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

### INTRODUCTION

Direct bonding of composite resin can provide an excellent and extremely conservative esthetic result. Treatment of this kind has progressed greatly since resin restorations were first introduced—color stability is greater and placement is much easier. The range of colors and differing translucencies and opacities available mean that, with practice, it is possible to reproduce what nature originally put there.

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### HISTORY

The patient was an 11-year-old girl in excellent health. Tooth #9 had been fractured in a playground accident some months previously (Figs 1 & 2). Her family dentist had recommended the placement of a crown to restore the tooth. The patient's grandmother, who brought her to our practice, wanted a second opinion as to whether this treatment was advisable.

On examination, it was noted that there was a large Class IV fracture, involving approximately half of the tooth. The fracture line extended into the dentin, but did not involve the pulp. The patient reported no pain or discomfort from the tooth, which responded normally to vitality testing (Figs 3 & 4).



Figure 1: Full-face, before.



Figure 2: Full-face, after.

## DIAGNOSIS AND TREATMENT PLAN

Given such a large fracture, it was surprising that no exposure of the pulp had occurred. Because several months had elapsed since the fracture and no pain, swelling, discoloration, or discomfort were reported by the patient or her grandmother, the health of the pulp was assumed. The patient was warned, however, that it was still possible for pulpal death to occur at this late stage.

A full-crown restoration could have been performed but, in a young patient with large pulp horns, the chance that the tooth would become non-vital was high. Also, the immature position of the gingival zenith at this age would mean that the facial margin would become visible within a few years, necessitating replacement (Figs 5 & 6).

An indirect Class IV restoration could have been used for such a large defect,<sup>1</sup> but color matching for these restorations is more easily achieved

chairside, so a direct technique was selected. This offered the additional advantage of only a single visit for treatment.

The HFO composite system was chosen because it allows anatomical layering that closely mimics the tissues being replaced (essentially, it is necessary to “put back what is missing”). With practice, a very natural-looking restoration can result.

