Clinical performance of esthetic posterior crowns in primary molars: a pilot study

Anna B. Fuks, CD Diana Ram, DrOdont Eliezer Eidelman, DrOdont, MSD

Dr. Fuks is a professor; Dr. Ram is an instructor; and Dr. Eidelman is a professor and chairman, and they are all at the Hadassah School of Dental Medicine, Department of Pediatric Dentistry, Hebrew University, Jerusalem, Israel.

Abstract

Purpose: *The aim of this pilot study was to assess the clinical performance of esthetic crowns and to compare these to conventional stainless steel crowns (SSC).*

Methods: *Twenty two crowns (11 conventional and 11 esthetic) were placed in mandibular primary molars obeying the following criteria: the tooth was not mobile; no fistulae were present; the tooth had at least one caries free or properly restored antagonist and had to be in contact with one adjacent tooth mesially, in the case of the primary second molars or distally in the case of the primary first molars. Crown preparation was done in a conventional manner, but reduction was more extensive for the thicker esthetic crowns, to allow for proper occlusion. The crowns were evaluated clinically and radiographically after 6 months and the following parameters were assessed: gingival health, marginal extension, crown adequacy, proper position or occlusion, proximal contact, chipping of the facing (for esthetic crowns) and cement removal.*

Results: *At the 6 month evaluation all esthetic crowns were intact, without chipping of the facing, and no excess of cement was observed in both groups. No difference was found for marginal extension, occlusion, proximal contact, crown adequacy, and bone resorption, but a significant difference was found for periodontal health between esthetic crowns and conventional SSC (P<0.001 McNemar test).*

Conclusion: *The esthetic crowns assessed had several inconveniences, as they resulted in poor gingival health, are very expensive, and, although not measured, are bulky and without a natural appearance. (Pediatr Dent 21:445-448, 1999)*

Preformed stainless steel crowns were introduced to pediatric dentistry by Humphrey in 1950. Since that time, they have become an invaluable restorative material in the treatment of badly broken-down primary teeth. They are generally considered superior to large multisurface amalgam restorations and have longer clinical lifespan than two or three surface amalgam restorations.[1]

There are two commonly used types of stainless steel crowns:

1) Pre-trimmed crowns, with straight, noncontoured but festooned sides, to follow a line parallel to the gingival crest. They still require contouring and some trimming.
2) Pre-contoured crowns, which are festooned and are also precontoured. Some trimming and contouring may be necessary, but usually these are minimal.[2]

Stainless steel crowns are mainly indicated to restore hypoplastic teeth, teeth with extensive caries, and after pulpotomy or pulpectomy when they become brittle and are prone to fracture.[3] These crowns have been used extensively for many years, with insignificant and or clinically acceptable gingival irritation.[4] The main drawback for this type of restoration is the poor esthetics. Several methods have been proposed to esthetically restore broken down anterior teeth,[6-8] but no efforts have been made thus far to solve the esthetic problem of posterior crowns. Recently, a new type of posterior crown appeared on the market, proposing both a functional and esthetic solution for badly decayed, pulpotomized or pulpectomized primary molars.

Esthetic crowns consist mainly of conventional stainless steel crowns to which a composite facing has been added in the laboratory. The composite veneer covers the facial, occlusal, mesial, and distal aspects of the crown, and its thickness varies from 0.6 mm at the mesio-buccal to 1.5 mm at the occlusal surface (Fig 1).

The manufacturer's recommendations for the use of these crowns are the following:

1. Prepare the tooth as for a standard stainless steel crown, bearing in mind that greater circumferential and occlusal reduction will be required.
2. Do not excessively force the crown onto the tooth. Find the crown size that is the closest fit and refine the preparation of the tooth to fit the crown. A properly fitted crown should have a passive fit.
3. Crimp the lingual aspect of the crown slightly, or contour the mesial and distal aspects of the

Fig 1. Photograph of esthetic crowns. Notice the difference in thickness of the composite facing at several areas of the crown. A (occlusal -1.7 mm), B (facial - 1.5 mm), C (cervical - 1.2 mm). Thickness of the stainless steel crown: 0.2 mm.

