Achieving Aesthetic and Functional Direct Posterior Restorations With a Polyglas® Material

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Direct posterior composite restorations occupy a unique position in restorative dentistry, since they enable preservation and reinforcement of the remaining tooth structure and provide enhanced aesthetics, all in a single appointment. The need for a simplified clinical protocol, supported by sound scientific evidence, has resulted in the development of a new material for direct posterior placement. This article discusses the innovative Polyglas® technology (Heraeus Kulzer, Inc., South Bend, IN) designed to achieve time-saving, easy-to-perform, and physiologically sound Class II restorations.

Figure 1. View of scanning electron microscopy (SEM), showing the unique porous fillers of Solitaire®.

Composite resins were introduced to dentistry in the mid-1960s by Rafael Bowen. Since then, they have gained universal acceptance by clinicians and have undergone significant improvement in their chemical, physical, and clinical properties.[1] Their popularity is attributed primarily to the aesthetics that they impart to restorations—a characteristic so highly regarded that most clinicians and patients are in agreement in selecting composite resins as the material of choice for direct anterior and posterior restorations.

Since conventional composite resins do not handle like amalgam, attempts to implement an amalgam-associated technique for the placement of composite restorations often resulted in failures. To avoid complications, such as marginal gaps induced by material shrinkage, higher-than-acceptable rates of secondary caries, and postoperative sensitivity, intricate layering techniques were developed.[2,3] A controversy still existed, however, regarding the benefits of incremental layering to minimize marginal gap formation,[4] and the extended time requirement also presented a barrier. Only clinicians willing to invest the time required to place, contour, and finish an incremental polychromatic restoration could ensure an optimal level of clinical success.

It has become evident that the more composite resins emulate the viscosity, injectability, and condensability of amalgam, the easier the restorative protocol will be, with greater potential for clinical success. To incorporate these beneficial properties, some manufacturers increased the filler content; however, substantial increases in porosity ensued.[5]

Innovative Material Development

An innovative posterior composite (Solitaire®, Heraeus Kulzer, Inc., South Bend, IN) was introduced in 1997 and presents excellent characteristics other than true amalgam-like condensability. Its innovative chemistry and advanced technology position Solitaire as a restorative material that combines a unique filler with a highly cross-linked matrix. Two elements compose the direct restorative: a multifunctional vitroid Polyglas monomer resin which, following polymerization, provides a glass-like structure; and unique filler particles with irregular surfaces that contribute to condensability (Table). The particles (ranging in size from 2.0 μm to 20.0 μm) are porous and facilitate penetration by the resin matrix to produce a more uniform mass under condensation (Figure 1). In combination with microglass fillers and Al-F-Si-glass components, the SiO_2 glass fillers occupy

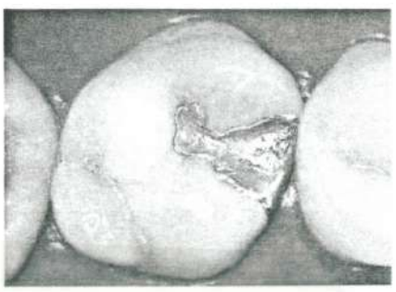

Figure 2. Preoperative view of maxillary molar with evident secondary caries undermining the mesiobuccal cusp.

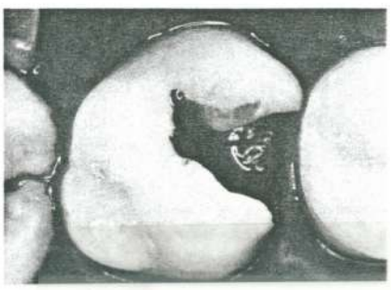

Figure 3. A caries-detecting dye is an indispensable adjunct in the process of caries removal.

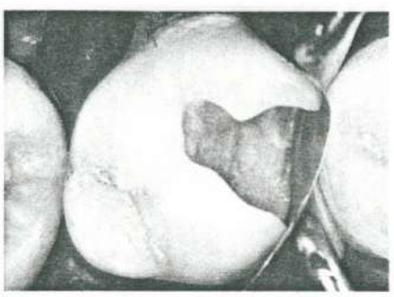

Figure 4. A matrix, wedge, and ring are secured into place to promote proper gingival adaptation, proximal contour, and contact.

