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New techniques for producing aesthetic, direct full-crown composite resin restorations for primary molars: a 24-month follow-up study of eight cases

ABSTRACT

Aim Although the demand for aesthetic restoration of primary molars has increased, techniques for producing aesthetic, direct full-crown restorations using light-cured composite resin for primary molars and the associated clinical outcome are not well established. The aim of this study was to describe the use of new techniques to produce aesthetic, direct full-crown restorations using light-cured composite resin for primary molars. The authors evaluate the clinical outcomes of the restoration method and investigate whether this technique could be used as an alternative to conventional methods.

Materials and methods Two new techniques, the resin block and the clear matrix, were studied by treating 8 teeth. The occlusal surface of stainless steel crowns was used for impression-taking to facilitate accurate reproduction of the anatomic structure, and the aesthetic restoration was obtained simply and consistently.

Results At the 24-month follow-up evaluation, these new direct techniques were completely satisfactory. Marginal discoloration was observed in one tooth treated with the clear matrix technique, and a small

partial wear was observed in another tooth treated with the resin block.

Conclusion The new techniques for restoration resulted in functional and aesthetic reproduction of occlusal morphology. Therefore, these techniques could be considered a practical alternative to conventional methods.

Keywords Aesthetic restorations; Clear matrix; Composite resin; Direct full-crown; Primary molar; Resin bloc.

Introduction

Demand for aesthetic restoration of primary molars is increasing. However, stainless steel crowns (SSCs) have been used for the full crown restoration of primary molars with severe caries, especially in patients receiving endodontic treatment, for many years. SSCs are easy to place on the tooth because they come preformed and are easy for the dentist to manipulate. Pre-veneered SSCs, which are modified by veneering the bucco-occlusal surface of SSCs with a composite resin or a hybrid composite [Fuks et al., 1999], have been used in recent years for aesthetic full crown restoration of primary molars. However, clinical reports indicate that the veneer material chips away from the surface of all SSCs within 4 years [Ram et al., 2003].

Composite resins have long been considered to be unsatisfactory materials for full crown restoration of primary molars because they exhibit different wear properties and are harder than primary enamel, resulting in severe attrition of opposing primary teeth. In fact, a significant amount of wear has been observed on the enamel, resin, or both, which may pose a problem clinically [Hickel et al., 2005; Puppini-Rontani et al., 2006]. However, bonding systems and composites have improved. To satisfy the aesthetic expectations of patients, we believe that the use of composite resins for full crown restoration of primary molars would be acceptable if these resins have proper wear resistance and cause little or no wear on the enamel of the opposing teeth.

The primary teeth usually present attrition according to age. Therefore, we previously determined the wear characteristics of occluding enamel and composite resin materials that were thought to be appropriate for full crown restoration of primary molars [Wada et al., 2011]. We reported that light-cured resin composites may be more appropriate for full crown restorations of primary molars than hybrid or chemically cured types [Wada et al., 2011].

For many years, SSCs have been recommended for

restoration of endodontically treated primary teeth [Croll, 1999; Guelmann et al., 2005] but without the support of actual data. One study reported that pulpotomised primary molars restored with composite resin were in good condition after 2 years [Cehreli et al., 2006].

Restoring primary molars with composites is a technique-intensive task, requiring adjustments, polishing, and considerable time. Use of the indirect technique for such restoration has been reported [Rabelo et al., 2005; Villalta et al., 2006]. However, the indirect technique also presents some drawbacks, as it requires laboratory time, especially for waxing of the occlusal surface.

The aim of this study was to describe the use of new techniques to provide aesthetic, direct full-crown restorations using a light-cured composite resin for primary molars. The authors evaluated the clinical outcomes of the restoration method and investigated whether this technique could be used as an alternative to conventional methods.

Materials and methods

Case presentation

Eight primary molars of pediatric patients aged 3–6 years were treated with full crown restoration using a light-cured composite resin at the Pediatric Dentistry Clinic of the Dental Hospital at Tokyo Medical and Dental University. All molars presented severe caries and required endodontic treatment followed by occluso-proximal restoration (i.e., MO or DO). The restoration treatment was performed after informed consent was received from the parents in every case. This study was conducted with the approval of the Ethical Committee of Tokyo Medical and Dental University (No. 1033).

