Scientific Article

The Repair of Preveneered Posterior Stainless Steel Crowns

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Abstract: ***Purpose:*** *This study's purposes were to determine the shear bond strength (SBS) for and to perform dye penetration (microleakage) and scanning electron microscopy (SEM) evaluations of preveneered posterior stainless steel crowns (SSCs) that were repaired using 2 different materials.* ***Methods:*** *Twenty-two crowns were used. They were stored in artificial saliva for 30 days and then thermocycled. A force was applied on the crowns' occlusal surfaces until the original veneer material appeared to be fractured. The fracture types and SBS values were recorded. The crowns were then repaired using Panavia opaque cement and Tetric Flow or Monoopaque and Tetric Flow. Twenty of the repaired crowns were subjected to dye penetration and SBS tests, and the remaining 2 were evaluated using SEM.* ***Results:*** *Statistical analysis revealed no statistically significant differences in the results of either the SBS or the dye penetration test (P=.58 and P=.38, respectively). A statistically significant difference was found between original and repaired crowns regarding fracture extent (P=.02), but not failure type (P=.08). SEM evaluation showed that there was no observable gap at the interface of the original or repaired materials and the stainless steel base.* ***Conclusion:*** *Preveneered posterior stainless steel crowns may be repaired using either repair material types tested here.* *(Pediatr Dent 2008;30:429-35) Received June 11, 2007 | Last Revision October 11, 2007 | Revision Accepted October 19, 2007*

KEYWORDS: PREVENEERED STAINLESS STEEL CROWNS, RESTORATIVE DENTISTRY, PRIMARY TEETH

Stainless steel crowns (**SSCs**) have been widely used since the 1950s for the restoration of grossly carious teeth, hypoplastic teeth, and teeth that have been treated by pulpotomy or pulpectomy.[1] The popularity of SSCs is due to advantages such as their easy placement, good durability, and relatively low cost.[2,3] SSCs have a metallic gray appearance, however, that may be a cause of patient dissatisfaction. Possible approaches to overcome this problem have been suggested by several authors and include the use of open-faced SSCs or chairside-veneered SSCs.[4-10] Among their disadvantages, these approaches[11-16]:

1. are time consuming to complete;
2. are still not optimally esthetic because of the exposed metal around the resin;
3. may be affected by gum bleeding and saliva;
4. may have a short lifespan;
5. require extensive laboratory preparation; and
6. may have poor color stability under oral conditions.

In the mid-1990s, preveneered SSCs were first developed and marketed for both anterior and posterior primary teeth restorations. These crowns were designed to overcome the aforementioned disadvantages.

Although many studies of anterior preveneered SSCs have been conducted both in vitro and in vivo,[11,13,17,18] published studies of posterior preveneered SSCs are limited. Fuks et al showed that the veneer material of posterior preveneered SSCs showed no evidence of chipping after a 6-month follow-up period. [19] They reported that all crowns, however, showed chipping of the veneer materials after 4 years.[20] It has been stated that local overload and occlusal relationships may cause chipping or fracturing of veneer material.[17,18,20]

Repair procedures may be considered an important alternative to complete replacement of a defective crown.[21] The advantages of repair are that it is cost effective, requires less time, and minimizes additional trauma to the teeth.[21-23]

No results of studies of the intraoral repair of fractured preveneered SSCs, however, have been reported to date. Machado et al stated that, although in vitro results may not always agree with results obtained under intraoral conditions, they can be very helpful in the prediction of clinical performance.[24] This study's purposes were to evaluate the shear bond strength (**SBS**) of the original veneered material of posterior SSCs and to evaluate the SBS and dye penetration of their repair with 2 different materials. In addition, the interface between the original or repair materials and the stainless steel base was examined using scanning electron microscopy (**SEM**).

