

Clinical evaluation of and parental satisfaction with resin-faced stainless steel crowns.

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Abstract

Purpose: This study evaluated the clinical success and parental acceptance of anterior primary dentition caries treatment with prefabricated resin-faced stainless steel crowns.

Methods: A retrospective analysis of maxillary anterior primary dentition caries treatment using Whiter Biter II Crowns was performed. Each crown was evaluated for retention, fracture, interface failure, color match, marginal integrity, and surface texture. Parental satisfaction regarding the esthetics of the crowns was evaluated by survey.

Results: Thirty-eight crowns were evaluated in 12 children. The average crown age at time of examination was 20.7 months. Three teeth were lost to trauma with all other crowns remaining intact. Twelve crowns (32%) showed loss of at least some facial resin. Nine crowns (24%) had complete loss of the resin facing. Overall parental satisfaction with the treatment was excellent, however, satisfaction with crown esthetics received the lowest rating.

Conclusions: While parental satisfaction with treatment of anterior primary dentition caries with prefabricated resin-faced stainless steel crowns is excellent, the high failure rate of the resin facings is problematic. *Pediatr Dent 23:28-31, 2001*

Early childhood caries remains a significant problem challenging our diagnostic, preventive, and restorative skills.¹ Often, caries in very young children involves the maxillary anterior teeth and the primary molars while the mandibular anterior teeth are generally not involved.² Carious involvement of the maxillary incisors not only potentially compromises the integrity of the dentition, but can create an undesirable esthetic appearance. Treatment of primary maxillary incisors is problematic because the teeth are small and a restoration is needed that is retentive, resists fracture and wear, and is esthetic.

Numerous treatment approaches have been proposed to address the esthetics and retention of restorations in primary maxillary incisors.³ Traditionally, there have been four types of full coverage restorations available to restore primary incisors.⁴ While each restoration has its advantages, all have certain limitations. Stainless steel crowns are retentive, easy to place, and durable, but the metallic appearance may be esthetically displeasing to both parent and child.⁵ Open-faced stainless steel crowns with a resin window give improved esthetics over traditional stainless steel crowns. A facial window is cut in the crown and composite resin is bonded to the tooth.⁶ Increased chair time and the need for using multiple materials are disadvantages to this type of restoration. Polycarbonate crowns, while having improved esthetics, are considered to be more

difficult to place, have poorer retention, and are prone to excessive wear. Acid-etched composite resin crowns, or "strip crowns," are the most esthetic of the crowns and show improved retention and better wear resistance than polycarbonate crowns.^{7,8} However, they are more technique sensitive to place compared with prefabricated crowns. Retention of resin bonded crowns is more dependent upon a clean, moisture-controlled field and having adequate remaining tooth structure for bonding compared with cemented stainless steel crowns.

An important addition to the armamentarium of esthetic anterior primary tooth restorations is the veneered stainless steel crown.⁴ These crowns are available with a variety of facing materials such as composite resin or thermoplastic resin bonded to the stainless steel crown. Esthetic veneers are retained on the stainless steel crowns using a variety of mechanical and chemical bonding approaches.^{9,10} Advantages of these restorations include enhanced esthetics and retention that should be similar to that of traditional stainless steel crowns. Several disadvantages with veneered stainless steel crowns include problems with contouring and/or crimping of the crown that could cause reduced crown retention and/or fracture and loss of the veneer. Pre-veneered crowns are substantially more expensive than traditional stainless steel crowns. The crowns cannot be heat sterilized due to damage of the veneer. Finally, there is no clinical data and very little laboratory data evaluating the failure rates of these restorations or the retention of the esthetic veneer.

Two studies evaluated the shear bond strength of the esthetic facings and showed all resin facings to be similarly retentive.^{9,10} However, it is unknown how this laboratory data will translate to actual performance in the oral environment. There have been no studies evaluating the overall retention of pre-veneered stainless steel crowns or failure rate of facings due to color change, wear, or facing loss. The purpose of this retrospective clinical study was to evaluate the longevity, failure rate, and acceptance of veneered stainless steel crowns used for the treatment of primary maxillary incisor dental caries.