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Table 1. Criteria for Clinical and Radiographic Evaluation

1) Gingival health: according to a modified gingival index (Silness & Loe)[13]
   - A: No bleeding
   - B: Bleeding with probe
   - C: Spontaneous bleeding
2) Marginal extension: measured in mm using a periodontal probe
   - A: 0.5 mm
   - B: 1 mm
   - C: More then 1 mm
3) Proper position or occlusion:
   - A: Normal position
   - B: Rotated but in occlusion
   - C: Faulty occlusion
4) Chipping of facing: only for esthetic crowns
   - A: Intact
   - B: Partially chipped
   - C: Completely lost
5) Proximal contact:
   - A: Excellent — resistance met while passing floss
   - B: Fair — contact present but floss passed without resistance
   - C: Poor — no contact with adjacent tooth
6) Cement removal
   - A: No cement left
   - B: Cement left without gingival inflammation
   - C: Cement retained causing gingival inflammation
7) Radiographic evaluation
   - A: Adequate crown: all dentin covered after caries removal
   - B: Short crown

crown slightly. Excessive flexure of the metal structure underneath the composite, however, may cause fractures in the composite.

4. The length of the crown may be altered by trimming the gingival margins with a diamond disc. However, this is not likely to be necessary if the tooth has been adequately prepared subgingivally.
5. The occlusion may be refined by shaping with a fine finishing bur.

To our knowledge there are no reports in the literature on the clinical performance of these crowns.

The purpose of this study was to assess the clinical performance of mandibular esthetic posterior crowns and compare them to that of conventional stainless steel crowns. The present report describes the preliminary results of this investigation.

Methods

The study was carried out at the postgraduate clinic of the Department of Pediatric Dentistry at the Hadassah School of Dental Medicine. The study was limited to mandibular molars for financial reasons, as it would become too expensive to purchase starter kits for first and second molars of both arches. Patients participating in the study had to possess at least two mandibular primary molars meeting the following criteria:

1) the tooth needed a crown restoration;
2) the tooth had at least one caries free or properly restored opposing tooth and had one adjacent tooth mesially in the case of primary second molars and two adjacent teeth in the case of primary first molars. The adjacent teeth had to be caries free or properly restored, with no space loss;
3) the tooth was not submerged;
4) the tooth was not mobile;
5) no fistulae were present.[9]

In addition, their parents had signed a consent form, following the approval by the human use committee.

A matched pair study design was used, as both the esthetic and the conventional stainless steel crown would be subjected to a similar oral environment and comparable hygiene habits. The tooth to be restored by an esthetic crown (NuSmile, Houston, Texas) was selected by the toss of a coin, and its antimere received a conventional one. Eleven children met these criteria and 22 crowns (11 conventional and 11 esthetic) were placed as a pilot study.

Crown preparation and cementation technique

The teeth were anesthetized and preparation of the crown was done under rubber dam using a conventional technique:[2] proximal reduction, long bevels on the lingual, and virtually no reduction of the facial bulge.

The occlusal surface reduction, however, was more extensive for the esthetic crowns than for the conventional ones (1.5 mm approximately), to allow for a proper occlusion, as the esthetic crowns are thicker. The esthetic crowns were not trimmed, but the conventional ones were contoured and trimmed as accepted in routine pediatric dentistry practice.

The crowns were cemented with a glass ionomer cement, that has been shown to provide better retention than the traditionally used zinc phosphate cement.[3]

Occlusion was checked by observing the proper intercuspation of the treated and contra-lateral side, particularly at the molars and cuspid areas; no articulation paper was used.