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Methods

Sample preparation. Twenty-two preveneered primary maxillary and mandibular first molar SSCs (NuSmile Primary Posterior Crowns, NuSmile Crowns, OT, Inc, Houston, Tex) were used in this study. After an impression of each crown's internal surface had been obtained, patterns were prepared. Following this, 22 cast dies were fabricated using a cobalt-chromium alloy. Impressions also were made from conventional SSCs in sizes similar to the preveneered SSCs to be tested, and specific wax patterns were prepared in the same way. The cast dies to be used for loading were also fabricated using a cobalt-chromium alloy.

The original veneer material of the NuSmile posterior crown is a hybrid resin composite. Fatigue tests of composite resins involve soaking the composites in water for at least 30 days.[25] Thus, in this experiment, the crowns were kept in a humid environment at 37°C for 30 days and then subjected to thermocycling at between 4°C and 55°C for 500 cycles. Each crown was then cemented onto one of the cast dies using temporary luting cement (Life Regular Set, Kerr, California, U.S.A.) mixed to the manufacturer's specification.

Shear bond strength of original crowns. After 24 hours following cementation, each die was placed into a mechanical testing machine (Hounsfield Test Equipment, Raydon, England) and loaded to obtain an SBS value before undergoing 1 of 2 different repairing procedures. Cobalt-chromium cast loading dies with a crosshead speed of 1.5 mm/minute were used to load onto the specimens' occlusal surfaces. The loading procedure was performed according to the occlusal contact relationship of lower and upper primary first molars.[26] The loading was continued until fracture of the original veneer material occurred, and the force required was recorded in newtons (N). The fractured test specimens were photographed under X10 magnification using a stereomicroscope (Nicon SMZ-U multi-point-sensor system, Tokyo, Japan). The bond failure of the original veneer material was scored as adhesive failure (at the steel/resin interface), cohesive failure (within the facing material), or adhesive/cohesive failure (mixed).

Repairing procedure. For the repair procedure, the 22 crowns were divided into 2 equal groups, in which the crowns had the same size. The repair procedures were performed as follows.

Group 1

Group 1 crowns were repaired using a modification of the method described by Weidenfield et al for veneering anterior SSCs.[10] The repair materials used were Panavia opaque cement (Kuraray Medical, Inc, Okayama, Japan) and Tetric Flow (Ivoclar-Vivadent, Schaan, Liechtenstein) resin composite. The fractured margins of the original veneer material were prepared using a diamond polishing bur (Diatech Dental AG CH-9435 Heerbrugg, Switzerland). In addition, exposed metal surfaces on the fractured crowns were sandblasted with 80-μm aluminum oxide for 5 seconds (Prep Start, Danville Engineering, Danville, Calif). Prepared metal surfaces had a dull, frosty appearance. Thirty-five percent phosphoric acid (Vocosid, Voco, Cuxhaven, Germany) was then applied to the prepared facial surface for 30 seconds. The surface was rinsed with a stream of water for 10 seconds and dried under compressed air. Subsequently, a bonding agent (ED Primer, Kuraray Medical, Inc) was applied to the etched veneer facing and the primed metal surfaces using a brush, left undisturbed for 60 seconds, and then dried with air flow. Panavia opaque cement (Kuraray Medical, Inc) was applied thinly over the sandblasted metal surface to mask the crown's metallic shade. Tetric Flow (A3, Ivoclar-Vivadent, Schaan, Liechtenstein) was added to obtain the original veneer material's shade.

Group 2

Crowns were prepared as aforementioned repaired using Monoopaque (A3, Ivoclar Vivadent) light-curing opaquer and Tetric Flow resin composite. A bonding agent (Monobond S, Ivoclar Vivadent) was applied to the etched veneer material with a brush and left for 60 seconds for the silanization reaction to occur. A layer of Monoopaque of 0.5-mm maximum thickness was directly applied to the exposed metal surface using a syringe and was allowed to cure for 40 seconds. Tetric Flow was added to complete the repair process and was allowed to cure for 20 seconds. The resin composite in both groups was finished using contouring and polishing discs (Sof-Lex, 3M ESPE, Seefeld, Germany).

