

Using injectable resin composite: part two

Douglas Terry¹ and John Powers²

Douglas Terry and John Powers illustrate another application of the injectable resin composite technique for use with the primary dentition.

The first part of this series provided an overview of the clinical applications of an injectable resin composite technique and described the procedure and its predictability for developing transitional resin composite restorations in the adult dentition.

Composite prototyping can be used to establish aesthetic and occlusal parameters such as restoration shape, physiologic contour, phonetics and occlusion. This article will describe and illustrate another 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 (Motisuki, Santo-Pinto, Giro, 2005; Mehta et al, 2012). Clinical indications for the use of full coverage crown include:

- Primary teeth with multiple carious surfaces
- Fractured primary teeth with a significant loss of tooth structure
- Primary teeth with developmental defects and discolouration
- Class II lesions in which the caries has extended beyond the anatomic line angles
- Pulpsectomised primary teeth with a significant loss of tooth structure
- Hypoplastic deciduous teeth (Mahoney, Kilpatrick, Johnston, 2013)
- Patients with special needs (Troutman, 1976; Salama, Myers, 1992; Waggoner, 2002; Waggoner, 2012; Kindelan et al, 2008; American Association of Pediatric Dentistry, 2013; Gilchrist et al, 2013; Christensen, 2012; Schwartz, 2014).

There is a myriad of methods and materials for restoring primary teeth with full coronal coverage (crowns) (Webber et al, 1979). These include polycarbonate crowns, traditional stainless steel crowns, open faced stainless steel crowns, stainless steel crowns veneered with tooth-coloured 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 include improper anatomical contours, gingival inflammation, fractured facings, microleakage, poor retention and an unnatural appearance (Figure 1).

In paediatric dentistry, manufacturers, researchers and clinicians continue to search

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Figure 1: The resin strip crowns on the maxillary primary central incisors reveal improper anatomical contours with gingival inflammation. Note the unnatural appearance.



Figures 2a and 2b: Preoperative facial view of the maxillary anterior primary incisors. Patient presented at the age of six with extensive interproximal caries on the maxillary primary incisors from excessive sugar intake and inadequate plaque control.



Figure 3a: A diagnostic wax-up was created to develop the original contours of the incisors.



Figure 3b: A clear vinyl polysiloxane matrix was fabricated to replicate the diagnostic wax-up, intraorally.



Figure 4a: Initial caries was removed.



Figure 4b: Shade determination was completed before final preparation.

for an ideal material and technique that will allow duplication similar to natural tooth structure and morphology. This biomaterial should be resistant to masticatory forces and possess an appearance akin to natural dentine and enamel.

In addition, it should have similar physical and mechanical properties to that of the natural tooth, because as the mechanical properties of a restorative material approximate

the enamel and dentine, the restoration's longevity increases (Summitt, 2001).

Also, in paediatric dentistry, the material should have the ability to be easily and efficiently placed and repaired. In addition, the technique should require minimal chair time (Mehta et al, 2012; Croll, 1998).

While no restorative material and technique currently fulfil all these prerequisites, one treatment modality and material



Figure 5a: Before initiating the adhesive protocol, the preparation design was completed and each tooth separated by applying tape on the adjacent teeth.

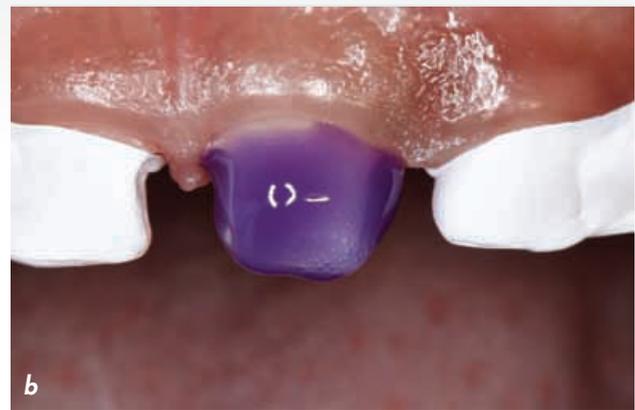


Figure 5b: A 37.5% phosphoric acid semi-gel was applied to the enamel and dentine surfaces, rinsed, and air dried.



Figure 5c: A single component adhesive was applied with an applicator to the tooth surfaces, allowed to dwell and air dried.



Figure 5d: Light cured for 10 seconds using a halogen LED curing light.

may provide some of these attributes.

A minimal invasive approach, known as the TIPCC, has been described for primary crown placement. This injectable resin composite technique is a novel indirect/ direct process of predictably translating a diagnostic wax-up into composite restorations using a highly filled flowable resin composite.

As a transitional technique, its application would be favourable 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, including:

- Caries risk assessment
- Age
- Behaviour
- Periodontal health
- Adequate remaining tooth structure
- Moisture-controlled field

- The longevity of the tooth
- Treatment conditions for the patient (Roberts, Lee, Wright, 2001; Guelmann et al, 2011).

