# Undetectable Integration of Composite Resin with Natural Tooth Structure

## Accreditation Clinical Case Report, Case Type IV: Class IV Direct Resin Restoration

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**Figures 1a & 1b:** Full-face smile before and after, 1:10. The patient was very happy to smile confidently again.

**Key Words: Accreditation, Class IV composites, composite bonding, minimally invasive, esthetic technique**

## Introduction

Dental trauma to the anterior maxillary teeth is common in children. Along with dramatic improvements in bonding technology, and resin composites' physicochemical properties and esthetic qualities, modern composite resin restorations can conservatively replace missing tooth structure. Bioesthetics is especially important when treating young patients, giving priority to additive, minimally or micro-invasive procedures to preserve tooth biology and biomechanics.[1]

Excellent and minimally invasive restorations can be created with relatively simple application and layering techniques using artificial dentin and enamel masses, which are completed with effect materials.

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**Figure 2:** Portraiture setup for a dental office.

## Clinical Case

### History and Complaint

The patient, a 10-year-old boy, came to the office with his mother to restore the fractured incisal two-thirds of his maxillary right central incisor. The etiology of the tooth fracture was a fall from a bicycle two days earlier. The fractured fragment of the patient's tooth had been lost. The patient's mother sought high-level, conservative, restorative treatment to restore the fractured tooth to its natural appearance. The patient had an unremarkable medical history and a dental history that included routine fillings and sealants.

### AACD Photographs

To perform a high-quality restoration requires more than consultation time, so the patient was invited to have photographs taken for review and study of the AACD Accreditation views.[2] The patient's portrait **(Figs 1a & 1b)** was taken in a portraiture setup for a dental office **(Fig 2)**[3]: two symmetrical strobes with a softbox and a light shaper as main lights, hair light strobe with a reflector, velvet curtain background, Nikon D300 camera (Melville, NY) and Nikkor lens 18-70 mm f/3.5-4.5G ED-IF zoom AFS DX. The patient's smile and teeth **(Figs 3-6)** were photographed using the same camera, Nikkor lens 105 mm F2.8G VR micro, Sigma electronic flash macro EM-140 DG (Sigma Photo; Ronkonkoma, NY); and dental photography accessories such as lip retractors, contrasting device, and occlusal mirrors **(Figs 7a & 7b)**.

A second appointment was made several days later to perform final treatment with composite.

### Examination

A thorough examination was performed and appropriate radiographs taken. The clinical exam revealed no signs or symptoms of temporomandibular joint or occlusal disorder. Visual and tactile inspection of the soft tissue showed them to be within normal limits and free of pathology. The teeth were evaluated and checked for any possible fractures, pulp exposures, and mobility. There was no radiographic or clinical evidence of pulpal exposure or root fracture and the patient had experienced no spontaneous pain since the accident. Tooth #8 responded to cold, was negative to percussion, and did not exhibit mobility.

**Figure 3:** Preoperative close-up right lateral view.

**Figure 4:** Preoperative 1:2 full natural smile view.

**Figure 5:** Preoperative 1:2 retracted frontal view.

**Figure 6:** Preoperative 1:2 occlusal view.


**Figures 7a & 7b:** The teeth were photographed using lip retractors, a contrasting device, and an occlusal mirror.

### Treatment Plan

A Class IV composite restoration was the treatment of choice because of the patient's age, and to conserve remaining tooth structure. Class IV composite combining microhybrid and microfill that are completed with effect materials would fulfill the patient and his mother's expectations and meet current biomechanical and esthetic standards.

The following esthetic and restorative issues were discussed with the patient's mother:

- functional issues
- longevity
- possible need for endodontic management and discoloration of the residual tooth structure and root of the traumatized tooth
- recare and maintenance: observation, management, and evaluation.

## Treatment

Color and texture mapping were used to guide the layering of composite to achieve a polychromatic result.

A topical anesthetic was applied in the buccal fold apical to #8, and the patient was anesthetized with one carpule of Septanest (Septodont; Lancaster, PA) with adrenaline 1/100,000.

A shade determination was done before the teeth became dehydrated and changed value during treatment. A spectrophotometer (Shadepilot, DeguDent; Hanau, Germany) reading was made on both #8 and #9 to help determine the appropriate shade of the final composite resin. The body shade was A-3 (VITA, Vident; Brea, CA).

