Enhanced resilience and aesthetics in a Class IV restoration

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In colonial times, homes were constructed of logs, mud and grass. New inventions throughout the decades brought the use of stronger and more urbane resources such as stone, concrete, steel, fibreglass and plastics. Builders utilised products that provided not only strength and durability but also, aesthetically pleasing results for homeowners. Following the same time line for dentistry, some colonists bared wooden teeth. New technology introduced the use of silver amalgams, gold crowns, microfills and hybrids. The dental community, like that of the builder, continually strives to enhance products that would provide a pleasing smile, while possessing endurance and resilience.

The buzzword of modern technology is 'user friendly'. Improvements in adhesive bonding and composite bonding systems in general have produced single component adhesives, 'no bottle adhesives' and the syringe-delivered system, which delivers greater bond strength and eliminates sensitivity and microleakeage. Even with such advances, the clinician must choose between the hybrid, the microfill or a combination of both in ameliorating restorations.

The single anterior tooth replacement represents a complex restorative challenge for the clinician in either composite restorative resins or porcelain systems. The challenge exists while attempting to achieve true harmonisation of the primary parameters in aesthetics (i.e. colour, shape and texture) (Vanini, De Simone & Tammaro, 1997; Vanini, 1996). While porcelain designing relies on stone models, photographs and the clinician's laboratory narrative description to the technician, direct restorative resin reconstruction relies on the surrounding dentition for correlation. The proximate

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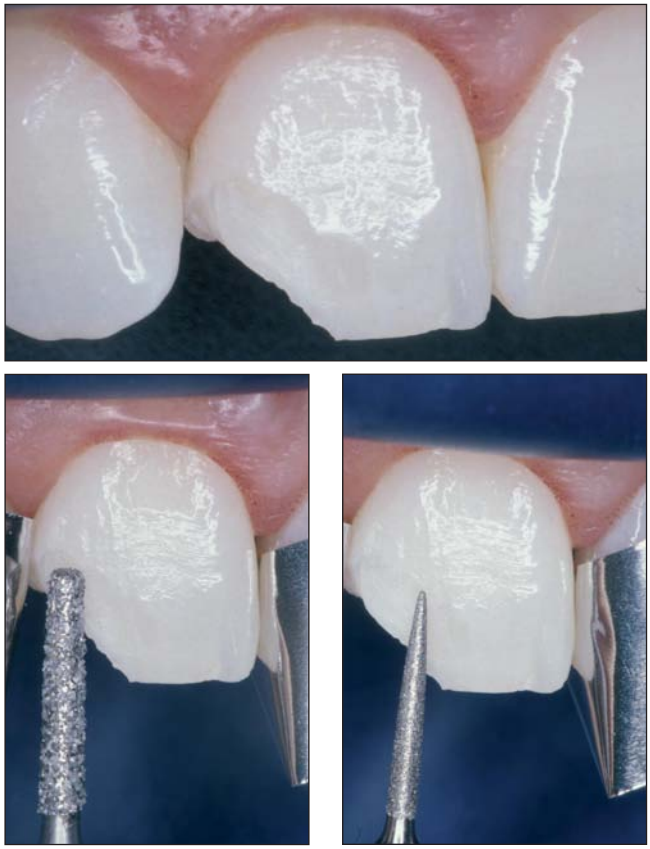
Figures 1a & 1b: Preoperative facial view shows a horizontal fracture

environment commands the appearance of any restoration (Pensler, 1998). This case presentation demonstrates the restoration of a Class IV fracture taking aesthetic consideration of the anatomic variations of the adjacent teeth to produce a direct composite resin in harmony with the surrounding dentition. Although stratification techniques are still necessary, by understanding the dimensions of colour, the properties of composite resins and the morphology of the tooth, the clinician will attain more predictable and aesthetic results. Utilising a recently developed optimised particle composite with improved mechanical and physical properties, this article will describe a methodological approach for preparing, restoring and finishing the incisal angle of the anterior dentition with a smaller particle composite.