Clinical evaluation

All patients were observed for 24 months after treatment. The restoration quality was evaluated at baseline and at 1, 3, 6, 9, 12, 15, 18, and 24 months after treatment. The endodontic treatment and the restorations were performed by the authors K.W. and M.M., respectively. The restoration quality was

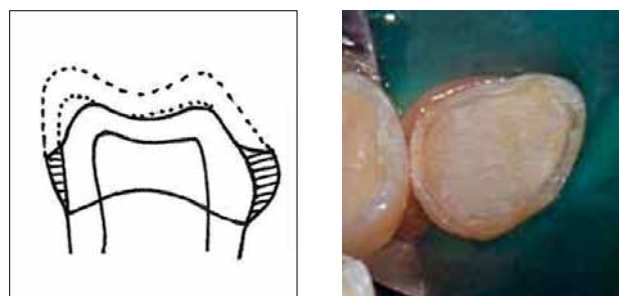


FIG. 1 Tooth preparation for a crown.

evaluated by 5 dentists.

Pre-treatment

In the endodontically treated molars, the surface of the pulp chamber and the access cavity were filled with light-cure composite resin (Fantasista [FS], Sun Medical Co. Ltd., Shiga, Japan) after the cavity surface was covered with self-curing dental adhesive resin cement (Super Bond C&B, Sun Medical Co. Ltd., Shiga, Japan).

In molars with an inter-proximal cavity, a metal matrix band was then applied and fixed with a wooden wedge. A one-component, self-etching, light-cured adhesive (G-Bond Plus, GC Corporation, Tokyo, Japan) was applied following the manufacturer's instructions. A small amount of FS resin was first applied to build up the proximal wall. After the light curing was completed, the inter-proximal matrix was removed.

Teeth were prepared using a diamond bur on a high-speed handpiece with copious water flow and a carbide bur on a contra-angle handpiece (Fig. 1). The margins were then finished and polished using silicon rubber points.

Procedures

- › Resin block technique (Group 1): the following case study illustrates a step-by-step direct full crown composite resin restoration technique using an occlusal resin block for primary molars (Fig. 2). There were 4 restorations: 74, 75, 84, and 85. In the first phase, occlusal analysis was performed using a study model. Vinyl polyxiloxane dental

FIG. 2 Resin block technique.





FIG. 3 Clear matrix technique in the first phase.

impression materials (EXAFINE putty and Fusion II wash type, GC Corporation, Tokyo, Japan) were used for impression-taking of the occlusal surface of SSCs (Anatom Primary Crowns, Dentsply Sankin, Tokyo, Japan) (Fig. 2A). The crown size of the patient's tooth was measured in the study model, and an occlusal resin block size suitable for the size of the patient's tooth was chosen from the 7 sizes of silicon plate. Using the incremental technique, FS was then inserted into the silicone plate to prepare an occlusal resin block (Fig. 2B). In the second clinical phase, a rubber dam was put into place. After pre-treatment, the appropriate green activator was applied to the tooth surface according to the manufacturer's instructions. The tooth was then rinsed copiously with water and dried with a gentle stream of air. Self-cure dental adhesive resin cement (Super Bond C&B) was applied, and the occlusal resin block was positioned and stabilised in the original anatomic position on the occlusal surface of the tooth (Fig. 2C). The rubber dam was removed. Excess composite was removed, and the surface was polished with an abrasive silicon carbide bur. The occlusion was checked using articulating paper (Fig. 2D).

› Clear matrix technique (Group 2): the following

case study illustrates the clear matrix technique in a stepwise manner (Fig. 3, 4).

There were 4 restorations: 74, 75, 84, and 85. In the first phase (Fig. 3), occlusal analysis was performed using a diagnostic study model (Fig. 3A). The occlusal surface of the SSCs (Anatom Primary Crowns) was cut (Fig. 3B) and placed on the treated tooth (Fig. 3C). Waxing was performed on the remaining tooth between the occlusal surface of the SSCs on the study model (Fig. 3D). An occlusal analysis was then performed on the study model. A clear partial-arch impression tray of the appropriate size was selected (Fig. 3E), a clear bite registration silicone material (Glassbite, Detax dental, Ettlingen, Germany) was placed into the impression tray (Fig. 3F), and an impression was taken (Fig. 3G). A clear occlusal matrix was then made. The internal detail of the clear occlusal matrix was checked (Fig. 3H). In the second clinical phase (Fig. 4), a rubber dam was set in place. After the pre-treatment, the clear occlusal matrix was positioned and stabilised in the original anatomic position on the occlusal surface of the tooth. The appropriate green activator was applied to the surface according to the manufacturer's instructions. The tooth was then rinsed copiously with water and dried with a gentle stream of air, and



FIG. 4 Clear matrix technique in the second clinical phase.

self-cure dental adhesive resin cement (Super Bond C&B) was applied. The clear occlusal matrix opened small escape routes for the composite resin. The FS composite resin was filled with the clear occlusion matrix, and light was applied through the matrix while it was held under pressure to ensure perfect positioning (Fig. 4A). The light was applied through the clear occlusal matrix for one minute to cure the FS composite resin. After polymerisation, the clear occlusal matrix was removed, and additional polymerisation was allowed to occur for 1 min. The rubber dam was removed from the tooth and the occlusal anatomy was evaluated. Excess composite was removed, and the surface was polished using an abrasive silicon carbide bur (Fig. 4B). The occlusion was checked using articulating paper (Fig. 4C).