## DESCRIPTION OF TREATMENT

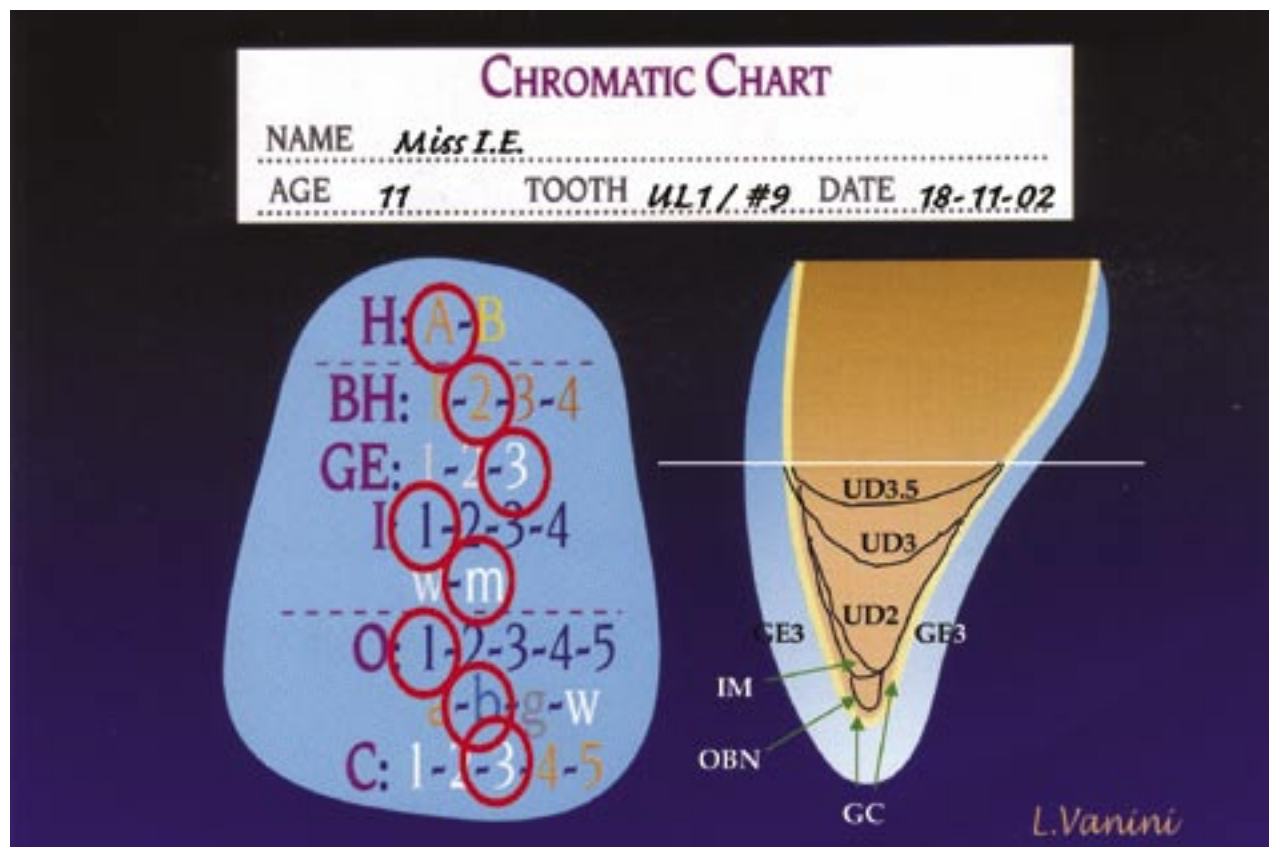
### COLOR AND TEXTURE MAPPING

Color matching is an extremely important part of the success of any restoration; this must be coupled with an understanding of the material that is to be used.<sup>2</sup> For direct restorations, the color classification system described by Vanini<sup>3</sup> is invaluable in mapping the colors in the adjacent teeth, so that the resins to be used may be precisely planned.

Color mapping of tooth #8 was accomplished using Vanini’s color chart.<sup>3</sup> This showed a basic chromaticity of A2, with thick, high-value enamel. Opalescent blue colors corresponding to “mammelon-like” translucency (O-1) were noted, as were intensive white spots (I-1) and a further characterization in the form of a halo (C-3). All these features were charted on the color map and appropriate colors of resin were selected (see Appendix 1).

As would be expected in a young person’s tooth, a highly textured surface was noted. This secondary anatomy (vertical developmental grooves overlying the internal mammelons) and tertiary anatomy (horizontal banding due to perikymata) can be reproduced after the final layer of resin has been placed, before polishing.<sup>4,5</sup> This reproduction of texture allows incoming light to be broken up in a similar way to the surrounding teeth and greatly helps the restoration to blend in.

## APPENDIX 1



### VANINI'S COLOR MAPPING SYSTEM AND HFO COMPOSITE

[Note: in the United States, this system is sold by Ultradent as Vitalence. The colors are the same, although their names are different. A "color translation chart" is given in Appendix 2.]

In his key article of 2001, Vanini<sup>3</sup> described how accurate color mapping could be performed with what he described as the "color dimensions" of the teeth. He reexamined the traditional Vita shade classification and determined that the C and D shades were simply variations in the value. He therefore classified all shades as being A or B shades, veering toward the reddish or yellowish end of the range of hues, respective-

ly. HFO dentin colors were provided in a range from A1-A6, and B1-B6. The intention was to place a dentin color that exactly matched the color of the tooth's dentin, which tends to be much darker in reality than in many of the systems on the market. Vanini subsequently revised the HFO+ dentin colors to just have "Universal Dentin" (UD) 1-6, corresponding to A1 to A6.

Enamel is used to modulate the value of the restoration via three shades and translucencies. The HFO system contains three "generic enamels" (GE). GE3 is used to replicate the high-value, quite opaque enamel found in young people; GE2 is used for "adult" enamel; and GE1

is used to reproduce the more translucent, thin, glass-like enamel of the elderly.

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Variations in the character of the teeth are described in terms of "intensives" (whitish colors in the enamel), "opalescents" (translucent colors in the incisal third) or "characterizations" (other details

## APPENDIX 2

Vitaescence-HFO+ color "translation" chart (Source: Optident Ltd, Ilkley, West Yorkshire, UK).

Vitaescence	HFO/HFO+	HFO+ abbreviation
Pearl Frost	Generic Enamel 3	GE3
Pearl Neutral	Generic Enamel 2	GE2
Pearl Amber	Generic Enamel 1	GE1
Opaque Snow	Intensive White	IW
Opaque White	Intensive Milky	IM
Translucent Orange	Opalescent Amber	OA
Translucent Blue	Opalescent Blue Natural	OBN
Translucent Ice	Opalescent Gray	OG
Translucent Gray	Gray	*
Translucent Yellow	Ivory 1	*
Translucent Amber	Ivory 2	*
Translucent Mist	White 1	*
Translucent Frost	No equivalent	-

\*These colors were deleted from the HFO range with the introduction of HFO+, as Vanini believed that they made the system unnecessarily complex and similar effects could be achieved by careful manipulation of the remaining colors.

such as amber colors or crack lines). These are reproduced using intensive milky or intensive white colors, opalescents such as opalescent blue or amber, and the other characterizations with tints and/or a combination of other colors.

This linking of the resins to be used to the color map greatly simplifies the resin selection process.