The following materials and shades were selected:

- flowable composite G-aenial Flo AO3 (GC America; Alsip, IL), as a cavity liner
- microhybrid composite G-aenial Anterior A03 for artificial dentin (AD), to provide opacity, hue, and chroma
- microhybrid composite G-aenial Anterior A2 for artificial chromatic enamel (ACE), to provide hue, chroma, and value
- Renamel Creative Color Opaquer White (Cosmedent; Chicago, IL), to reproduce whitish, opaque enamel hypoplasia effects
- Renamel Microfill Incisal Medium for artificial achromatic enamel (AAE), to create effects ranging from translucency to milky-whiteness and for polishing ease and longevity when exposed to varying degrees of pH levels (i.e., low pH, high acidity, and brushing)[4]
- Adhesive Prime&Bond NT (Dentsply DeTrey GmbH; Konstanz, Germany).

A color mock-up was completed in the patient's mouth to verify the composite "recipe" that would mimic the colors and texture of the adjacent intact central tooth. During this process, the lingual shelf, the dentin, characteristics of white spots, and chromatic and achromatic enamels were applied to envision a highly esthetic final result. The mock-up allowed for thickness corrections prior to creation of the final restorations.[5,6]

Undetectable integration of composite resin with natural tooth structure requires attention to detail and the use of correct composite materials, as well as the application of a consistent protocol.

Prior to preparation, the teeth were cleaned using fluoride-free toothpaste (Zircate, Dentsply), prophy brushes, and dental floss. Tooth #8 was disinfected with chlorhexidine.

### Preparation

Preparation began with a round-end diamond bur (6856-016, Brasseler USA; Savannah, GA) with a deep and long bevel extended 2 mm around the entire facial and lingual margins. This greatly increases the surface area of enamel available for bonding. When giving the preparation its final inspection, using an extra-fine diamond bur (7803, Shofu Dental; San Marcos, CA), any unstable or overhanging enamel structures were removed, as they have a negative effect on the adhesive bond of the restoration. Weak enamel structures left untrimmed at the margins lead to the so-called "prism effect" once composite is applied.[7]

### Adhesion

The rubber dam (SigmaDam, Sigma Dental Systems GmbH; Flensburg, Germany) was applied from tooth #3 to #14. The prepared tooth #8 was sandblasted with 50 µ aluminum oxide (MicroEtcher II A, Danville Materials; San Ramon, CA) to clean the preparation and enhance adhesion.

Acid-etching with 38% phosphoric acid (Etch-Rite etching gel, Pulpdent; Watertown, MA) was performed over enamel for 30 seconds and dentin for 15 seconds to remove the smear layer, which forms after dentin preparation, and to open collagen fibers. After rinsing with water for 30 seconds, adequate humidity control is important since the total dehydration of dentin is contraindicated.[8] When using phosphoric acid as an etchant, a wet bonding technique is necessary to keep the collagen meshwork open for resin monomer penetration. Adhesive (Prime&Bond NT) was applied, air-thinned, and light-cured for 20 seconds.

### Composite Placement

Flowable composite was injected into the floor of the cavity ensuring there were no bubbles, and polymerized for 20 seconds using a light-emitting diode (LED) curing unit (Bluephase 20i; Ivoclar Vivadent; Amherst, NY). Applying flowable composite as a liner improves contact with the preparation walls, reducing bubbles or gaps between the adhesive layer and the composite resin.[9] Also, the flowable composite liner reduces polymerization shrinkage stress and can act as a sort of "shock absorber."[10]

Then, in three subsequent layers, AD composite (shade A03) of higher chroma than the intended enamel chroma was applied and sculpted to conform to the histological boundaries of the natural dentin and light-cured for 20 seconds each. To maximize curing effectiveness, curing light guides should be maintained in close proximity to the surface of the light-activated restorative material.[11]

This was followed by applying a layer of ACE (shade A2) on the palatal aspect of the tooth. The palatal enamel wall was modeled freehand and light-cured for 20 seconds. Then material of ACE (shade A2) was used over the labial surface of the composite. This layer was smoothed and shaped with an artist's brush (#3, Cosmedent) to provide an even surface and minimize the incorporation of any air pockets. The IPCT carver (Cosmedent) was used to make a random bevel and groove for the subsequent incisal composite, and the layer was light-cured for 10 seconds.