The criteria for tooth replacement, defects, trauma, and caries, as well as the basic definition of cavity preparation, has remained unchanged over 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 (Dixon, Moon, 2011; Illie, Renez, Hickel, 2013). 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

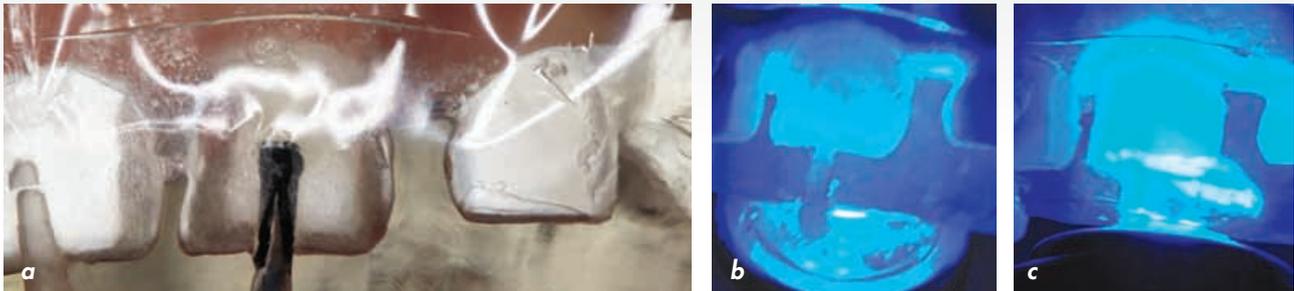


Figure 6a: The clear silicone matrix was placed over the anterior segment of the maxillary arch and an opacous A1 shaded flowable resin composite was initially injected through a small opening above each tooth, followed by a B1 shaded flowable resin composite. Figures 6b and 6c: The resin composite was cured through the clear matrix on the incisal, facial and lingual aspect for 40 seconds



Figure 7: The primary composite crown after composite sprue removal and prior to the finishing and polishing procedure.

tooth and restoration, which results in an increased structural integrity while reducing and dissipating functional forces along the entire restorative interface (Terry, Geller, 2013).

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 pulpectomised primary teeth.

Vital teeth require only removal of pre-existing defective restorative material and/or caries while pulpectomised teeth should have a resin-modified glass ionomer placed

intracoronally to improve marginal seal of the pulpotomy (Guelmann et al, 2011; Berg, Donly, 1988).

The general design guidelines for the adhesive preparation for vital and pulpectomised 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 0.3mm in depth to increase the enamel adhesive surface and to allow for a sufficient bulk of material at the margins (Terry, Leinfelder, 2004)
- Occlusal reduction 1.5-2mm 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 disc but with no silicone points or cups because these contaminate the bond.

A premix slurry of pumice and an aqueous 2% chlorhexidine solution can be used to remove potential



Figure 8a: The composite crown was completed on the maxillary right primary central using the same restorative procedure.

Figure 8b: The excess polymerised composite resin was removed.

Figure 8c: The incisal composite sprue was removed with a 30-fluted tapered finishing bur.



Figure 9a: Before the adhesive procedure, tape is applied to the teeth adjacent to the maxillary left primary lateral to ensure an optimal 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.

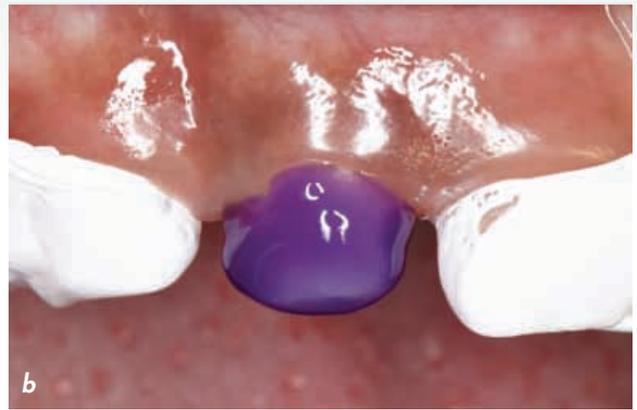


Figure 9b: The etchant was applied to the enamel and dentine surfaces for 15 seconds, rinsed and gently air dried.



Figure 9c: Adhesive was applied to the enamel and dentine surfaces with a #2 sable brush, allowed to dwell, air dried and light cured.



Figure 9d: 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.

contaminants.

The following case study illustrates the use of the Terry Injectable Primary Composite Crown (TIPCC) technique to restore the primary maxillary anterior dentition.

Case report

A six-year-old male was referred to the VS Dental College and Hospital in Bangalore, India. The child was healthy and had no history of systemic disease.

