been discussed in the context of the unnatural "white" appearance, which becomes more apparent with fewer teeth restored.[2,4,9] It is possible that this affected parental satisfaction of PVSSCs in the present study, as anywhere between one to four crowns were restored.

This study found two parents were dissatisfied with the shape and alignment of ZCs, while examiners found no significant difference in the position of the crowns at follow-up. In the literature, clinical findings of the size and shape of ZCs have been found to correlate well between parents and dentists.[13] The passivity of fit of ZCs may result in rotations at cementation that result in nonideal alignment, as detected by parents.

Limitations and directions for further research. One limitation of this study is the disproportion of gender, insurance status, and dmft scores among groups at baseline. Given the limited variability in the results, it was not statistically possible to adjust for these variables. Longer follow-up data and a larger

sample may result in increased variability, and regression analysis could rule out these potential confounders.

Another limitation of this study is the number of patients lost to follow-up. Yet the post hoc power calculation provided grounds for the validation for the study. Further, some clinical failures may not be present at 12 months and longer follow-up data is recommended. This study did not have radiographs for all participants at follow-up. In this study, limiting pediatric radiation exposure was a critical component of approval by the Human Subjects Review Board.

While this study evaluated NuSmile PVSSCs and ZCs, there are at least three additional manufacturers of each. There are variations in preparation and placement, crown thickness, intaglio surface architecture, surface gloss, and transparency. These factors could contribute to different results.

No teeth received pulp therapy, although some teeth possibly had prior applications of silver diamine fluoride. This information was not recorded, and therefore it is unknown whether or not SDF applications resulted in a reduced need for pulp therapy.

Conclusions

Based on this study's results, the following conclusions can be made:

1. All crowns were clinically acceptable at 12 months.
2. Zirconia crowns and preveneered stainless steel crowns had better color, retention, facing integrity, and marginal adaptation than composite strip crowns at 12 months.
3. Parental satisfaction with PVSSCs, ZCs, and CSCs was high. The main esthetic concern of parents after 12 months was color, as the majority disliked the color match of CSCs.

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