Dye penetration testing of repaired crowns. All repaired crowns were maintained in the artificial saliva at room temperature for 24 hours, thermocycled 500 times in water between 4°C and 55°C, and soaked in 0.5% basic fuchsin dye solution for 24 hours. Dye penetration of the original veneer material and the repair material interface was evaluated and photographed using a stereomicroscope (Nikon SMZ-V multipoint-sensor system, Tokyo, Japan) at X60 magnification.

Shear bond strength of repaired crowns. After dye penetration was evaluated, 20 of the repaired crowns were debonded in the test machine as described for the original SBS test. The force required was recorded in newtons as before. The debonding failure of the repaired crowns was also evaluated under the stereomicroscope at X10 magnification. The failure types observed for both repair materials were noted according to the following criteria: adhesive failure (dislodgement at the SSC and/or the original veneer resin interface); cohesive failure (failures within the repairing materials); or adhesive/cohesive failure (mixed). In addition, the extent of fracture of the original veneer and both repair materials were examined as a whole, composed of the occlusal and vestibular parts, and was easily classified as follows: 1) no loss, but cracking visible; 2) loss of one third; 3) loss of one half; and 4) complete loss.

After the repair test procedure, one specimen from each repair group was selected for photographic evaluation of the esthetic quality of the repair procedures. Crowns were repaired using both repair materials with a shade based on the body color of the fractured facings.

SEM evaluation of repaired crowns. The remaining 2 repaired crowns were used for evaluation by SEM (JSM-6400, JEOL, Tokyo, Japan). Crowns were sectioned along the crown's axis in the buccolingual direction, coated with Au-Pd using ion coating equipment (SEM Coating Unit E 500, Polaron Equipment Limited, Barcelona, Spain), and evaluated by SEM. The SEM evaluations were performed at 3 interfaces: (1) original veneer material—stainless steel base; (2) repair material—stainless steel base; and (3) original-repair material interfaces.

Statistical analysis. The SBS values obtained from the original veneer material and the 2 repair materials were analyzed using 1-way analysis of variance (ANOVA).

Dye penetration was analyzed using the Mann-Whitney U test. The type of failure and extent of fracture of both the original veneer material and the 2 repair methods were compared using the Kruskal-Wallis test and the Mann-Whitney U test. For all statistical analyses, the significance level was set at $P<.05$.

Table 1. THE MEAN FORCE REQUIRED TO FRACTURE THE ORIGINAL VENEER MATERIAL AND BOTH REPAIR MATERIALS

Groups	No.	Mean force (N)±(SD)
NuSmile *	22	870.6±190.5
NuSmile+Panavia+Tetric Flow †	10	835.3±180.5
NuSmile+Monopaque+Tetric Flow †	10	763.2±127.8

* Original veneer material.
† Repaired group.

Results

The mean SBS values are given in Table 1. The mean SBS values obtained from the original veneer material were slightly higher than those of both repair materials. No significant difference, however, was found among the groups (P=.58). In group 1 (Panavia), there was a 4% reduction. In group 2 (Monoopaque), the reduction was 9%. Group 1, therefore, showed an SBS that was approximately 5% higher than that of group 2. The difference between groups 1 and 2, however, was not statistically significant (P=.12).

Dye penetration between the original veneer and the repair material was seen in 20% of all specimens (Figure 1). All specimens in both repair groups showed similar dye penetration, and there was no significant difference between the groups (P=.38).

No significant difference was found between the occlusal and vestibular portions of primary maxillary and mandibular crowns with either the original veneer or the repair materials (P=.62).

The failure types and fracture extents observed are summarized in Table 2. The fractures that occurred in both the original veneer material and the repair materials were characterized as either cohesive or mixed failures. When all failure types were compared, there was no significant difference among groups (P=.08). In addition, failure types of primary maxillary and mandibular crowns with both original veneer material and repair materials were not statistically significant (P=.07 and P=.28, respectively). Fracture extents varied from Class I (no loss, but cracking visible) to Class III (loss of one half) (Figure 2). No specimens had Class IV fractures (complete loss). There was a statistically significant difference in fracture extents between the original veneer material and the repair materials (P=.02). According to the Mann-Whitney U test results, the source of this significant difference was group 2.