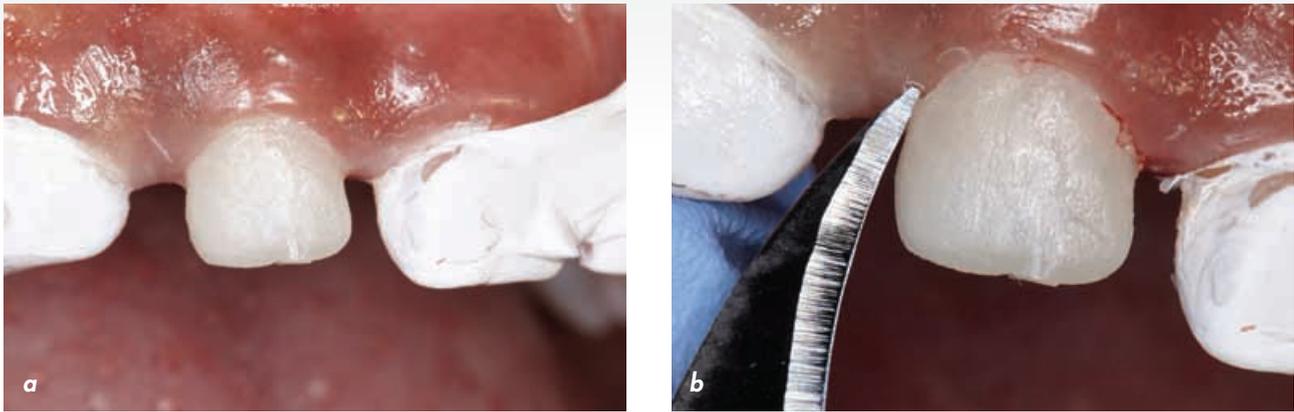
On examination, a complete primary dentition was present with extensive caries on the maxillary primary (Figures 2a and 2b).

After clinical and radiographic evaluations were

performed, a treatment plan was established. Upon explaining the restorative technique to the patient and his parents, they accepted the suggested treatment and signed an informed consent form before the treatment started.

A full-mouth alginate impression was taken of the patient's maxillary arch and poured with type IV stone. 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. The maxillary incisors were waxed to an ideal contour and a clear vinyl polysiloxane matrix was fabricated to replicate the diagnostic wax-up (Figures 3a and 3b). The impression was taken in a non-perforated plastic tray. Other



Figures 10a and 10b: After the incisal composite sprue was removed, the excess polymerised composite resin was removed with a scalpel.



Figure 11a: Gingival tissue was retracted with a 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 discs, silicone polishing points and cups.

Figure 11b: A goat hair wheel and diamond polishing paste are used to further enhance the surface luster of the composite resin.

Figure 11c: The final surface gloss was achieved with a dry cotton buff using an intermittent staccato motion applied at conventional speed.

methods for restoring ideal contour include the use of block-out resin, resin composite or utility wax.

During the next visit, local anaesthesia was administered and the initial caries was removed (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 colour matching that may result from dehydration and elevated values (Terry, 2005; Fahl, Denehy, Jackson, 1995).

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 (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.

A 37.5% phosphoric acid semi-gel was applied to the enamel and dentine surfaces for 15 seconds (Figure 5b), rinsed for five seconds, and gently air dried. A single-component adhesive was applied with an applicator to the enamel surface, allowed to dwell for 10 seconds (Figure 5c), air dried for five seconds, and light cured for 10 seconds using an LED curing light (Figure 5d).

The clear silicone matrix was placed over the maxillary arch, and a highly filled flowable resin composite (Gaenial

Universal Flo, GC) was injected through a small opening above each tooth. An opacious A1 shaded flowable resin



Figure 12: The completed maxillary primary incisors.

composite (G-aenial Universal Flo, GC America) was initially injected followed by a B1 shaded flowable resin composite (Figure 6a). The resin composite was cured through the clear silicone matrix on the incisal, facial and lingual aspect for 40 seconds (Figures 6b and 6c).

After the incisal composite sprue was removed, the excess polymerised resin composite was removed with a scalpel for each restoration (Figures 7-8c). This restorative procedure was completed for each tooth prior to initiation of the next tooth (Figures 9a-10b).

As described in part one of this series, an optimally finished restoration should provide a smooth surface that will prevent plaque accumulation and resist staining. 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 (Joniot et al, 2000).

Furthermore, finishing and polishing directly affect the aesthetic qualities of colour and gloss of the composite restoration. 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 restoration while promoting improved gingival health.

The same simplified finishing and polishing protocol as described in part one of this series was utilised (Figures 11a-11c).

Conclusion

Aesthetic restoration of primary teeth in children has been an ongoing challenge for the paediatric and general dentist, and the most effective aesthetic materials and techniques for restoring deciduous teeth are still in question.

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 children (Figure 12).

Although not a panacea to all paediatric restorative challenges, this technique offers an alternative restorative solution for various clinical situations and is provided to complement (not 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 materials that clinicians are able to utilise in restorations limit the knowledge and desire to create. Continuing technological breakthroughs allow the clinician to not only comprehend the

'building blocks' of the ideal restoration, but also to implement and maximise new materials in attaining more predictable and aesthetic results. 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

The list of references that accompany this article are available on request.

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