A Predictable Resin Composite Injection Technique, Part 2

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INTRODUCTION

The first part of this series on the injectable resin composite technique provided an overview of its clinical applications and described the procedure and its predictability for developing transitional resin composite restorations in the adult dentition. As presented in part one, composite prototyping can be used to establish aesthetic and occlusal parameters such as restoration shape, physiologic contour, phonetics, and occlusion. The second part of this series will describe and illustrate another revolutionary application of the injectable resin composite technique for use with the primary dentition described as the Terry Injectable Primary Composite Crown (TIPCC).

Extensive caries and trauma represent the major reasons for the restoration of primary teeth with full coronal coverage. Clinical indications for the use of full-coverage crowns include primary teeth with multiple carious surfaces, fractured primary teeth with a significant loss of tooth structure, primary teeth with developmental defects and discoloration, Class II lesions in which the caries has extended beyond the anatomic line angles, pulpectomized primary teeth with a significant loss of tooth structure, patients with special needs, and hypoplastic deciduous teeth. There are a myriad of methods and materials for restoring primary teeth with full coronal coverage (crowns). These include polycarbonate crowns, traditional stainless steel crowns, open-faced stainless steel crowns, stainless steel crowns veneered with tooth colored materials (ie, composite, ceramic), the acid-etched resin strip crown, and zirconium crowns. The treatment challenges associated with these various types of crowns in the past have included improper anatomical contours, gingival inflammation, fractured facings, microleakage, poor retention, and an unnatural appearance (Figure 1).

In pediatric dentistry, the material should have the ability to be easily and efficiently placed and repaired, and the technique should require minimal chair time. While no restorative material and technique currently fulfill all these prerequisites, one treatment modality and material may provide some of these attributes.

The TIPCC technique, a novel and minimally invasive approach, has now been introduced and used for primary crown placement. This injectable resin composite technique is a unique and novel indirect/direct process of predictably translating a diagnostic wax-up into composite restorations using a highly filled flowable resin composite. As described in part one, this is a transitional technique. Thus, its application would be favorable for a transitional dentition such as the primary teeth. When selecting this procedure for children, several factors should be considered prior to selecting the injectable composite material. These include caries risk assessment, age and behavior, periodontal health, adequate remaining tooth structure, moisture-controlled field, the longevity of the tooth, and treatment conditions for the patient.

The criteria for tooth replacement, defects, trauma, and caries, as well as the basic definition of cavity preparation, have remained unchanged throughout the last 100 years. However, the physical preparation design for the replacement of natural tooth structure and/or existing restorations has been continuously altered as advances in materials occur. The newer formulations of syringeable universal composites have improved physical, mechanical, and optical characteristics. Thus, the adhesive application of these highly filled flowable resin composite systems permits a more conservative tooth preparation. Furthermore, restoring the natural dentition with bonded resin composite reinforces the tooth and restoration, which results in an increased structural
integrity while reducing and dissipating functional forces along the entire restorative interface.\textsuperscript{36} Although many of the basic preparation principles are similar for all adhesive preparations, there is consideration in the preparation design that is different for vital and pulpectomized primary teeth. Vital teeth require only removal of pre-existing defective restorative material and/or caries, while the pulpectomized teeth should have a resin-modified glass ionomer placed intracoronally to improve marginal seal of the pulpotomy.\textsuperscript{28,37} The general design guidelines for the adhesive preparation for vital and pulpectomized anterior and posterior primary teeth include the following:

- Any pre-existing defective restoration (composite or alloy) and/or caries should be removed.
- To allow for a better resin adaptation, all internal or external line angles should be rounded and cavity walls smooth. Unsupported enamel walls should be removed to improve the path of flow of material.
- A circumferential chamfer is placed 0.3 mm in depth to increase the enamel-adhesive surface and to allow for a sufficient bulk of material at the margins.\textsuperscript{38}
- Occlusal reduction 1.5 to 2 mm should be achieved.

Vertical proximal, facial/buccal, and lingual walls with slight convergence toward the occlusal will break proximal contacts. The preparation can be completed with a finishing disk, but with no silicone points or cups because these contaminate the bond. A mixture of plain pumice and aqueous 2% chlorhexidine solution (Consepsis [Ultradent Products]) can be used to remove potential contaminants.