Table 2. Six Month Clinical-Radiographic Evaluation

Clinical Evaluation	Gingival Health			Marginal Extension			Occlusion			Contact			Chipping		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Esthetic	-	10	1	10	1	-	9	2	-	11	-	-	11	-	-
Conventional	11	-	-	10	1	-	11	-	-	10	1	-			
Radiographic Evaluation	**Crown Adequacy**			**Bone Resorption**											
	A	B		A	B										
Esthetic	11	-		10	1										
Conventional	11	-		11	-										

Evaluation

The crowns were evaluated clinically and radiographically after six months according to the parameters and criteria presented in Table 1 and analyzed statistically (McNemar test).

Results

The results of the clinical parameters evaluated at the six month examination are summarized in Table 2. Gingival health was rated B (gingival bleeding was present on probing) in 10 esthetic crowns and one scored C (spontaneous bleeding), and had to be replaced. All the conventional crowns were rated A (no bleeding). This difference was statistically significant ($P<0.001$).

Extension of the crowns in the buccal surface was similar in both groups: all but one crown in each group extended 0.5 mm subgingivally (score A) and the remaining crown of each group was rated B (1mm.).

All the conventional crowns and nine esthetic crowns occluded in a proper position (score A) while two of the esthetic crowns were slightly rotated, but in occlusion. This difference was not statistically significant. The contact point with the adjacent teeth was rated A for all the esthetic crowns and 10 conventional crowns; one conventional crown scored B (loose contact). No excess cement nor caries was observed in both groups, and bone resorption could be seen radiographically in one esthetic crown.

Discussion

The ideal restorative technique should assure strength, durability, esthetics, and efficiency in placement.[2,5] Many of the currently available regimens fail to fulfill one or more of the goals mentioned above. Most efforts have been directed to improve esthetics for primary anterior teeth. Restorative techniques currently in use to treat these teeth include composite strip crowns, polycarbonate crowns, open faced stainless steel crowns, and commercially veneered stainless steel crowns. Each of these techniques presents technical, functional, or esthetic compromises, that complicate their efficient and effective use.[2,10] Less effort has been placed in finding an esthetic solution for primary posterior teeth, probably based in these difficulties.

In the last few years esthetic crowns for primary molars appeared on the market, definitely an asset if it could keep the advantages of the conventional stainless steel crowns.

In the present pilot study gingival health should have been evaluated preoperatively. However, as the teeth to be crowned had extensive caries and consequently were prone to plaque accumulation and gingival inflammation, this was not done. Moreover, immediate postoperative assessment was not relevant, as most crowns of both types presented with slight bleeding right after cementation. The correct approach would have been to assess gingival health one or two weeks after placement, but this was not practical as most parents would refuse coming to the clinic just for this purpose.

The only objective difference that could be observed was related to periodontal health and gingival index that was definitely superior in the conventional crowns (Table 2). This was probably due to the bulk of the veneer on the esthetic crown, resulting in a thicker margin. Thickness of the crown walls was measured with a caliper and varied from 0.7 mm and 1.7 mm depending on the part of the surface checked, much thicker than the conventional ones (about 0.2 mm) (Fig1). This difference could lead to plaque accumulation, as it seems to be more difficult to brush and keep clean the gingival margin area. Roberts[7] reported good results with an open face stainless steel crown in a primary molar followed up until exfoliation. Although no reference is made to gingival health, it is assumed that it was similar to the conventional stainless steel crowns. However, the presence of the visible metal at the cervical margin definitely compromises the esthetics.

Fig 2. Mandibular second primary molar just prior to cementation, and before rubber dam removal. Notice the blanching of the buccal gingiva and the bulky appearance of the crown.