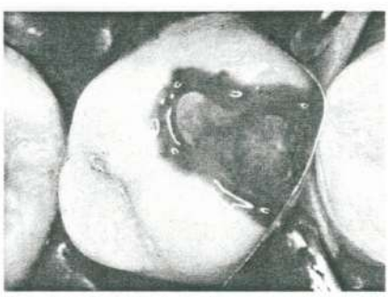

Figure 5. Acid-etching is initially performed along the enamel margins.

Filler	Charisma®	Solitaire®
Ba-Al-B-F-Si-glass D_{50} 0.7 μm, D_{99} 2.0 μm	./.	26%
Ba-Al-B-Si-glass D_{50} 0.7 μm, D_{99} 2.0 μm	67%	./.
Pyrogenic SiO_2 0.01 μm to 0.04 μm	5%	./.
Highly porous SiO_2 glass D_{50} 8.0 μm, D_{99} 22.0 μm	./.	30%
Al-F-Si-glass D_{50} 8.0 μm, D_{99} 2.0 μm	./.	5%
Fluoride Salt D_{99} 1.0 μm	./.	5%
Filler content by weight	~72%	~66%

Table. Filler composition of Solitaire® in comparison to Charisma®.

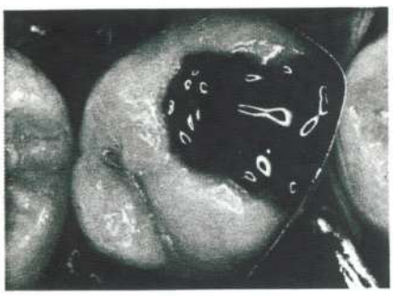

Figure 6. Gel etchant is then injected into the cavity and left in contact with the dentin for 15 seconds.

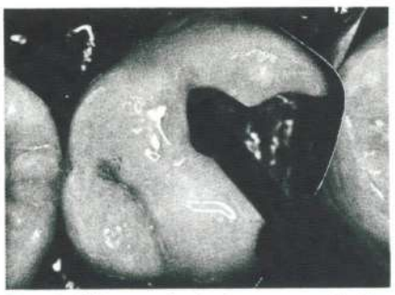

Figure 7. A fifth-generation single component adhesive is applied to the enamel and dentin.

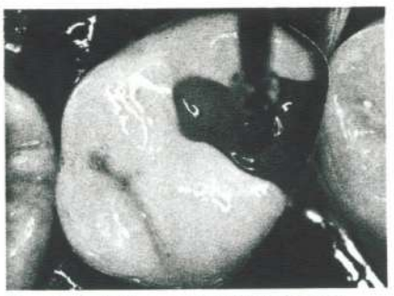

Figure 8. The first increment of Solitaire® is tease-condensed against the gingival and axial walls.

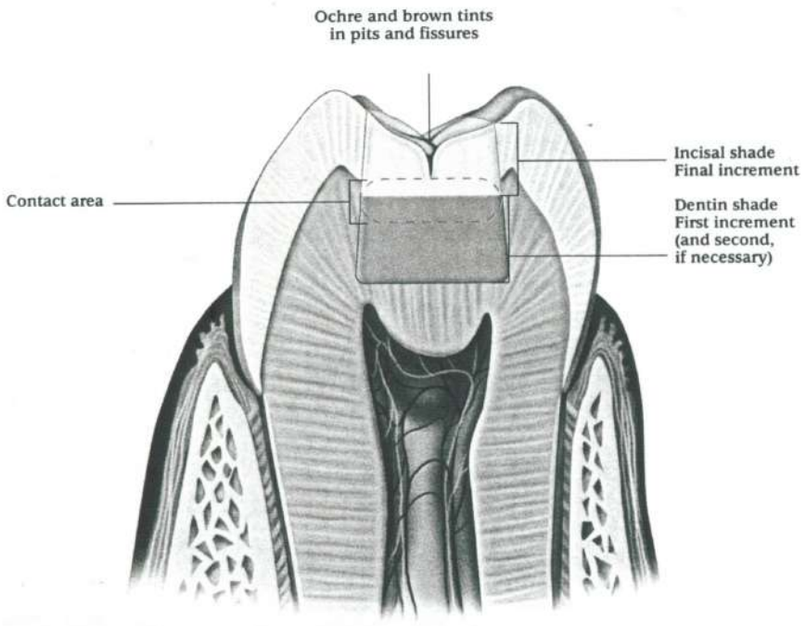

Figure 9. Illustration of the incremental placement technique utilized for Solitaire® restorations.

