Clinical Evaluation of Two Different Methods of Stainless Steel Esthetic Crowns

Yucel Yilmaz, DDS, PhD *Mutlu Elçin Koçoğullari, DDS*

ABSTRACT

Purpose: The purpose of this study was to compare the clinical success of stainless steel crowns (SSCs) made esthetic by open facing or veneering on posterior primary teeth.
Methods: Thirty-three crowns (18 open-face and 15 veneered) were placed and followed up for 18 months with semiannual evaluations.
Results: Crowns made esthetic with the open-face method showed a success of 95%, while the veneered crowns showed a success of 80% based on greater than two thirds facing retention. Statistical evaluation by 2 proportion test showed no significant difference between groups ($P>.05$). In addition, a statistically significant difference was found between upper and lower crowns by Fisher's exact test ($P<.05$).
Conclusions: This study showed that open-face SSCs had a higher but not significantly different success rate than veneered SSCs. Upper-arch crowns exhibited a higher success rate than those in the lower arch. (*J Dent Child.* 2004;71:212-214)

KEYWORDS: PRIMARY TEETH CROWNS, OPEN-FACE STAINLESS STEEL CROWN, VENEERED STAINLESS STEEL CROWN, ESTHETIC POSTERIOR PRIMARY TEETH RESTORATION

Little data are available related to using open-face stainless steel crowns (SSCs) on posterior teeth, and reports are limited to technical or case presentations.[1,2] Some reports suggest cement removal from the window to make the underlying tooth tissue visible on the SSC's vestibular surface.[3-5] When little tooth tissue remains and the crown is cemented with glass ionomer cement, composite resin can be strongly bonded to the cement if it is not removed from the window.[6] To provide the resin material with stronger bonding, a 1-mm groove on the gingival area and cement removed around the window as far as 1-mm deep inside from the surface is recommended.[7]

Veneering is the other method used to make the SSC esthetic, and different techniques and materials are used. Tofukuji et al[8] veneered the SSC with thermoset resin. The strongest stability with this resin was achieved when an orthodontic cleat was soldered onto the crown to provide mechanical stability. Bahannan and Lacefield[9] found that Panavia EX and Cover-up were significantly more effective than Silicoating.

Dr. Yilmaz is assistant professor, and Dr. Koçoğullari is research assistant, Department of Pedodontics, Atatürk University, Faculty of Dentistry, Erzurum-Turkey. Correspond with Dr. Yilmaz at yyilmaz25@atauni.edu.tr

Veneered SSCs for both primary anterior and primary posterior teeth have been marketed to decrease chair time. Studies of these crowns suggested veneering material bonded on the underlying structure was positive.[10-12] Disadvantages include sterilization and high costs.[11-14]

The purpose of this study was to evaluate the clinical success of SSCs that were made esthetic clinically and applied to primary molar teeth.

METHODS

A convenience sample of 21 children (mean age=6.28 years) applying to the Clinic of Pediatric Dentistry at the Faculty of Dentistry, Atatürk University, Erzurum, Turkey, were included in this study after receiving permission from thier parents. Clinical loss of tooth structure requiring SSCs in the lower or upper first or second primary molars was among the inclusion criteria. No pathology could be present or endodontic treatment given, and the proportion of root resorption could not exceed one third of the root.

Two operators each trained and experienced with both technique groups prior to testing, were calibrated regarding the open-face crown preparation and veneer crown construction. Thus, crowns were prepared or constructed by the operators. Crown type for upper or lower arch was selected via a coin toss.

After meeting the clinical and radiographic criteria, 33 teeth

received SSCs (3M Dental Products St. Paul, Minn) and were divided randomly into 2 groups for open-face or veneered SSC preparations. Color selection of resin was made for both groups at this time.

The crowns, onto which windows would be opened for the open-face technique, were cemented on the selected teeth using a luting glass ionomer cement (Aqua Meron art. no.1172, Voco. Cuxhaven, Germany). In this same visit, a window was opened on the crown's vestibular surface and tooth hard tissue was made visible by removing this surface's luting cement. The window previously opened was covered with a temporary restorative material (Cavit-G, ESPE Dental AG D-82229, Seefeld, Germany) without eugenol and was kept so until the second visit. The temporary restorative material was removed.

Next, the exposed tooth hard tissue was etched with phosphoric acid (Voco, Cuxhaven, Germany) for 60 seconds, washed, and dried with polyurethane foam pellets (Pele Tim, Voco, Cuxhaven, Germany). Prime&Bond 2.1 (Dentsply, DeTery GmbH D-78467, Konstanz, Germany) was applied and, after 20 seconds, cured with visible light for 10 seconds. Dyract (Dentsply, DeTrey GmbH D-78467, Konstanz, Germany), a polyacid modified resin composite, was then placed incrementally with each layer and cured for 40 seconds with visible light. The surface was finished by Sof-Lex (3M Dental Products, St. Paul, Minn) contouring and polishing discs.