An artist's brush (#1, Cosmedent) was used to apply patches and bands of Creative Color Opaquer White to reproduce the fluorotic enamel structure **(Fig 8)**, as seen on tooth #9. The layer was light-cured for 20 seconds.

A final layer of AAE composite (Incisal Medium) was applied to cover the entire facial aspect. This achromatic enamel has the ability to diffuse the light to some extent, while permitting the colors of the underlying layers to selectively show through.[5] The layer was cured for 20 seconds.

The intact cervical hard tissues of #7 and #8 allowed a transparent strip (KerrHawe; Bioggio, Switzerland) to be wedged in (Luciwedge Soft, KerrHawe), adapted, and correctly shaped. Then a thin layer of AAE composite (Incisal Medium) was applied to the facial and palatal surfaces. To achieve uniform composite transition from the facial to palatal surfaces and contour proximal surfaces in convex form, the matrix was slightly pulled to the palatal, then pressed from both sides (controlling avoidable composite overhangs on the palatal surface), and light-cured for 20 seconds. The final layer wedge, strip, and rubber dam were removed.

### Finishing

A composite polishing disc (Sof-Lex extra/coarse, 3M ESPE; St. Paul, MN) and flame-shaped fine and extra-fine diamonds (8859-010, 859EF-010, Brasseler) were used to remove excess material, recontour, and establish outline form. The flame-shaped burs were worked along the axis of the tooth, from mesial to distal side, producing a perikymatous surface structure. The contouring was guided by comparison with the three planes of the contralateral tooth. Excess material on the palatal side was removed using a football-shaped diamond bur (6368-023, Brasseler).

Symmetry of the central incisors was verified using a digital caliper (Dentagauge, Erskine Dental; Marina Del Ray, CA).

**Figure 8:** Creative Color Opaquer White was used to reproduce the fluorotic enamel structure.

**Figure 9:** In the "after" 1:1 frontal view, the translucency, halo, and whitish, opaque enamel hypoplasia effects create a lifelike mirroring of the adjacent central incisor.

The proximal surface was polished using a finishing diamond strip (NTI-Kahla GmbH; Kahla, Germany). Facial and palatal surfaces were modeled with ultra-fine diamonds (LT2, 7406, Shofu). Static and dynamic occlusion was optimized using articulating film (TrollFoil, Trollhätteplast AB; Trollhättan, Sweden). All surfaces were polished using polishing points (Enhance, Dentsply) and FlexiDiscs (Cosmedent).

Before the final polishing, the restoration was covered with a layer of "air-block" water-soluble glycerin (Glycerin-gel, Ivoclar Vivadent). Final polymerization was carried out with 20-second cycles on the palatal and facial surfaces to obtain the maximum monomer conversion in the uppermost layer of composite material, normally inhibited by oxygen.[12] A FlexiBuff disc with Enamelize paste (both Cosmedent) was used to obtain the final gloss **(Fig 9)**.

The patient was given home care instructions and scheduled to return three days later for a final check of function and esthetics, and to complete photographic and radiographic documentation **(Figs 10a-10d & 11)**. He was invited for post-treatment photography six months later **(Figs 12a-12c)**.

## Summary

For young patients, Class IV direct resin restorations are an excellent treatment modality for restoring fractures of anterior teeth, especially central incisors. This case illustrates how direct composite resin can be used to provide an excellent and minimally invasive restoration that will clearly benefit the long-term biomechanical behavior of affected teeth.

The patient and his mother were extremely happy to have avoided a more invasive crown preparation and could not believe that the restored part of the fractured tooth was virtually undetectable from the surrounding natural dentition.

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**Figure 10a:** Postoperative close-up right lateral view.