Methods

The Human Subject Institutional Review Board approved this retrospective study and consent was obtained from all parents or guardians for each participant. This retrospective cross-sectional study was designed to evaluate the retention and longevity of pre-veneered stainless steel crowns that had been placed on children having been treated for dental caries of the primary maxillary anterior teeth over a 32-month period. A total of 83 children had received such treatment and were thus

Table 1. Clinical Evaluation Criteria

Treated tooth exfoliated	0 = yes 1 = no
Crown / Facing retention	0 = Crown intact 1 = Partial or complete facing loss 2 = Loss of crown
Facing fracture	0 = No fracture 1 = Small fracture (less than 1/4 facing) 2 = Bulk fracture (greater than 1/4 facing)
Area of facing loss	0 = No loss 1 = Incisal 1/3 only 2 = Incisal 1/2 3 = Entire facing
Interface failure site	0 = No failure 1 = Resin - Resin 2 = Resin - Metal 3 = Metal - Metal
Facing repair	0 = None 1 = Repair present
Facing color	0 = Unchanged 1 = Minor deviation from original 2 = Unacceptable discoloration
Facing wear	0 = No wear 1 = Incisal wear only 2 = Greater than incisal wear
Facing surface texture	0 = Smooth 1 = Minor roughness 2 = Unacceptable surface roughness

eligible for possible inclusion in the study. All families were contacted by phone and asked to participate in the study by returning for a clinical evaluation of the restorations.

All the restorations were placed under ideal conditions while the children were being treated in the operating room with the aid of general anesthesia due to the amount of dental treatment required and their inability to cooperate in a traditional dental setting. Whiter Biter II pre-veneered stainless steel crowns (Whiter Biter Inc.) were placed on all the teeth according to the manufacturer's instructions. The Whiter Biter II Crown is a pre-fabricated stainless steel crown that has a white polyethylene plastic attached to the facial surface of the crown. The resin is attached by means of a wire mesh and bonding resin. Small cuts in the crown at the mesial and distal incisal angles are present that allow the resin facing to lock into the crown to help reduce facing loss from shear forces at the incisal edge. These incisal retention cuts were a modification from the original crown design and were added in response to clinical failures of the resin facing. Traditional anterior stainless steel crown preparations were completed and crowns selected for placement based on having a retentive fit. The crowns were not cut and crown crimping, when necessary to improve retentive fit or marginal adaptation, was completed only on the lingual surface so as not to stress the facial veneer. All crowns were cemented with glass ionomer cement.

Crowns were examined clinically and photographed to document the clinical appearance. All information regarding the child and the status of the crowns were recorded on a clinical data form. Data collected on the child included age, sex, overjet, overbite, and Gingival Score.¹¹ The Gingival Score was: 0 = no inflammation; 1 = mild inflammation; 2 = moderate inflammation; 3 = marked inflammation. Each restoration was assessed as to date the crowns were placed, teeth crowned,

crown retention, facing retention, facing fracture, facing repair history, facing color match, marginal integrity of facing, and surface texture of the resin facing. Each of these criteria was assessed and scored according to the scales illustrated in Table 1. Color stability was evaluated using one crown from the original kit as a standard that was held up to each individual restoration for color comparison.

Parents of the children also participated in a survey designed to evaluate their satisfaction of the restorations. Parents were asked to score parameters such as the crown's shape, size, color, durability, and their overall satisfaction on a 1 to 5 scale with 1 being very unsatisfied and 5 being very satisfied. Parents were also given the opportunity to make open-ended comments regarding the restorations. Parents were then asked to give a rating of their overall satisfaction with the crowns on a scale of 1 to 10 with 1 being they were very dissatisfied and 10 being they were very satisfied with the restorations.

Data analyses

One of the study's primary aims was to examine the clinical success of treatment of anterior teeth with prefabricated resin-faced stainless steel crowns. Factors such as overjet and overbite were also analyzed to examine the association on both wear and crown retention/loss. Overjet was measured in millimeters distance from the incisal edge of the maxillary incisors to the incisal edge of the opposing mandibular incisors. Overbite was measured in percentage overlapped of opposing teeth.