The mean kappa value for intraexaminer repeatability for failure type, fracture extent, and dye penetration was calculated as 0.90.

Sections of 2 repaired crowns were evaluated under SEM and photomicrographs were obtained (Figures 3-5). No gaps were seen at the interface between the original or repair materials and the sandblasted stainless steel base (Figures 3 and 4). In addition, the interface between the original veneer and the repair materials showed an intimate adaptation (Figure 5). Both repair methods gave similar esthetic results (Figure 6).

Table 2. FAILURE TYPES AND EXTENT OF FRACTURES IN THE ORIGINAL VENEER MATERIAL AND BOTH REPAIR MATERIALS

		Failure type			Fracture extent*			
Groups	N	Adhesive	Cohesive	Mixed	Cracking	1/3	1/2	1/1
NuSmile †	22	0	4	18	3	15	4	0
NuSmile+Panavia+Tetric Flow ‡	10	0	0	10	0	7	3	0
NuSmile+Monopaque+Tetric Flow ‡	10	0	4	6	4	6	0	0

† Original veneer material.
‡ Repaired group.
* 1/3=loss of one third of veneer material; ½=loss of one half of veneer material; 1/1=complete loss of veneer material.

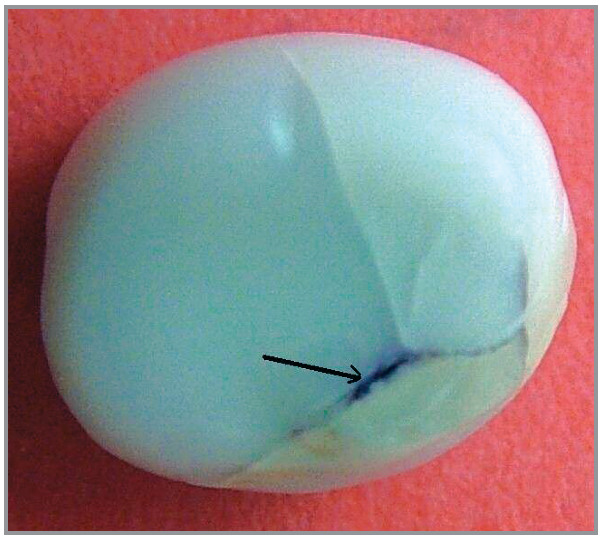

Figure 1. Dye penetration between original veneer and repair material (see arrow).

Figure 2. Extents of fractures varied among Class II and loss of one third of the original veneer material (original magnification X10).

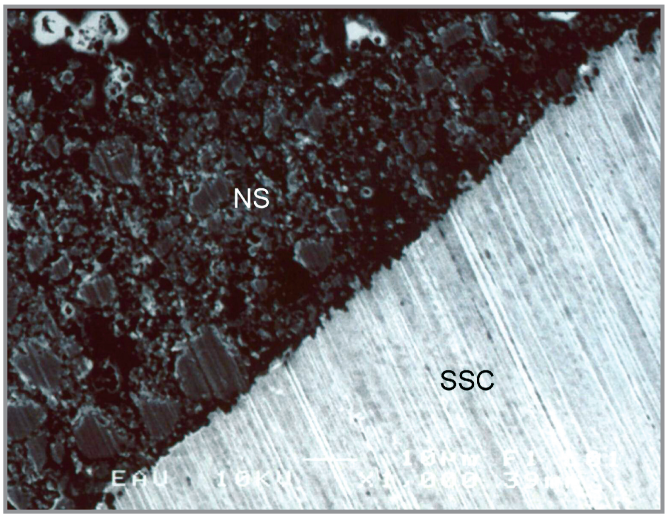

Figure 3. Scanning electron micrograph showing no gap between original veneer material and sandblasted stainless steel base. NS=NuSmile crown; SSC=stainless steel crown. The bar represents 10 μm (original magnification X1,000).