## ARMAMENTARIUM

- HFO+ composite and shade guide (Optident; Ilkley, UK)
- HFO+ plus glass connector (Optident)
- HFO+ plus stain white (Ivoclar Vivadent; Schaan, Liechtenstein)
- Vita Classic shade guide (Vita Zahnfabrik; Bad Sackingen, Germany)
- Verone lab putty (Schottlander; Letchworth, UK)
- Ultraetch 37% phosphoric acid (Ultradent; Salt Lake City, UT)
- Supersnap polishing discs (Shofu Inc.; Kyoto, Japan)
- Prime & Bond NT (Dentsply; Weybridge, UK)
- Enhance (Dentsply)
- 889-009 coarse grit short flame-shape bur (Schottlander)
- TI-95 speed-increasing hand-piece (NSK Corporation; Tochigi, Japan)
- Jiffy brush (Ultradent)
- Enamel shiny ABC (Optident)
- Optilux 501 curing light (Kerr; Peterborough, UK)
- American Eagle composite instruments (Comp 6, IPC-T, and F-6 PFI) (Optident)



Figure 3: Unretracted before smile, 1:2 view.



Figure 4: Unretracted after smile, 1:2 view.

## TREATMENT SEQUENCE

For such a large fracture, it is essential to plan the shape of the final restoration so that occlusal adjustment does not intrude upon the layers of resin that have been placed, as this may affect the overall translucency of the restoration. Ideally, this is done outside the mouth using a diagnostic wax-up. This allows a putty index to be used as a template for layering of the resin.<sup>6</sup> However, this was not possible for this case as the patient and her grandmother were in town for that day only. Therefore, a direct mock-up was fabricated using one shade of resin and only spot bonding. This allowed direct fabrication of the putty matrix in the mouth. It also allowed evaluation of the proposed color of the restoration, which was confirmed to be Vita A2. The precise anatomical layering technique used with HFO+ means that any adjustments to the palatal surface after placement can adversely affect the translucency of the restoration. Therefore, the oc-

clusion was adjusted on the mock-up prior to fabricating the putty index to ensure minimal adjustment would be needed after completion of the definitive restoration. The mock-up was then displaced from the tooth using gentle pressure from an explorer.

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*A 45° bevel was extended 1 mm beyond the fracture margin; this greatly increases the surface area of enamel available for bonding.*

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The enamel at the margins was lightly beveled buccally and lingually using a coarse polishing disc. A 45° bevel was extended 1 mm beyond the fracture margin; this greatly increases the surface area of enamel available for bonding.<sup>7</sup> Although the bond strength achievable with dentin bonding is reliably good today, bonding to enamel will always be stronger. Enamel and dentin were then etched using 37% phosphoric acid. A total-etch technique was used, starting on enamel and mov-

ing on to dentin for a total etch time of 20 seconds for the enamel and 10 seconds for the dentin. Dentin bonding agent was applied in two layers according to the manufacturer's instructions and light-cured for 20 seconds.

Using the putty matrix, the palatal enamel layer was placed, using the GE3 composite. A thin layer of glass connector was then placed to mimic the protein layer between dentin and enamel, and to improve light reflection at this interface. This was followed by dentin layers in "universal dentin" UD3.5, UD3, and UD2 to give the overall body shade of Vita A2. Internal mammelons were added using the intensive milky white color, and translucency using opalescent blue natural. A further thin layer of glass connector followed by a final layer of GE3 was placed on top of this, supplemented with small spots of white stain to mimic the hypocalcifications in the surface layers of the enamel. Each addition was cured for 20 seconds immediately after placement.



*Figure 5: Retracted before smile, 1:2 view.*



*Figure 6: Retracted after smile, 1:2 view.*



*Figure 7: Retracted left lateral before, 1:1 view.*



*Figure 8: Retracted left lateral after, 1:1 view.*

The primary anatomy (overall outline and facial line angles) was refined using a medium-grit polishing disc and a disc-shaped rubber polisher. The same rubber polisher was used to place secondary anatomy. Water coolant was used intermittently to prevent the generation of excessive heat. Tertiary anatomy was carefully added by lightly drawing a coarse-grit (100 $\mu$ m) flame-shaped diamond bur across the surface (Figs 7 & 8). A speed-increasing handpiece was used to move the

bur, yet was operated at a speed much slower than the fast air-rotor, allowing far more control. This type of handpiece (sometimes referred to as an "electric handpiece") fits onto a slow handpiece attachment on the dental chair and holds friction-grip burs, but is geared to increase the speed of rotation by 1:5, making for overall speeds similar to that of an air-rotor but with more torque and control.

The occlusion was rechecked but no adjustment was found to be necessary. Polishing was completed using a silicon carbide brush and 3  $\mu$ m and 1  $\mu$ m diamond polishing pastes on a bristle brush, followed by aluminum oxide paste on a buffing disc.

Final photographs were taken a few hours later, before the patient returned to her home several hundred miles away (Figs 9 & 10).



Figure 9: Retracted before, 1:1 view.



Figure 10: Retracted after, 1:1 view.

## CONCLUSION

This case illustrates how direct composite resin restorations can be used to provide an excellent and minimally invasive restoration, even when large defects are present. The patient was very happy to have her tooth and smile back, and her parents were extremely happy to have avoided a more invasive crown preparation. *Ap*

## Acknowledgments

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