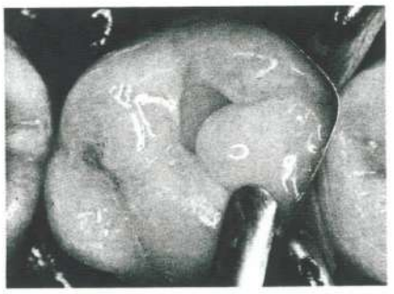

Figure 10. A final increment of the incisal shade of Solitaire® is placed into the cavity.

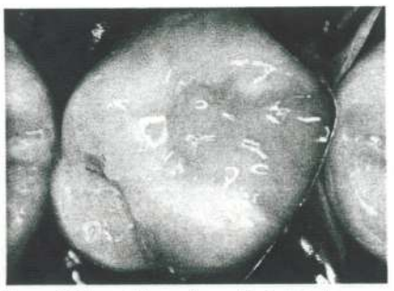

Figure 11. View of the condensed incisal shade.

66% (by weight) of the material and release fluoride ions that can be recharged over time utilizing a fluoride-containing dentifrice.[6]

Excellent marginal adaptation is another significant characteristic of the Polyglas material (Solitaire). With conventional composite resins, the stress load placed on the cavity wall increases rapidly upon initiation of light activation. Due to the "integrated soft-start polymerization,"[7] Solitaire presents a delayed development of high-shrinkage stresses at the polymerizing interface of the restorative and bonding agents and within the restoration itself. This phenomenon results in optimized contact between the restorative and tooth surfaces, promoting enhanced marginal integrity.[8,9] The viscoelastic properties and physiological wear resistance enable this material to withstand masticatory forces and render it suitable for Class I and II restorations and in Class V abfraction lesions.[10]

Clinical Advantages

Solitaire is available in five Vita dentin shades (A10, A20, A30, B20, B30) and one incisal shade, and is packaged in an assortment of syringes or preloaded (PLT) unit-dose tips, with written and illustrated instructions. The Polyglas material may be applied and molded utilizing standard composite instruments or conventional amalgam condensers; it is packable and not sticky. Since the material does not "slump," it facilitates an easy formation of surface morphology, minimizing the finishing procedures. Thin conventional or sectional metal matrices may be utilized to develop proximal contacts and contours. Although Solitaire responds similarly to freshly mixed amalgam under condensation, effective wedging is still required to ensure physiologically tight interproximal contacts.

Placement Protocol

Placement of direct adhesive posterior restorations requires time and care. A technique for the replacement of an existing defective amalgam restoration (Figure 2) with Solitaire, using a single-component, acetone-based fifth-generation bonding agent (Gluma® One Bond, Heraeus Kulzer, Inc., South Bend, IN), is presented.

Shade Selection

Shade selection is the first step; for Solitaire, two shades are sufficient. Using the manufacturer's or a Vita® shade guide (Vident, Brea, CA), the shade is selected from the cervical third of the tooth to be restored, ie, the high-chroma dentin replacement shade to be used internally. The I (incisal) shade is used as the final layer to emulate the appearance of natural enamel. Correct isolation is essential to the success of all bonded restorations, and placement of a rubber dam is required. When properly applied, a rubber dam will enhance visual acuity, eliminate saliva/blood contamination, protect the patient, and save treatment time.