Figure 2: Shade selection with custom-fabricated shade tabs

Preoperative considerations

A young female patient presented with a hor`ontal fracture after a traumatic blow to the maxillary right central (Figures 1a & 1b). In fractures of young teeth, the clinician must assess clinically and radiographically the extent of trauma and pulpal injury. A finding of acute pathology requires the alteration of all treatment plans, utilising all necessary actions for resolution. At this appointment a pre-visualised mock-up was performed with a selection of the composite restorative materials, modifiers selected, and their orientation, which was charted to be applied at the restorative stage. The shade selection was performed at this visit to prevent an elevated value and/or the selection of improper shade after tooth dehydration (Figure 2).



Figures 3a to 3c: A chamfer 0.3mm in depth was placed 2mm long around the entire margin. A 'scalloped' bevel was placed on the chamfer with a long tapered diamond. A bevel was placed at the chamfer margin

Clinical procedure - preparation

Once anaesthesia had been administered to the patient, isolation was accomplished with rubber dam, using a modified technique. The technique involved the creation of an elongated hole that allowed placement of the rubber dam over the retainers to achieve adequate field control (Croll, 1985; Liebenberg, 1994). A chamfer was placed approximately 0.3mm in depth extending 2-3mm long around the entire margin. This preparation provides a greater fracture resistance due to the larger volume of composite resin available at the restoration margin (Bichacho, 1996). A 'scalloped' bevel on the chamfer was placed to break up the straight chamfer line with a long tapered diamond (777C Kerr/Sybron, Orange, CA).

If there is not a harmonious blend in colour at the interface of the bulk of composite resin and the natural tooth, a bevel placed at the chamfer margin will improve this. Also, to improve microleakage at this interface, the gingival margin is bevelled 0.5mm since it is on enamel (Miller, 1989) (Figures 3a to 3c). The lingual aspect of the chamfer was extended 2mm onto the lingual surface, but not onto the occlusal contact area. The margin should not end on the occlusal contact area unless relocating it to a contact free area would require excessive reduction of healthy tooth structure. The preparation was completed with a finishing disk and polished with rubber cups that contained a premixed slurry of pumice and 2% chlorhexidine (Consepsis, Ultradent, South Jordan, UT).

Development of the restoration

The preparation was rinsed and lightly air-dried, and a soft metal strip was placed interproximally to isolate the prepared tooth from the adjacent dentition. The 'total etch' technique was utilised due to its ability to minimise the potential of microleakage and enhance bond strength to dentine and enamel (Kanca, 1992; Nakabayash, Nakamura & Yasuda, 1991; Kanca, 1992). The preparation was etched for 15 seconds with 37.5% phosphoric acid (Gel-Etchant, Kerr/Sybron, Orange, CA), rinsed for five seconds, and gently

Figure 4: The preparation was etched for 15 seconds with 37.5% phosphoric acid (GelEtchant)

Figures 5a to 5c: A single-component adhesive (OptiBond Solo Plus) was applied with an applicator for 15 seconds, lightly air-dried for three seconds, and light-cure for 20 seconds

air dried for five seconds (Figure 4). The etch should extend several millimetres beyond the bevels and the adjacent teeth should be protected from the conditioner with a soft metal strip. A single component adhesive (Optibond Solo+Plus, Kerr/Sybron, Orange, CA) was applied with a brush for 20 seconds with continuous motion and was lightly air-dried for five seconds. The agent was light cured for 20 seconds (Figures 5a to 5c). Although a small amount of excess adhesive can be applied over the margins to improve sealing, this excess should be removed during finishing procedures in order to avoid adverse periodontal sequellae.