Because of the dichotomous nature of the dependent variables, Logit regression models were used for the analyses.¹² The first model examined the association between wear and overjet and overbite. The outcome measure in this model was wear present or not present and the major explanatory variables were overjet and overbite. The second model examined the association between crown retention and overjet and overbite. The outcome measure in this model was crown retention or partial/full loss of crown and the major explanatory variables were overjet and overbite. Also included in both models were sociodemographic control variables such as sex and age of patients. STATA Statistical Software was used for all the data analyses (STATA Corporation, 1998).

Results

Of the 83 patients that had received the veneered stainless steel crowns during the 32-month time period, 12 children (8 females and 4 males) were available and their parents willing to participate in the study. The child population receiving this type of treatment was generally of lower socioeconomic status and during recruitment for the study it was found that many families had moved, changed, or lost phone services or were otherwise not contactable. Three additional parents were interviewed by phone to complete the parental satisfaction survey as they were unable to bring their child to an appointment. Of the 12 children evaluated, 38 primary maxillary anterior teeth had been restored with Whiter Biter II crowns. Of these, three teeth were lost due to trauma. The 35 teeth clinically evaluated included 15 central incisors, 16 lateral incisors, and 4

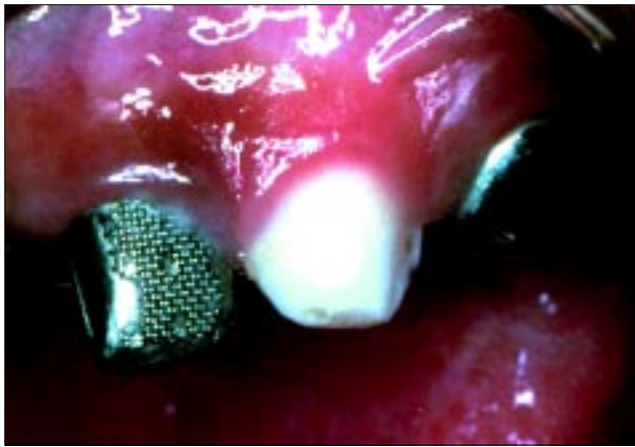


Fig 1. Facing loss at the resin-metal mesh interface occurred in this crown by 8.5 months.



Fig 2. Moderate wear of the resin facing at the incisal edge and partial loss of a lateral incisor facing occurred by 32 months in this child.

canines. The average crown age at time of evaluation was 20.7 months (range 8.5 – 36.3 months).

Characterization of crown failure

All of the stainless steel restorations were present at the time of evaluation with the exception of the three teeth lost to trauma. Evaluation of facing failure revealed that 12 crowns had lost all or part of their facing due to resin fracture or tearing (Table 2). Total facing loss was the most prevalent (9 or 24%) form of facing failure with only 3 facings (8%) showing evidence of partial veneer loss. Facing loss was most common

Category	Count	Percentage
Entire facing	9	24%
Site of failure		
Resin-Resin	4	
Resin-Metal	3	
Metal-Metal	1	
Could not be determined	1	
Veneer fracture/Tear	3	8%
Incisal 1/3	2	
Incisal 1/2	1	
Unacceptable facing failure total (N= 38 crowns)	12	32%

Category	Mean
Appearance	3.6
Color	3.9
Shape	4.3
Size	4.2
Durability	3.9

1-5 scale was used with 1=very dissatisfied and 5=very satisfied.

at the resin-resin and resin-metal interface (Fig 1). Loss of the metal mesh was observed in one case.

Of the remaining non-fractured or lost veneers, 20 crowns demonstrated wear of the resin facing at the incisal edge (Fig 2). Only 3 crowns presented with no noticeable wear on any part of the crown. Two separate Logit regression models were executed. In the wear and crown retention models, the association between overbite and the outcomes of interest was found to be significant ($P=0.05$) with a positive relationship. Overbite was marginally significant ($P=0.10$) with a negative relationship.

Color stability was rated as excellent with most crowns having a color indistinguishable to the original crown that had not been in the oral cavity. Excluding the 9 crowns with lost facing, 19 of the restorations had a good color match compared with the original and 7 had a slight mismatch in color that was considered clinically acceptable (Fig 3). Marginal integrity of the resin/crown interface and resin surface texture was optimal in all cases having partial or total facing retention. Gingival health around the crowns was generally excellent with a mean Gingival Scores of 0.58 indicating there was typically either no inflammation or mild inflammation around the crowns.