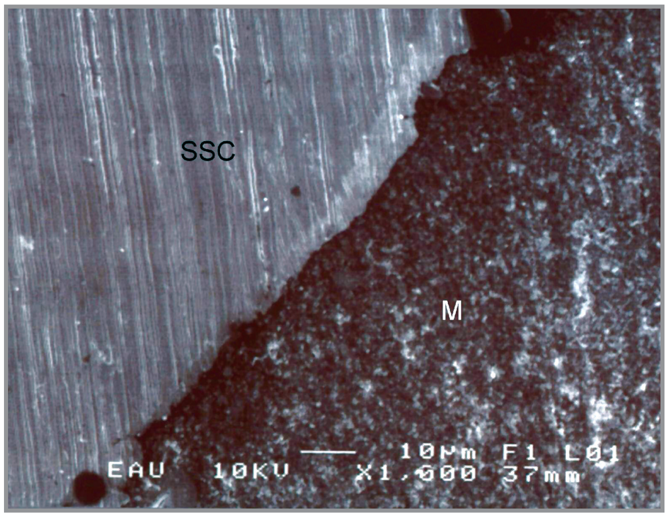

Figure 4. Scanning electron micrograph showing a continuous internal adaptation relationship between Monoopaque and sandblasted stainless steel base. M=Monoopaque; SSC=stainless steel crown. The bar represents 10 μm (original magnification X1,000).

Discussion

It has been stated that a high retention rate in the oral cavity is important for the success of a restorative material.[27] The results of previous clinical studies have shown that preveneered posterior SSCs have a high retention rate. These studies, however, demonstrated a high rate of fracture of the veneer material.[17,18,20] Until now, no results of a study on the repair of fractured veneer material in preveneered posterior SSCs have been reported. In the present in vitro study, NuSmile preveneered posterior SSCs, one of several brands available, were tested because they were the preferred product used in previous studies conducted using preveneered posterior SSCs.[19,20] They also were chosen because of their known chemical interaction with ED primer and the Monobond S stainless steel base. Panavia opaque cement and Monoopaque were selected for the study due to their ability to mask metallic reflections. The test procedures used included the evaluation of the SBS of the original veneer material and the repair materials, and dye penetration of the repair materials and the repair interface.

The veneer material used in NuSmile crowns is a hybrid resin composite. In general, bonding between composite layers is achieved in the presence of an oxygen-inhibited layer of unpolymerized resin.[28] Therefore, in this study, specimens were aged for 30 days in artificial saliva before testing, thus preventing the formation of chemical bonds between the original veneer material and the repair materials.

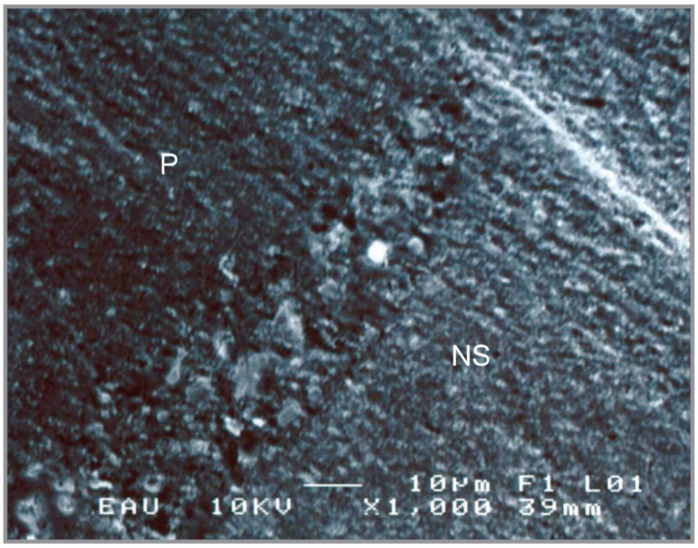

Figure 5. Scanning electron micrograph showing a continuous internal adaptation relationship between Panavia and sandblasted stainless steel base. P=Panavia; NS=NuSmile crown. The bar represents 10 µm (original magnification X1,000).

Figure 6. Preveneered stainless steel crown repaired with Monoopaque (original magnification X10).