The first layer - the artificial dentine body - of A1-shaded composite resin (Point 4, Kerr/Sybron, Orange, CA) was applied and contoured with a long bladed composite instrument and smoothed out with an artist's sable brush (Figure 6). This step was crucial since surface irregularities could interfere with placement of tints for internal characterisation. This composite layer was polymerised with a curing unit (Optilux 501, Demetron, Danbury, CT) for 10 seconds which allowed placement of subsequent increments without deforming the underlying composite layer. This process was repeated with a second layer of A1-shaded composite to form the dentine lobes. In order to prevent overbuilding of the 'artificial dentine' layer, it is important to monitor the composite placement from the incisal aspect so as to provide adequate space for the final 'artificial enamel' layer. Although this composite resin exhibits opacious characteristics a diluted white tint (Kolor+Plus, Kerr/Sybron, Orange, CA) was placed in an infinitesimal amount along the interface to disguise the fracture line (Figure 7). To emphasise the tooth form a diluted yellow tint was applied in a thin wash vertically at the distofacial line angle and highlighted with a white modifier (Figure 8). This technique utilises colour variation to impart a three-dimensional effect to the restoration. The 'artificial enamel' was created in two composite layers to impart an aesthetic hue variation and to instil a more realistic depth of colour. The first enamel layer of B1-shaded composite resin (Point 4, Kerr/Sybron, Orange,CA) was applied with a long bladed composite instrument (Figure 9) and then smoothed with an artist's sable brush. Surface irregularities were carefully eliminated, and the increment was polymerised with a curing unit (Optilux 501, Demetron, Danbury, CT) for 40 seconds. The final 'artificial enamel' layer was restored (Figure 10). This represents the principal determinant of the value of the restored tooth and is selected to correspond to the contra-lateral teeth.

Figure 6: The artificial dentine body of A1-shaded composite resin (Point 4) was applied and contoured with a long-bladed composite instrument and smoothed out with an artist's brush to form the dentine lobes

Figure 7: A diluted white tint was placed along the interface to disguise the fracture line

Figure 8: A diluted yellow was applied in a thin wash vertically at the distofacial line angle and highlighted with a white modifier

The final restorative phase

The final restorative phase is accompanied by contouring and finishing the restoration, which remains critical for enhancing aesthetics and the longevity of the restored teeth (Jefferies, Barkmeier & Gwinnett, 1992; Goldstein, 1999). Proper surface texture of composite restorations is relatively difficult to achieve, demanding intensive training, meticulous attention to technique, and very close observation of the surrounding natural teeth (Yamamoto, Miyoshi & Kataoka, 1990). In this case, particular attention was given not only to the relationship between the expanse and direction of the ridges and grooves and the anatomic variations of the teeth that will be adjacent to the restoration, but also to the light refraction and surface reflection resulting from microstructure of the tooth surface (Hegenbarth, 1998). To reproduce the shape, colour, and gloss of the natural dentition (Strasseler, 1992) while enhancing the aesthetics and longevity of the restoration, the following protocol was implemented (Jefferies, Barkmeier & Gwinnett, 1992; Goldstein, 1999).

The initial contouring was performed with a series of finishing burs in order to replicate natural form and texture (Dietschi, 1995). The facial contouring was initiated with 8 and 12 fluted needle shaped burs (7714, Kerr/Sybron, Orange, CA), while closely observing the tooth-resin interface and using a dry protocol (Figure 11). The lingual surfaces were contoured with 8 and 12 fluted football shaped burs (7406, Kerr/Sybron, Orange, CA) (Figure 12). Finishing the proximal, facial and incisal angles was performed with aluminum oxide disks and finishing strips. These were used sequentially accordingly to grit and ranged from coarse to extra fine (Figures 13 & 13b) For characterisation, finishing burs, diamonds, and rubber wheels and points were used to create indentations, lobes and ridges (Figure 14). To impart a high lustre while maintaining the existing texture and surface anatomy, a soft white goat hair brush (Vivere, Leach and Dillon, Cranston, RI) with composite paste was used to polish the restoration (Figure 15). After the polishing was completed, the restoration was polymerised for an additional 60 seconds. Harmonious integration with the surrounding dentition was achieved by developing tooth anatomy and surface texture