This article presents a case report involving the use of the TIPCC technique to restore the primary maxillary anterior dentition.

CASE REPORT

Diagnosis and Treatment Planning

A 6-year-old male was referred to the department of pedodontics at the V. S. Dental College and Hospital in Bangalore Karanataka, India. The child was healthy and had no history of systemic disease. Upon examination, extensive interproximal caries was present on the maxillary primary central incisors and maxillary right primary lateral incisor from extensive sugar intake and inadequate plaque control (Figure 2). After clinical and radiographic evaluations were performed, a treatment plan was
established. The restorative technique was explained to the parents and patient, and they accepted the suggested treatment and signed an informed consent form before the treatment was initiated.

**Clinical Protocol**

A full-mouth alginate impression was taken of the patient’s maxillary arch and poured with type IV stone (GC FUJIROCK EP [GC America]). The stone model was removed from the impression one hour later and shaped on the model trimmer. This process can be expedited by using a fast set dental die stone (NEW FUJIROCK FAST SET [GC America]). The maxillary incisors were waxed to an ideal contour and a clear vinyl polysiloxane (ExaClear [GC America]) matrix was fabricated to replicate the diagnostic wax-up (Figure 3). The impression was taken in a nonperforated plastic tray. Other methods for restoring ideal contour include the use of block-out resin, resin composite, or utility wax.

During the next visit, local anesthesia was administered and initial caries removal accomplished (Figure 4a). Shade selection was performed prior to the restorative procedure and confirmed during the procedure (Figure 4b). It is important to perform a shade analysis before the restorative treatment to prevent an improper color matching that may result from dehydration and elevated values.39,40 The adhesive preparation was completed according to the aforementioned design guidelines for the vital primary anterior incisor. It is important that the unsupported enamel walls of the Class III be removed to allow the material an unrestricted path of flow.

After the preparations were completed, each tooth was separated by applying Teflon tape (DuPont) (Figure 5a) or a small amount of glycerin to the adjacent teeth. This proximal adaptation technique allows for optimal integration of flowable resin composite in the interproximal region while preventing adhesion of the material to the adjacent tooth surfaces.38,41-43 A 37.5% phosphoric acid semi-gel (Gel Etchant [Kerr]) was applied to the enamel and dentin
Figures 8a to 8c. (a) The composite crown was completed on the maxillary right primary central incisor using the same restorative procedure. (b) The excess polymerized composite resin was removed with a scalpel blade (No. 12 Bard-Parker [BD Medical]). (c) The incisal composite sprue was removed with a 30-fluted tapered finishing bur.

Figures 9a to 9d. (a) Before the adhesive procedure, the Teflon tape was applied to the teeth adjacent to the maxillary right primary lateral to ensure an optimal and smooth integration of the flowable composite in the interproximal region. This also prevents adhesion of the material to the adjacent tooth surfaces. The tape can be adapted to the tooth surfaces and tucked into the gingival sulcus, using an interproximal instrument (IPC-L [TN] [American Eagle]). (b) The etchant was applied to the enamel and dentin surfaces for 15 seconds, rinsed for 5 seconds, and gently air dried; (c) an adhesive was applied to the enamel and dentin surfaces with a No. 2 sable brush, using a light brushing motion for 15 seconds, air-thinned for 5 seconds, and light cured. (d) After the same shade combination of flowable composite material was injected into the clear matrix and allowed to cover the entire tooth surface, the material was cured through the matrix from all aspects for 40 seconds.

Figures 10a and 10b. After the incisal composite sprue was removed, the excess polymerized composite resin was removed with the No. 12 scalpel blade.

Figures 11a to 11c. (a) The gingival tissue was retracted with a gingival protector while the tooth-composite resin interface was finished using a tapered finishing bur. After finishing each primary composite crown with interproximal finishing strips and disks, silicone polishing points and cups, (b) a goat-hair wheel and diamond polishing paste were used to further enhance the surface luster of the composite resin. (c) The final surface gloss was achieved with a dry cotton buff using an intermittent staccato motion applied at conventional speed.
surfaces for 15 seconds (Figure 5b), rinsed for 5 seconds, and gently air dried. A single-component adhesive (Opti-Bond Solo Plus [Kerr]) was applied with an applicator to the enamel surface using a light brushing motion for 15 seconds (Figure 5c), air-thinned for 5 seconds, and light cured for 10 seconds using an LED curing light (Figure 5d). For difficult-to-manage children, a self-etch adhesive (G-ænial Bond [GC America], Scotchbond Universal Adhesive [3M ESPE], ALL-BOND UNIVERSAL [BISCO Dental Products]) may be used to expedite the adhesive procedure. In addition, preparing the enamel with a diamond bur may improve bond strengths.