The average force required to dislodge one of the original crowns or both types of repaired crown ranged from 763.2 to 870.6 N. These crowns, therefore, showed resistance to fracture by forces that were greater than the average biting force of 5- to 10-year-old children (375 N).[29]

The mean debonding force of the repaired crowns was found to be approximately 96% to 91% of that of the original crown (groups 1 and 2, respectively). This finding was not consistent with the results reported by Yilmaz and Yilmaz, who showed that repair materials were susceptible to significantly lower mean debonding forces than the original veneer material (approximately 48% to 58% of the original).[30] This difference may be due to variations in the repair systems and crowns used, because Yilmaz and Yilmaz repaired the NuSmile anterior crowns using a flowable resin composite without an opaquer system and with a crown and bridge veneering resin.

In the present study, the group 1 repair material had slightly higher SBS values than that used by group 2 (by approximately 5%). Although a chemical interaction occurs between the stainless steel base and both the 10-MDP in ED Primer and the MPS in Monobond S,[31-33] this difference may not depend on the chemical constitution of ED Primer or Monobond S. Therefore, the difference between groups 1 and 2 is difficult to explain.

It has been demonstrated that the efficiency of a composite repair may be due to improvement of the bond strength at the repair interface.[34] Hadavi et al stated that a clinically adequate bond should be able to prevent microleakage at the repair interface.[35] In the present study, the average force required for the dislodgment of the repair materials was similar to that of the original veneer material. In addition, intimate adaptation at the interface between the original veneer material and the repair materials was observed on the SEM micrographs, but none of the repair materials completely eliminated dye penetration. Dye penetration was seen in 20% of all repaired specimens. It is assumed that the bur used to prepare the veneer material did not create a sufficient micromechanical area for interlocking to occur between the original veneer material and the repair materials.

Cavalcanti et al evaluated the effects of a bonding agent combined with a diamond bur, jet prophylaxis, and aluminum oxide on microleakage at the composite repair interface.[36] They observed microleakage in 21% of all specimens tested, which is similar to the result reported here. Microleakage may occur surrounding the region of the repair[22] and may lead to deterioration of the bond and staining at the repair interface.[37,38] More studies of methods to reduce the occurrence of microleakage are, therefore, required.

Ram et al found that the veneer materials of preveneered posterior crowns showed chipping within 4 years.[20] They did not, however, report the location (occlusal or vestibular) of fractures occurring in the veneer material. In the present study, fractures occurring in primary maxillary and mandibular crowns within the original veneer and the repair materials were observed on both the occlusal and the vestibular portions of the veneer material. There was no significant difference in the frequency of fractures between the 2 locations.

In this study, failure types of the original veneer material and repair materials were either cohesive or mixed (adhesive/cohesive). No crowns showed a pure failure of adhesion. This could be because we used aluminum oxide particles to roughen the stainless steel base. Penetration of the bonding agent into the irregular surface created may improve the microretention of repair materials by interlocking. This may explain the failures characterized by separation from the stainless steel base of both the original veneer material and repair materials. If the veneer material had been attached to the stainless steel base by meshwork, different results might have been obtained.

Group 2 was found to be the source of the significant difference in the extent of the fractures. This difference may have been due to the physical properties or the thickness of the opaquer (Monoopaque) used in group 2. Ozcan et al stated that such properties may affect the adhesion of repair material.[33]

Both repair methods used in this study (Panavia opaque cement and Tetric Flow or Monoopaque and Tetric Flow) gave similar esthetic results because of the high power of the sealing of the opaquers. In a clinical situation in which fractures of preveneered SSCs are experienced, either repair material used in this study may be used.

Conclusions

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

1. Both repair materials gave statistically equivalent shear bond strength (SBS) values when compared with the original veneer material. Continuous internal adaptation was noted in the repair interfaces viewed by scanning electron microscopy (SEM). Microleakage, however, was not completely eliminated.
2. The fracture types observed were either cohesive or mixed for both the original veneer material and the repair materials, but none of the specimens showed an adhesive fracture.
3. There were statistically significant differences between the groups in terms of fracture extent; group 2 was the source of this difference.