Preparation

Cavity preparation involves removal of the defective amalgam material and all caries and is best accomplished with the aid of a caries-detecting dye (Figure 3). Sound enamel margins (at least 0.6-mm thick) should be refined with rotary and hand instruments, retaining the cavosurface margins at a 90° angle to provide proper material bulk. The use of metal matrices is preferable, since they are thinner and more easily handled. A simplified technique requires the use of thin precontoured sectional metal matrices. The matrix is adapted interproximally and secured with a wedge that promotes tight cervical adaptation and slight tooth separation. Using rubber dam forceps, a ring is placed in position to determine appropriate tooth separation and matrix contour (Figure 4).

To disinfect the cavity, a bactericidal solution, such as 2% chlorhexidine or 1% benzalkonium chloride, may be used. The etchant (Esticid®–20FG, Heraeus Kulzer, Inc., South Bend, IN) is applied initially on all enamel margins (Figure 5) and then injected into the cavity to remain in contact with the dentin for 15 seconds (Figure 6). The preparation is then thoroughly rinsed with water spray for five seconds and briefly air dried. The dentin surface should appear moist, with no pooling of water.

The adhesive is now dispensed into a well to prevent unwanted evaporation of the acetone solvent and thickening of the resin monomers. Two or more coats are applied with a disposable brush or an applicator to ensure saturation of the dentin (Figure 7). The adhesive is then gently spread with a stream of air for five seconds to evaporate the water and solvent. If the cavity surface is not uniformly shiny following this application, additional coats are required. The adhesive is then polymerized for 20 seconds.

Incremental Technique

An increment of the selected dentin shade restorative is manipulated into a convenient ball shape and attached to the instrument for placement; amalgam carriers or preloaded tips may be utilized. The first increment is placed carefully into the cavity preparation and adapted against the cavity walls using fast tapping movements (Figure 8). The absence of stickiness in the Polyglas material (Solitaire) prevents pull back with the instrument. Solitaire may be placed in increments of up to

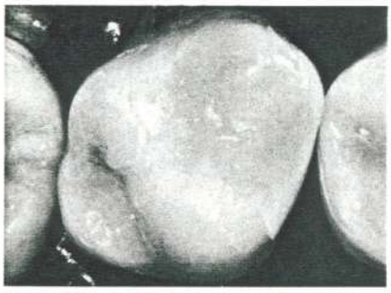

Figure 12. Correct proximal contour and contact are evident upon removal of the matrix, wedge, and ring.

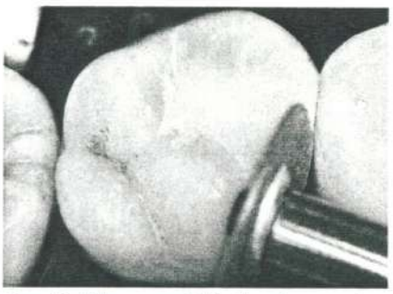

Figure 13. Disks are essential for the refinement of embrasures.

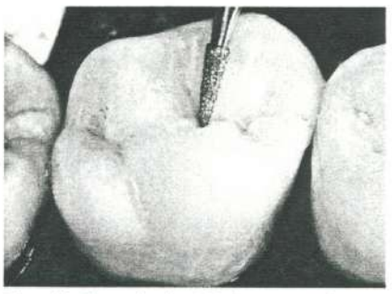

Figure 14. Diamond and carbide burs are used to impart secondary and tertiary anatomy.

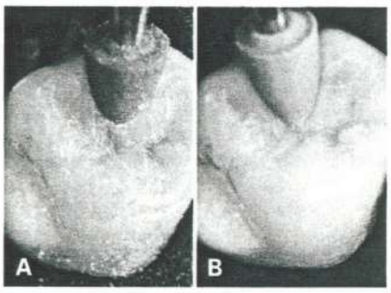

Figure 15A and B. Finishing is performed with silicone points, and polishing completes the restoration.

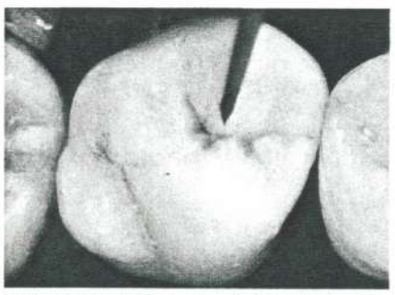

Figure 16. Optional tints are applied into the pit and fissure areas to impart natural polychromy to the definitive restoration.