The clear silicone matrix was placed over the maxillary arch, and a highly filled flowable resin composite (G-ænial Universal Flo [GC America]) was injected through a small opening above each tooth. An opaques A-1 shaded flowable resin composite (G-ænial Universal Flo) was initially injected followed by a B-1 shaded flowable resin composite (Figure 6a). The resin composite was cured through the clear silicone matrix on the incisal, facial, and lingual aspects for 40 seconds (Figures 6b and 6c). After the incisal composite sprue was removed, the excess polymerized resin composite was removed with a scalpel (No. 12 Bard-Parker [BD Medical]) for each restoration (Figures 7 and 8). This restorative procedure was completed for each tooth prior to initiation of the next tooth (Figures 9 and 10).

The same simplified finishing and polishing protocol as described in part one of this series was utilized (Figure 11).

An optimally finished restoration should provide a smooth surface that will prevent plaque accumulation1,43-46 and resist staining.1,43,47 In addition, the presence of microfine particles, composed of mineral filler and strongly bound to the organic matrix, has been proven to produce the appearance of an aesthetically polished and smooth surface.48,49 Furthermore, finishing and polishing directly affects the aesthetic qualities of color and gloss of the composite restoration.36 Thus, finishing and polishing techniques for composite primary crowns require a simplified, methodical, and efficient protocol to achieve a pleasing outcome and may provide the benefit of increased longevity of the restoration36,47 while promoting improved gingival health.

IN SUMMARY
Aesthetic restoration of primary teeth in children has been an ongoing challenge for the pediatric and general dentist, while the most effective aesthetic materials and techniques for restoring deciduous teeth are still in question.6 With the advancement of dental materials and techniques in conservative dentistry, a multitude of aesthetic treatment modalities have been introduced for the management of dental caries and trauma in the primary dentition. The TIPCC is a technique that can be used to restore caries and fractured anterior and posterior primary teeth to an ideal anatomical form. The described technique is simple and can be used to predictably replicate anatomical morphology, re-establish function, and restore natural aesthetics in young children (Figures 12 and 13). Although not a panacea to all pediatric restorative challenges, this technique offers an alternative restorative solution for
various clinical situations and is provided to complement—not to replace—our existing clinical repertoire. However, there is need for long-term clinical studies to further assess the success and potential clinical benefits of this technique with these alternative biomaterials.

Although the philosophy for the modern restorative dentist has remained the same, the mindset of the clinician must be transformed to continue to explore and develop ideas, techniques, and protocol. The knowledge and desire to create are limited by the materials that clinicians are able to utilize in restorations. Continuing technological breakthroughs allow the clinician to not only comprehend the “building blocks” of the ideal restoration, but also to implement and maximize new materials in attaining more predictable and aesthetic results. 50 This knowledge must be integrated with the proper technique for each clinical situation and requires the clinical experience and judgment of the operator. While the past may have given us great minds with great discoveries, continuing to strive for excellence will produce an even greater number of advances for future generations to write about.

REFERENCES

23. MacLean JK, Champagne CE, Waggoner WF, et al. Clinical outcomes for primary anterior teeth treated...


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   a. True    b. False

2. Extensive caries and trauma represent the major reasons for the restoration of primary teeth with full coronal coverage.
   a. True    b. False

3. The Terry Injectable Primary Composite Crown technique is an injectable resin composite technique that predictably translates a diagnostic wax-up into composite restorations using a modern all-ceramic material.
   a. True    b. False

4. A circumferential chamfer is placed at only 0.7 mm in depth to increase the enamel-adhesive surface and to allow for a sufficient bulk of material at the margins.
   a. True    b. False

5. Finishing and polishing directly affect the aesthetic qualities of color and gloss of the composite restoration.
   a. True    b. False

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Please check the correct box for each question below.

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2. ☐ a. True  ☐ b. False
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