Clinical outcomes

Evaluation of clinical outcomes at the 24-month observation of the restorations may highlight the problems, advantages, and improvement of these techniques over conventional methods. Brittleness or fracture of the composite resin restorations was not observed in any case. No caries were present between the restoration and enamel, the restoration of the marginal adaptation was fully intact, and the enamel along the restoration margins was free of any visible cracks, fractures, or loss. Additionally, significant wear was not observed on the antagonist enamel. Marginal discoloration was observed after 9 months in one tooth at the boundary between the remaining tooth and the restoration treated with the clear matrix technique. Small partial wear was observed after 12 months in one tooth in the distal occlusal region of the resin restoration treated with the resin block technique.

Discussion

At the 24-month follow-up evaluation, the quality of the full crown composite resin restorations prepared using these new direct techniques was completely satisfactory. Our results indicate no significant wear and no fractures of composite resin restorations or enamel along the restorative margins. In addition, no significant wear was observed on the antagonist enamel, which is a major concern for clinicians apprehensive about using nonconventional materials. Our results at 24 months after treatment suggest that these new techniques could be applicable in clinical use. However, because marginal discoloration was observed after 9 months in one tooth at the boundary between the remaining tooth and the restoration prepared using the clear matrix technique, improvements to the polishing and coating agents are required to prevent this discoloration. Furthermore, a small partial wear was observed after 12 months in one tooth in the distal

occlusal region of the resin restoration treated with the resin block technique. Thus, a patient's occlusion should be observed frequently to detect changes. Care must be taken to fully secure the clearance and resin block thickness during pre-treatment.

The direct composite resin restoration technique using the occlusal resin block and clear occlusal matrix are applied using adhesives. Accurate recovery of the anatomic form is easy, and aesthetic restoration can be obtained simply and consistently.

Impressions taken from the occlusal surface of SSCs enable preservation of the original SSC anatomy, which can be directly transferred to the composite resin of the restoration. The occlusal surface of SSCs can thus be regenerated simply, accurately, and aesthetically. By eliminating the need for sculpturing and wax-up of the occlusal surface, this method saves time. Additionally, because advance preparations were performed using a model, fewer patient visits to the department were required.

The resin block method produced aesthetically suitable and anatomically detailed results because of the use of impressions made from the occlusal surface of SSCs. We made impressions of the SSCs and used them to produce upper, lower, right, and left molded silicon plates in 7 sizes for each tooth. The crown size of the patient's tooth was measured on a study model, and the resin block size suitable for the patient was chosen. The molded silicon plate has the benefit of being reusable. The thickness of the occlusal resin block was adjustable to the remaining tooth structure. If the resin block becomes misaligned during placement, occlusal adjustment will be difficult. Thus, the marginal ridge of the adjacent tooth should be checked routinely during the procedure. Care should be taken to ascertain appropriate clearance and resin block thickness during pre-treatment.

The clear matrix of Glassbite is manufactured using crystal-clear silicone. Glassbite accurately reproduces occlusal details and performs true to the original when used as a matrix material for precasts. Glassbite can also be used for positioning auxiliaries and for orthodontic applications. Occlusal replicas of permanent teeth can be made using several materials, including a transparent silicone mold [Goracci and Mori, 1999], an acrylic resin matrix [Baratieri et al., 1996], polyvinyl siloxane impression material [Liebenberg, 1996; Conte and Cianconi, 2008], and occlusal devices [Castro et al., 1997; Martos et al., 2010]. According to our literature search, the use of a clear matrix in primary molar restorations has not been reported. In this study, we found that Glassbite was easy to trim during elimination of excess material because it is neither too flexible nor too brittle. We also observed no undesirable deformation or stickiness. Light can be transmitted through the clear matrix, and the clear matrix and cured resin could be removed easily. Additionally, the

clear matrix solves the curing problems caused by an oxygen-inhibited layer [Conte and Cianconi, 2008; Martos et al., 2010]. We opened an escape route in the clear matrix to reduce the pressure on it. Furthermore, the need for modification of a crown was prevented. It should be noted that the clear matrix deteriorates after two days. Accordingly, the clear matrix should be produced no sooner than the day before treatment.