**Figure 10b:** Postoperative 1:2 full natural smile view.

**Figure 10c:** Postoperative 1:2 retracted frontal view.

**Figure 10d:** Postoperative 1:2 occlusal view.

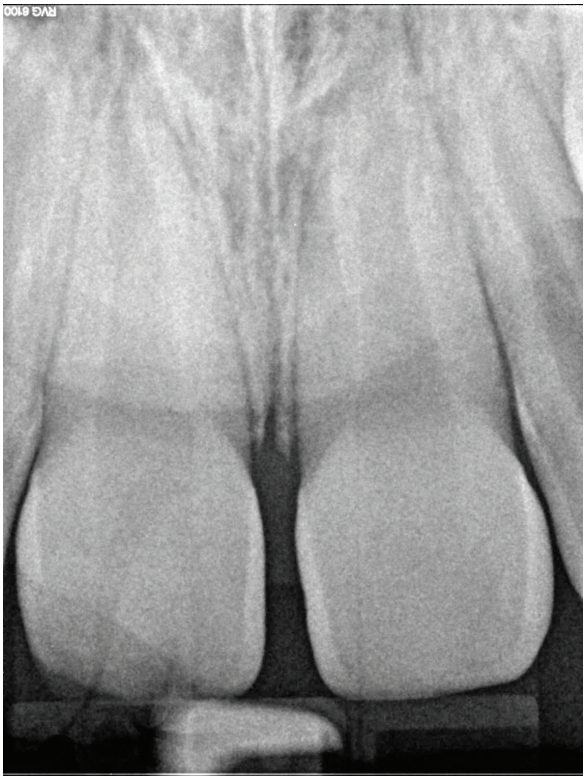

**Figure 11:** A periapical radiograph reveals no root fracture and satisfactory composite adaptation.


**Figures 12a-12c:** Six-month post-treatment clinical images. Note healthy gingival tissue and good marginal integration.


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# Examiners' Commentary

# Passing the "Litmus Test"

## Class IV Direct Resin Restoration: Fracture Case

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Illustration by Zach Turner

> "This is everyday dentistry that many patients need and should be able to afford."

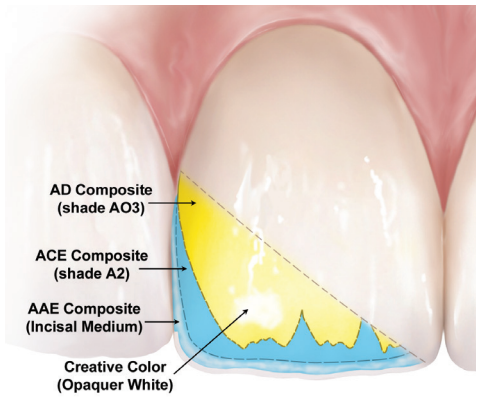


**Figure 1:** The color map details the layering process of the composite resin.

The Class IV fracture repair is one of the most common and relevant case types for AACD Accreditation. This is everyday dentistry that many patients need and should be able to afford. The ideal patient for this type of treatment is like the young boy discussed in Dr. Ivance's article. Many dentists do not take the time to learn a polychromatic layering process and finishing and polishing techniques that can yield natural, lifelike results. What a shame it would be to "grind down" a tooth like this for a full crown. In this case, a well-done composite resin can look better, be less traumatic to the pulp, be more conservative, and yes, the restoration can last a long time! The dentist can be a true artist and is in complete control of the situation. A great way to increase your skill in mastering composite resins is by taking hands-on courses at the AACD scientific sessions.

Dr. Ivance did an excellent job with this case, handling the composite resin and blending the restoration into the natural tooth structure. The color selection was well done. The milky-white incisal halo and incisal translucency mimicked the contralateral tooth. The white opaque effect was just slightly overdone, but it was very close (and it is not such an easy thing to accomplish) **(Fig 1)**.

This Class IV fracture case was passed by all of the examiners. However, some of their deductions were as follows:

- Criterion #61: Visible margins on the restoration.
- Criterion #44: Surface finish and polish did not mimic that of contratateral tooth.
- Criterion #86): Tooth #8 slightly longer than tooth #9.

This case demonstrated clinical excellence and deserved to pass. However, the restoration was not perfect (few cases, if any, ever achieve perfection). A good "litmus test" for the Class IV fracture case is "Can you see the restoration?" If you have to look closely to see where the restoration is, then the case should pass. Dr. Ivance's case passed the "litmus test" for this Accreditation case type. **jCD**

Dr. Peyton is an AACD Accredited Fellow and has been an AACD Accreditation Examiner since 2000. A part-time instructor at the UCLA School of Dentistry, he practices in Bakersfield, California.

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