Figures 9a & 9b: The first enamel layer of B1 shade composite resin (Point 4) was applied and contoured with a long-bladed composite instrument and smoothed with a sable brush

Figure 10: The final 'artificial enamel' layer was restored with T-1 shaded composite resin (Point 4) which was applied and contoured with a long-bladed composite instrument and smoothed with a sable brush

Figure 11: Facial contouring was initiated with 12- and 30- fluted needle-shaped burs

Figure 12: The lingual surfaces were contoured with 12- and 30- fluted rugby-shaped burs

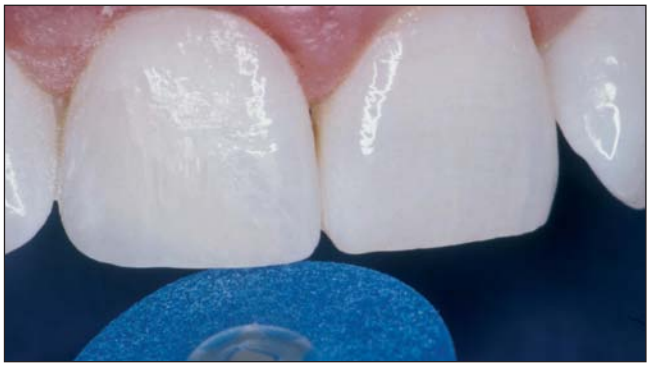
that contribute to light and shade reflectance (Figures 17a to 17d) (Pensler, 1998; Baratieri et al, 1998).

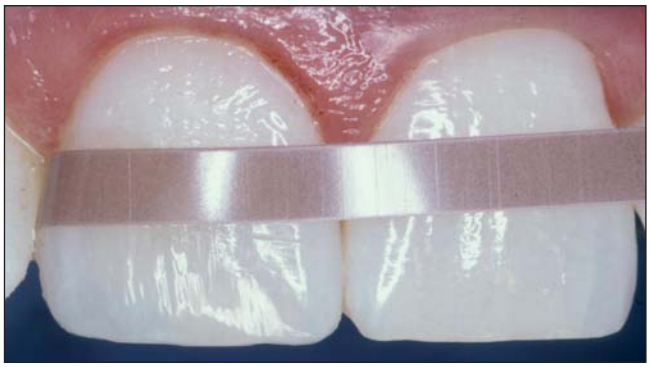
Conclusion

Understanding the total morphology of a tooth and utilising natural teeth as the basis for morphological thinking, the clinician possesses the knowledge to create restorations with a more natural appearance (Yamamoto, Miyoshi & Kataoka, 1990). Unfortunately, the knowledge and desire to create are limited by the products clinicians are able to utilise in restorations. Continuing technological breakthroughs allow the clinician to not only comprehend the 'building blocks' of the ideal composite restoration, but also to implement and maximise new products in attaining more predictable and aesthetic results. This procedure demonstrates a methodological protocol of incremental application of composite resins and modifiers to transform the Class IV fracture into a final restoration that mimics nature (Figure 18).

Figure 14: Surface texture was created with a knife-edge wheel

Figure 15: A soft brown goat hair brush with a loose abrasive composite polishing paste was used to impart a high lustre while maintaining the existing surface texture





Figures 13a & 13b: Finishing the proximal, facial, and incisal angles was performed with aluminum oxide disks and finishing strip