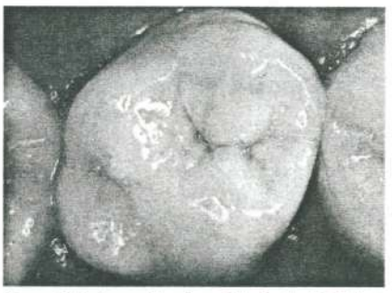

Figure 17. Postoperative view of the finished Solitaire® restoration. Note the biofunctional and aesthetic integration achieved.

5.0 mm, depending upon shade. Each increment is light cured for 40 seconds. If the cervical cavosurface margin is at the gingival level or slightly subgingival, a second increment of dentin shade should be applied and light cured. Ideally, the first increment is retained short of the proximal contact area to enable placement of the incisal shade increment (Figure 9).

A final increment of the incisal shade is then placed into the cavity and condensed to create occlusal morphology—the triangular and marginal ridges, sulci, and fossae (Figures 10 and 11). Placement of excess material should be avoided to minimize finishing procedures. As a result of Solitaire's handling properties, surface morphology is easily created. Following final increment polymerization, the matrix band is removed, and the restoration is further light cured from the buccal and lingual aspects of the proximal box. Upon removal of the matrix band, wedge, and ring, the correct proximal contours and contacts are evident (Figure 12).

Finishing

The proximal margins and occlusal embrasures are refined utilizing contouring discs (Figure 13). A #12 scalpel blade is used to carve away excess material at the gingival portion of the proximal box, and medium-grit diamond and carbide burs are used to create fossae and sulci and to refine triangular ridge anatomy (Figure 14). A 7903 12-fluted carbide bur (Brasseler USA, Savannah, GA) is utilized to create pits and fissures; silicone points of varying abrasiveness finish and polish the restoration surfaces and margins (Figure 15). To polish the groove areas, diamond and aluminum oxide pastes may be used either alone or in conjunction with silicon carbide brushes.

If enhanced polychromatic effects are desired, tints may be applied sparingly in the pit and fissure areas. Following finishing and polishing, the entire occlusal portion of the restoration is acid-etched beyond the margins for 15 seconds, rinsed, and dried. If desired, ochre and brown tints may be flowed into the deep anatomical areas and light cured (Figure 16). To fixate the tints and to seal any surface imperfections, a surface sealant is applied and light cured for 20 seconds.

Upon removal of the rubber dam, the occlusion is evaluated and adjusted. If placement and carving of the restorative material have been performed correctly, only minor adjustments may be required. The final restoration should exhibit proper contours, tight proximal contacts, and occlusal anatomy that closely resemble natural dentition (Figure 17).

Conclusion

Solitaire is an aesthetic posterior restorative material for clinicians who have utilized amalgam successfully over the years and have been reluctant to change to composite resin due to the more intricate clinical protocol required. With handling properties that enable an easier manipulation than either amalgam or conventional composite restoratives, Solitaire may be readily incorporated into most practices. Although more time is required to place Polyglas than amalgam, there is a definite time gain—67%—when compared with conventional composite placement techniques.[5] As more restorative materials are introduced that resemble the polyglas material (Solitaire), clinicians and patients will abandon amalgam and realize the benefits of biofunctional and aesthetic dentistry.

References

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Characteristics of Solitaire®

Advantages/Benefits

- Optimal packability
- Soft-start polymerization
- Enhanced marginal adaptation
- Easy interproximal contact points
- Absence of stickiness
- Superior handling characteristics
- Excellent wear resistance
- Fluoride release
- Available in five Vita® dentin shades and one incisal shade

Clinical Indications

(Posterior resin material)

- Class I and II restorations
- Class V abfraction lesions

Newton Fahl, Jr., DDS, MS, maintains a private practice, emphasizing Restorative and Aesthetic Dentistry in Curitiba, Brazil. Dr. Fahl is a founding member and President of the Brazilian Society of Aesthetic Dentistry, and lectures and conducts continuing education seminars on Aesthetic Dentistry in Brazil and internationally.