SSCs that were already adapted and would be veneered were not cemented during the first visit and were kept for laboratory procedures. The crown's vestibular surface was made rough with Sof-Lex contouring and polishing discs. Four parallel grooves in the occlusogingival direction and 1 groove vertical to them in the mesiodistal direction were prepared for retention by means of a no. 012 diamond round bur (North Bell International, Milano, Italy). K-ETCHANT GEL (Kuraray Co, Ltd, Japan) was applied to the prepared surface for 10 seconds, according to the manufacturer's instructions, then washed and dried with compressed air for 20 seconds. A thin layer of Panavia 21 resin cement (Kuraray Co, Ltd, Japan) was placed with a plastic applicator. Over it was placed Prime&Bond 2.1 dentin bonding agent, which was cured with a visible light for 10 seconds.

After this procedure, Dyract was applied on the vestibular surface—leaving 0.5 mm of metal exposed next to the gingival area—and was polymerized for 40 seconds. The thickness of the placed esthetic material, together with the SSC, was maintained close to 1.5 to 2 mm. Both the Dyract material and gingival crown margin were finished and polished with Sof-Lex discs, the crowns were cemented with Aqua Meron luting cement, and occlusion was checked.

Children were followed over the next 18 months at 6-month intervals for evaluation of the esthetic material's clinical success. A loss of one third or more of the esthetic material was recorded as failure of the technique. The authors independently evaluated each facing. When disagreement occurred, decision by consensus was made. Differences between the groups' success levels were analyzed using the 2 proportion test. In addition, success rates of upper and lower crowns were compared using Fisher's exact test.

Table 1. Crown Distribution According to Success Rates During Observation Periods and Positions

Crown type	Positions		Success rates (failures)		
	Upper	Lower	6 mos	12 mos	18 mos
Open-face	11	7	100% (0)	100% (0)	95% (1)
Veneered	6	9	87% (2)	92% (1)	100% (0)

RESULTS

The distribution of crowns per jaw and clinical evaluation results are shown in Table 1. The success rate for open-face SSCs was 100% for the first 6 months and 95% for the last 6 months. The success rates for veneered crowns at each evaluation period were 87%, 92%, and 100%, respectively. Open-face crowns had a 95% success rate, and veneered crowns showed an 80% success rate. There was no statistically significant difference between the groups (t=1.69; P>.05). All failures occurred in open-face and veneered SSCs in the lower jaw. Fisher's exact test revealed significant differences between success rates for upper and lower crowns (P<.05).

DISCUSSION

Posterior primary molars made esthetic by means of open-face and veneering techniques were not statistically different in terms of facing loss.

The higher success rate of open-face SSCs may be caused by: (1) firmly bonding resin to teeth tissue; (2) using dentin bonding; and (3) phosphoric acid etching. A rough and porous structure may be formed on the remaining glass ionomer cement. Unfilled resin may infiltrate into this irregular and hard surface, form holding tags, and, thus, contribute to bonding.[15]

Prime&Bond 2.1 and Panavia 21 are materials containing phosphate. It is believed that bonding to metals occurs between oxygen atoms of phosphate and carboxylate groups of adhesives and surface metal oxides.[16,17] The dentin bonding system used in this study may be thought to have contributed to bonding resin material in a similar way by touching upon the crown's interface in both SSC groups.

Knight et al[18] showed that dentin adhesive systems, including Prime&Bond 2.1, might be used to bond resin materials to metal alloys. Wiedenfeld et al[19] stated that the surface thickness of esthetic material in crowns on anterior primary teeth veneered in laboratory conditions was between 1 and 2 mm. Fuks et al[14] explained that the thickness of crown walls of preveneered SSCs for molar primary teeth was between 0.7 and 1.7 mm.

In this study, the thickness of the vestibule face of veneered crowns was kept between 1.5 and 2 mm. This increase in volume occurring on the veneered crowns' vestibular surface may cause the esthetic material to be subjected to higher chewing force and to display failure. The fact that all failures in the veneered SSCs applied by the authors occurred only in the lower jaw supports this situation.

Commercially preveneered crowns can be difficult to fit, due to the tendency to fracture esthetic materials during contouring and crimping.[14,20] In both techniques used in this study, however, contouring and crimping of SSCs are accomplished before the esthetic process. Additionally, Dyract was preferred in this study for both techniques because of its anticariogenic and esthetic features.

Open-face SSCs reflected higher success rates, although they displayed less esthetics than veneered crowns when compared at the end of the 18-month period (95%, 80%).

Albers[21] stated that primary teeth on which SSCs would be applied should remain in the mouth at least 2 years. Starting from that point of view, the authors believe that it would be more appropriate to use the open-face technique when these crowns are made esthetic.

CONCLUSIONS

Based on this study's results:

1. Although the open-face crowns were more successful than veneered construction crowns, there was no significant difference between groups.
2. All failures occurred in the lower arch. Upper-arch crowns had higher success rates than lower-arch crowns.

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