References

1. Humphrey WP. Uses of chrome steel in children`s dentistry. Dent Surv 1950;26:945-9.
2. Smith NL, Seale NS, Nunn ME. Ferrric sulfate pulpotomy in primary molars: A retrospective study. Pediatr Dent 2000;22:192-9.
3. Strange DM, Seale NS, Nunn ME, Starange M. Outcome of formocresol/ZOE sub-base pulpotomies utilizing alternative success criteria. Pediatr Dent 2001;23:331-6.
4. Yilmaz Y, ME Kocoğullari. Clinical evaluation of 2 different methods of stainless steel esthetic crowns. J Dent Child 2004;71:1-3.
5. Hortmann CR. The open-face stainless steel crown: An esthetic technique. J Dent Child 1983;50:31-3.
6. Heplin ML. The open-face crown restoration in children. J Dent Child 1983;50:34-8.
7. Roberts JF. The open-face stainless steel crown for primary molars. J Dent Child 1983;50:262-3.
8. Tofukuji WT, Caputo AA, Matyas J, Jedrychowski J. Effect of surface preparation on the bond strength of termoset resins to stainless steel. J Pedod 1989;9:77-3.
9. Carrel R, Tanzilli R. A veneering resin for stainless steel crowns. J Pedod 1989;14:41-4.
10. Weidenfield KR, Draughn RA, Welford JB. An esthetic technique for veneering anterior stainless steel crowns with composite resin. J Dent Child 1994;61:321-6.
11. Baker LH, Moon P, Mourino AP. Retention of esthetic veneers on primary stainless steel crowns. J Dent Child 1996;63:185-9.
12. Wickersham GT, Seale N, Howard F. Color change and fracture resistance of two preveneered stainless steel crowns after sterilization. Pediatr Dent 1998;20:336-40.
13. Waggoner WF, Cohen H. Failure strength of four veneered primary stainless steel crowns. Pediatr Dent 1995;17:36-40.
14. Croll TP, Heplin ML. Performed resin-veneered stainless steel crowns for restoration of primary incisors. Quintessence Int 1996;27:309-13.
15. Salama FS, El-Mallakh BF. An in vitro comparison of four surface preparation techniques for veneering a compomer to stainless steel. Pediatr Dent 1997;19:267-72.
16. Herbst HA, Mourino AP, Moon PC. Retention of composites on alumina-blasted stainless steel crowns. J Pedod 1988;12:179-89.
17. Shah PV, Lee JY, Wright JT. Clinical success and parental satisfaction with anterior preveneered primary stainless steel crowns. Pediatr Dent 2004;26:391-5.
18. Roberts C, Lee JY, Wright JT. Clinical evaluation of and parental satisfaction with resin-faced stainless steel crowns. Pediatr Dent 2001;23:28-31.
19. Fuks AB, Ram D, Eidelman E. Clinical performance of esthetic posterior crowns in primary molars: A pilot study. Pediatr Dent 1999;21:445-8.
20. Ram D, Fuks AB, Eidelman E. Long-term clinical performance of esthetic primary molar crowns. Pediatr Dent 2003;25:582-4.
21. Mjör IA. Repair versus replacement of failed restorations. Int Dent J 1993;43:466-72.
22. Denehy G, Bouschlicher M, Vargas M. Intraoral repair of cosmetic restorations. Dent Clin North Am 1998;42:719-37.
23. Brosh T, Pilo R, Bichacho N, Blutstein R. Effect of combinations of surface treatments and bonding agents on the bond strength of repaired composites. J Prosthet Dent 1997;77:122-6.
24. Machado C, Sanchez E, Alapati S, Seghi R, Johnston W. Shear bond strength of the amalgam-resin composite interface. Oper Dent 2007;32:341-6.
25. Fan PL, Edahl A, Leung RL, Stanford JW. Alternative interpretations of water sorption values of composite resins. J Dent Res 1985;64:78-80.
26. Ash MM, Ramfjord S. Occlusion in operative and restorative dentistry. In: Occlusion. 4th ed. Philadelphia, Pa: WB Saunders Co;1995:53.
27. Celik C. Ozgünaltay G, Attar N. Clinical evaluation of flowable resins in noncarious cervical lesions: Two-year results. Oper Dent 2007;32:313-21.