Although no statistical differences could be seen in the present evaluation, there are several subjective points that should be taken into consideration:

a) Occlusal reduction for esthetic crowns has to be greater than that for conventional crowns, as suggested by the manufacturer, to compensate for the thickness of the veneer. This can be a problem in teeth of very young children, where the dentin is thinner than in older children and the pulp horns are higher and closer to the surface. A more aggressive occlusal reduction in these teeth might result in pulp exposure. This is not a problem in pulpotomized teeth.

b) Adequate adaptation of the esthetic crown at the buccal gingival margin is much more difficult to obtain due to its thickness, which pushes and irritates the buccal gingival tissue. This is aggravated by the impossibility of crimping the crown in this area; some crimping can be done at the lingual and proximal margins (Fig 2).

c) The crowns have to fit loosely, as pressure creates strain that might endanger the stability of the facing. The new brands of crowns seemed to have overcome this problem.[11] It should be emphasized that all the esthetic crowns in the present study were intact without chipping.

d) The final esthetic result is not always pleasing to the parents, as the crowns are bulbous and stand out next to the more delicate and natural looking adjacent teeth (Fig 3).

e) Although time for preparation and cementation are similar, esthetic crowns are considerably more expensive than the conventional, and the cost to the patient would have to be much higher.

Stainless steel crowns have been recommended to restore badly broken down teeth, and have been considered to be superior to large multisurface amalgam restorations.[1] However, esthetic dentistry has developed considerably in the last two

Fig 3. Mandibular second primary molar one year post-operatively. Notice the inflamation at the gingival margins and facial bleeding after probing.

Fig 4. Mandibular first primary molar crown one year after service. Notice its bulky appearance and moderate inflammation on the mesial gingival papilla and at the marginal gingiva.

decades, and a good condensable composite could be the answer to restore these teeth. Good clinical and radiographic preliminary results have been observed in pulpotomized teeth restored with composite when compared to stainless steel crowns (Fuks and Papagiannoulis unpublished results). Another option has been recently described: the undermined cusp could be reinforced with composite and the cavity restored with bonded amalgam or composite.[12] However, placement of composite resins is time consuming and technique sensitive.

Therefore, esthetic crowns will have a larger role in pediatric dentistry if some improvements are made to lessen the thickness of the veneer, thus reducing the bulk and giving it a more natural appearance.

Conclusion

The esthetic crowns assessed had several inconveniences, as they result in poor gingival health, are very expensive, and although not measured, are bulky and without a pleasing appearance.

References

1. Messer L.B, Levering NJ: The durability of primary molar restorations: Observations and predictions of success of stainless steel crowns. Pediatr Dent 10(2):81-85, 1988.
2. Waggoner WF: Restorative dentistry for the primary dentition in pediatric dentistry. In Infancy Through Adolescence, Pinkham. 2nd Ed. WB Saunders Company, 1994. pp 312-17.
3. Garcia Godoy F, Bugg JL: Clinical evaluation of glass- ionomer cementation on stainless steel crown. J Pedod 11 (4):339-44, 1987.
4. Einwag J: Effect of entirely preformed stainless steel crowns on periodontal health in primary, mixed dentition. ASDC J Dent Child 51 (5): 356-59, 1984.
5. Weidenfeld KR, Draughn RA, Welford JB: An esthetic technique for veenering anterior stainless steel crowns with composite resin. ASDC J Dent Child 61(6):321-26, 1994.
6. Weidenfeld KR, Draughn RA, Gotra SE: Chairside veneering of composite resine to anterior stainless steel crowns: another look. ASDC J Dent Child 62 (4): 270-73, 1995.
7. Roberts JF: The open-face steel crown for primary molars. ASDC J Dent Child 50(4):262-3, 1983.
8. Waggoner WF, Cohen H: Failure strength of four veneered primary stainless steel crowns. Pediatr Dent 17 (1):36-40, 1995.
9. Adair SM, Felsenstein J: Development and application of weighted criteria to assess stainless steel crown restorations on primary teeth. J Pedod 11 (4):345-57, 1987.
10. Helpin ML: The open-face steel crown restoration in children. J Dent Child 50:34-38, 1993.
11. Berg JH: The continuum of restorative materials in pediatric dentistry: a review for clinicians. Pediatr Dent 20: 93-100,1998.
12. Eidelman E: Composite resin support of undermined enamel in amalgam restorations. Pediatr Dent 21:118-120,1999.
13. Loe H, Sillness J: Periodontal disease in pregnancy: Prevalence and severity. Acta Odontol Scand: 21: 533-551, 1963.