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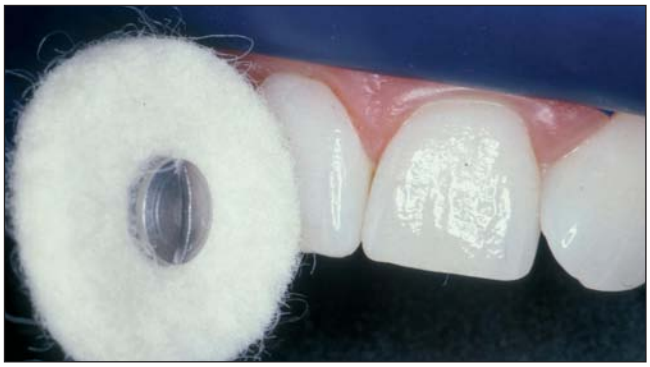
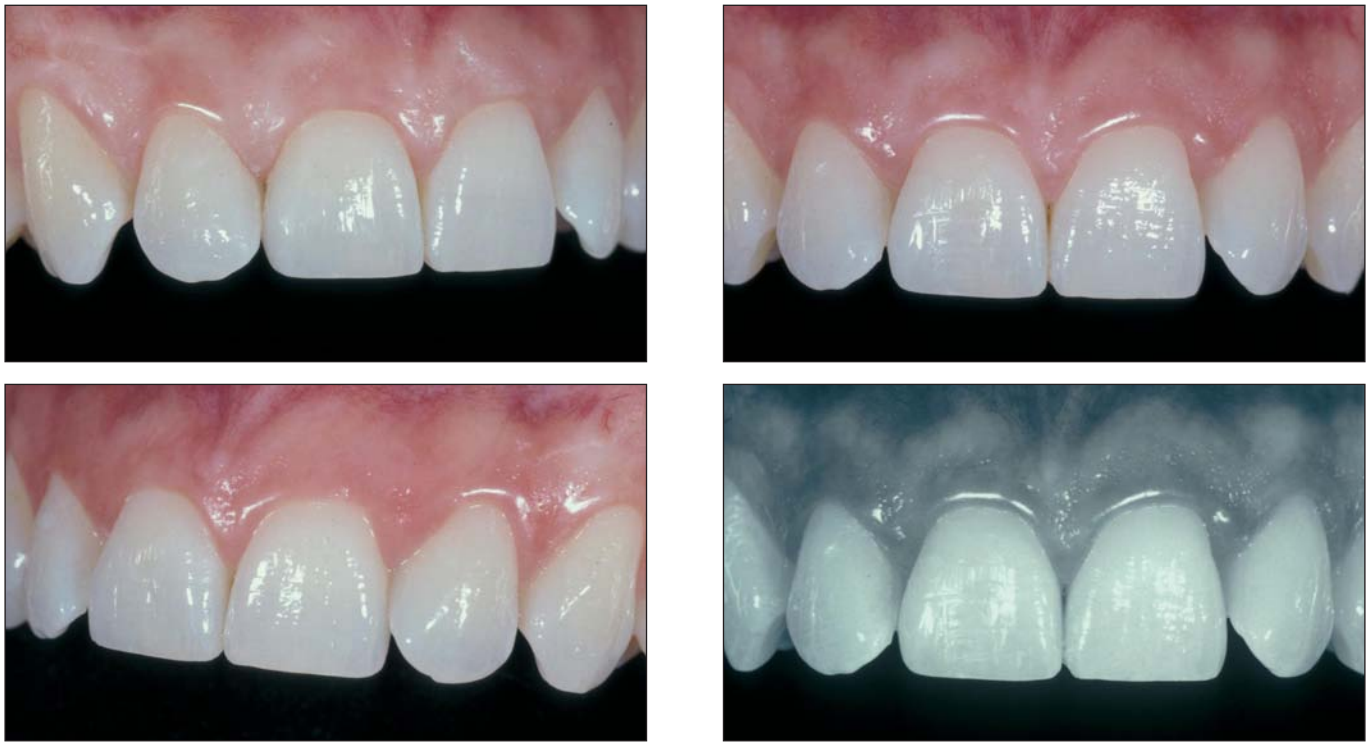


Figure 16: A high gloss surface reflectivity was accomplished with a dry felt wheel using an intermittent circular staccato motion



Figures 17a to 17d: The completed restoration was harmoniously integrated with the surrounding dentition. Notice the symmetrical anatomical morphological characteristics depicted in the black and white photograph

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Figure 18: A final aesthetic harmony was achieved between the central incisors and the smile was enhanced by developing natural aesthetics for the personality of the patient

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