28. Li J. Effect of surface properties on bond strength between layers of newly cured dental composites. J Oral Rehabil 1997;24:358-60.
29. Bakke M, Holm B, Jensen BL, Michler L, Möller E. Unilateral, isometric bite force in 8- to 68-year-old women and men related to occlusal factors. Scand J Dent Res 1990;98:149-58.
30. Yilmaz Y, Yilmaz A. Repairing a preveneered stainless steel crown with two different materials. J Dent Child 2004;71:135-8.
31. Toledano M, Osorio E, Osorio R, Garcia-Godoy F. Microleakage and SEM interfacial micromorphology of amalgam restorations using three adhesive systems. J Dent 2000;28:423-8.
32. Souza M, Retief DH, Russell CM. Laboratory evaluation of phosphate ester bonding agents. Am J Dent 1994;7:67-73.
33. Ozcan M, Vallittu PK, Huysmans MC, Kalk W, Vahlberg T. Bond strength of resin composite to differently conditioned amalgam. J Mater Sci Mater Med 2006;17:7-13.
34. Lewis G, Johnson W, Martin W, Canerdy A, Claburn C, Collier M. Shear bond strength of immediately repaired light-cured composite resin restorations. Oper Dent 1998;23:121-7.
35. Hadavi F, Hey JH, Ambrose ER, Elbadrawy HE. Effect of different adhesive systems on microleakage at the amalgam/composite resin interface. Oper Dent 1993;18:2-7.
36. Cavalcanti AN, Lobo MM, Fontes CM, Liporoni P, Mathias P. Microleakage at the composite-repair interface: Effect of different surface treatment methods. Oper Dent 2005;30:113-7.
37. Chalkley Y, Chan DC. Microleakage between light-cured composites and repairs. J Prosthet Dent 1986;56:441-4.
38. Saunders WP. Effect of fatigue upon the interfacial bond strength of repaired composite resins. J Dent 1990;18:158-62.

Abstract of the Scientific Literature

Predicting factors of poor behavior in children during the induction phase of general anesthesia

The aims of this study were to delineate factors that would aid in predicting negative behavior compliance in children prior to the induction phase of general anesthesia; and to use these factors in developing a predictive model to be used preoperatively in assessing children. These factors were identified from the patient, the procedure and the health care system. The study examined 861 children from the ages of 1-13 years, who were developmentally normal and classified as ASA I to III. The use of an induction room permitted all parents to be present for the induction procedure. The Induction Compliance Checklist (ICC), an observational scale of 10 behavior characteristics, was used to assess the behavior of each child during the induction. Scores were noted for each of the 10 characteristics observed with a total > 4 being poor. The expectation of poor behavior resulting from multiple factors led to the use of a multivariable ordinal logistic regression model which was evaluated by the c statistic. Poor behavior was exhibited by 21% of the children with several contributory factors such as younger age, previous induction anesthesia, pre-induction high anxiety and short preparation time increasing the odds of negative behavior compliance. Using this ICC model, the factors determined mild-moderate differences between the children showing negative compliance and those showing the most positive compliance. From the contributory factors a predictive algorithm was determined that might help identify children who are high risk for behavioral and or pharmacological interventions.

Comments: *When considering the multi-factorial causes of negative behavior and the use of pharmacological and behavioral guidance interventions, the resulting algorithm from this study, if simplified, might aid pediatric dentists by providing a more measurable preoperative assessment of patients at high risk for poor behavior compliance.* ***JGJ***

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Varughese A, Nick TG, Gunter J, Wang Y, Kurth CD, Factors predictive of poor behavioral compliance during inhaled induction in children. Anesth Anal 2008;107:413-21.

26 references