Parental acceptance of veneered crowns

Parental acceptance surveys were completed for 14 restorative cases. Results of the parental acceptance survey are presented in Table 3. When considering the parental ratings for appearance, color, shape, size, and durability, the lowest scores were received for appearance and color. Parents were most satisfied with the shape and size of the restorations. Parental concerns were relayed via answers to open-ended questions included dissatisfaction with metal visibility and facing failure. Most parents showed an overall positive rating of the crowns (8.9 on a 10 point scale).

Discussion

This study is the first to describe the clinical performance of prefabricated resin-faced stainless steel crowns for restoring primary anterior teeth. Crown retention was found to be 100%, providing further evidence that stainless steel crowns are a highly retentive restoration. However, there was a high prevalence of facing failure with about 1/3 of the facings showing complete or substantial facing loss. Facing failures occurred most commonly at the resin-resin and resin-metal interface. This suggests that future research and development of approaches to optimize the resin bond at these interfaces could improve the retention rate of resin facings.

Two patient-related factors appeared associated with the failure of resin facing. Overjet was positively associated with an increase in resin facing failure. In other words, children



Fig 3. Good to excellent color match was seen in most of the resin facings that were retained as seen in this case 13.8 months after crown placement. Color is being compared with a new crown.

having larger overjets were increasingly likely to experience resin-facing failure. This may be related to the increased likelihood that the restorations could experience trauma. Alternatively, increased facing failure could result from their experiencing increased functional stress due to their more forward position. The observation of increased facing failure in patients with increasing anterior overjet suggests that clinicians may want to select alternative, more durable esthetic treatment approaches and that parents be advised of an increased likelihood of facing failure in children with an overjet greater than normal (>6mm).

This study also showed a trend towards an increased overbite being associated with a decreased frequency of facing failure. The relationships of occlusion to the longevity and retention of different anterior esthetic restorations certainly warrants further study. This knowledge is critical for clinicians in their selection of different treatment modalities.

Despite problems with facing failure the overall level of parental satisfaction with the prefabricated resin-faced crowns was quite good (8.9 on a 10 point scale). Most parents stated they would select the prefabricated resin-faced crown treatment for their child again. Although an overall high parental satisfaction rating was given, the lowest satisfaction was reported for the crown's esthetics. Esthetic concerns expressed by parents included the large size, color and visualization of some metal. It must be emphasized that despite these concerns, parents were positive in their perception of the Whiter Biter II crowns overall esthetic qualities.

Patients presenting with lost facings were managed by bonding a new resin veneer to the crown. A variety of approaches can be used to place or repair facings.¹³⁻¹⁵ In most instances, facings were replaced without any mechanical modification of the facial surface of the crown. The Scotchbond Multipurpose Metal Bonding System™ was used according to the manufacturer's instructions. After placing and curing a thin layer of bonding agent, a thin layer of resin opaquer was applied to the facial surface and polymerized prior to placement of the resin facing. The resin facing was then applied and contoured to the facial surface and polymerized.

During the past decade a variety of new esthetic treatments for the esthetic management of dental caries in the anterior primary dentition have become available. This investigation shows that while 100% of the pre-fabricated resin-faced stainless steel crowns remained in place during the time evaluated,

resin-facing failures occurred in 1/3 of the cases. Even though loss of the facing does not diminish the function of the restoration, it does markedly affect the esthetics and reduces parental satisfaction with the procedure. There is a critical need for clinical studies to evaluate the multitude of esthetic treatment modalities available for primary dentition caries and to identify potential risk factors for increased failure rates such as excessive overbite.

Conclusions

1. All pre-fabricated resin faced stainless steel crowns remained intact during the study, supporting the high rate of retention for anterior stainless steel crown restorations.
2. About 1/4 of the resin facings were completely lost in 3 years or less.
3. Increased overbite was significantly associated with an increased facing failure rate indicating tooth position influences treatment outcome.
4. Parental satisfaction with the prefabricated resin-faced crown restoration was highly positive.

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