SSCs and pre-veneered SSC restorations present some drawbacks. Removal of some of the remaining tooth other than the cavity may be necessary. In addition, adequate restoration of the cervical diameter is not always possible. Poor adaptation of a restoration can be a risk factor for periodontal disease [Checchio et al., 1983]. Our techniques used adhesives, avoiding the need to remove parts of the remaining tooth other than the cavity, and promoting good adaptation. These restorations are placed above the cervical area of the tooth and thus will not trigger periodontal disease. However, SSCs and pre-veneered SSC restorations have the advantage of being less time-consuming. Therefore, we chose the direct technique with the use of adhesives. Our techniques were performed on a study model so that patients did not have to visit the department any more often than when using SSCs or pre-veneered SSCs. Furthermore, these restorations have better proximal contacts, as appropriate inter-proximal wedges of the metal matrix band were used for proximal restoration. The indirect technique presents some advantages and drawbacks. The advantages include better definition of outlines, better marginal adaptation, and adequate recovery of the mesiodistal diameter and cervico-occlusal height [Rabelo et al., 2005]. Drawbacks include the use of lab time, especially for wax-up of the occlusal surface, and frequent department visits. Our methods retained the advantages of the indirect technique while avoiding the drawbacks of traditional techniques such as SSCs, pre-veneered SSCs, and the indirect technique.

Conclusion

Application of the proposed resin block and clear matrix direct full-crown restoration techniques using light-cured composite resin to treat primary molars could provide functional and aesthetic reproduction of the occlusal morphology. Hence, our results in this setting were considered successful. Thus, these techniques could be considered a practical alternative to conventional methods and should be encouraged for different types of paediatric aesthetic restorations

using light-cured composite resin, which may lead to improved aesthetic restoration techniques for children.

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References

- › Baratieri LN, Monteiro Junior S, Correa M, Ritter AV. Posterior resin composite restorations: a new technique. *Quintessence Int* 1996;27:733-738.
- › Castro JJ, Keogh TP, Llamas Cadaval R, Jimenez Planas A. A new system for the transferral of the occlusal morphology in posterior direct composite resin restorations. *J Esthet Dent* 1997;9:311-316.
- › Cehreli ZC, Cetinguc A, Cengiz SB, Altay AN. Clinical performance of pulpotomized primary molars restored with resin-based materials. 24-month results. *Am J Dent* 2006;19:262-266.
- › Checchio LM, Gaskill WF, Carrel R. The relationship between periodontal disease and stainless steel crowns. *ASDC J Dent Child* 1983;50:205-209.
- › Conte G, Cianconi L. A clear PVS matrix technique for the placement of posterior direct composites. *Dent Today* 2008;27:124-127.
- › Croll TP. Preformed posterior stainless steel crowns: an update. *Compend Contin Educ Dent* 1999;20:89-104.
- › Fuks AB, Ram D, Eidelman E. Clinical performance of esthetic posterior crowns in primary molars: a pilot study. *Pediatr Dent* 1999;21:445-448.
- › Goracci G, Mori G. Esthetic and functional reproduction of occlusal morphology with composite resins. *Compend Contin Educ Dent* 1999;20:643-648.
- › Guelmann M, McIlwain MF, Primosch RE. Radiographic assessment of primary molar pulpotomies restored with resin-based materials. *Pediatr Dent* 2005;27:24-27.
- › Hickel R, Kaaden C, Paschos E, Buerkle V, Garcia-Godoy F, Manhart J. Longevity of occlusally-stressed restorations in posterior primary teeth. *Am J Dent* 2005;18:198-211.
- › Liebenberg WH. Occlusal index-assisted restitution of esthetic and functional anatomy in direct tooth-colored restorations. *Quintessence Int* 1996;27:81-88.
- › Martos J, Silveira LF, Ferrer-Luque CM, Gonzalez-Lopez S. Restoration of posterior teeth using occlusal matrix technique. *Indian J Dent Res* 2010;21:596-599.
- › Puppini-Rontani RM, de Goes MF, Voelske CE, Garcia-Godoy F. Clinical performance and SEM evaluation of direct composite restorations in primary molars. *Am J Dent* 2006;19:255-261.
- › Rabelo RT, Caldo-Teixeira AS, Puppini-Rontani RM. An alternative aesthetic restoration for extensive coronal destruction in primary molars: indirect restorative technique with composite resin. *J Clin Pediatr Dent* 2005;29:277-281.
- › Ram D, Fuks AB, Eidelman E. Long-term clinical performance of esthetic primary molar crowns. *Pediatr Dent* 2003;25:582-584.
- › Villalta P, Oliveira LB, Imparato JC, Rodrigues CR. Indirect composite onlay restorations in primary molars: a clinical report. *J Clin Pediatr Dent* 2006;31:17-20.
- › Wada K, Miyashin M, Nango N, Takagi Y. Wear of resin composites and primary enamel and their applicability to full crown restoration of primary molars. *Am J Dent* 2011;24:67-73.