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A Clear PVS Matrix Technique for the Placement of Posterior Direct Composites

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During the last 10 years many innovative materials and techniques have been introduced for restorative treatment, especially in the area of direct and indirect aesthetic restoration of posterior teeth. Despite the effectiveness of preventive treatments, the decreasing DMTF index, and the decreasing demand for prosthetic restorations, restorative dentistry continues to comprise a large portion of the dentist's daily practice schedule. Silver amalgam, which has been a material of choice in the treatment of posterior caries for 150 years, has recently experienced a steady decline in use. This material has been enduring much criticism, not by the international scientific literature, but instead by the media, alternative medicine, and the governments of various countries expressing environmental concerns regarding its use and disposal. As a result, in the last few years, many new materials such as compomers, ormocers, giomers, packable composite resins, flowable resin-based materials, and glass ionomers have been introduced to the market.

There have not been any major innovations in the organic matrix used, since light-curing materials are all still derived from Bowen's monomers (bis-GMA) or at least urethane-dimethacrylate (UDMA). Research has focused on fillers, interfacial surfaces (organic matrix/filler-silane), and on aggregation technology of filler particles. Technical innovations have been more significant in the realm of light-curing units, devices linked with these materials, and new clinical techniques for the layering and polymerization of resin-based materials used for restoration of posterior teeth.[1] The layering styles that most practitioners use are the incremental and stratified techniques. Also, many light-curing options have been introduced. These include continuous, fast, soft-start, pulse, and pulse-delay programs.[2] Broadened indications for resin composites have resulted in their increased use by a growing number of clinicians in stress-bearing areas like posterior arches.[3,4] In any case, it should be emphasized that the potential drawbacks of using composites in posterior regions, such as polymerization shrinkage, wear, marginal leakage at the cervical margin (especially in dentinal margins), discoloration, secondary caries, and dentin adhesion, is still of great concern.[5-7] Aesthetic posterior restoration wear is attributable mainly to impact, friction, organic matrix and hydrolytic degradation of the interfacial surface, surface roughness, Young's modulus and hardness of these materials, and chemical erosion.[8] Recently, some authors have identified the lack of correlation between patient's habitual occlusion and a restoration's anatomical morphology as a significant cause of premature composite wear.[9,10]

The main purpose of this clinical report is to present a new preoperative occlusal registration technique that reproduces occlusal surfaces before the placement and polymerization of the composite resin, thus reducing the time needed for shaping, polishing, and occlusal adjustments. This technique, due to the occlusal registration method utilized, allows us to efficiently and predictably reproduce the occlusal morphology being restored with direct or indirect resin-based restorations. Furthermore, this technique solves the curing problems associated with the oxygen-inhibited layer in direct composite restorations where oxygen, saturating superficial reactive sites, decreases the degree of polymerization of the most superficial layers.[11]

Figure 1. A partial-arch, clear impression tray in an appropriate size is selected (Ardag; Catanzaro, Italy).

Figure 2. Clear PVS impression material is used.

Required materials for this technique are common packable composites with their associated enamel and dentin adhesive systems, a clear partial-arch impression tray of an appropriate size (Figure 1), and a clear polyvinyl siloxane impression material (Kristall DENS [Ardag]; Catanzaro, Italy; Figure 2). The technique presented here differs from the one presented by Baratieri, et al, mainly because of the material employed to achieve the occlusal registration.[12] Baratieri proposed using an acrylic resin matrix to reproduce the occlusal morphology. It is the authors' opinion that, due to the stiffness of acrylic resin, if the resin flows into the numerous dental undercuts it could be difficult to remove the impression from the teeth once the resin has completely polymerized. On the other hand, the removal of the tray before the resin is completely cured could lead to undesirable deformation. Furthermore, any pre-existing composite resin restorations would need to be accurately isolated from the acrylic resin impression material to prevent any sticking problems.

For the reasons cited above, the authors propose utilizing a clear polyvinyl siloxane material that will have the needed properties for this procedure, including elasticity, elastic memory, and adequate viscosity. The following case study illustrates a step-by-step technique to achieve an anatomical, functional, and aesthetic posterior direct composite restoration.

CASE REPORT

Figure 3. A clinical photo shows discoloration in the distal aspect of the occlusal surface of tooth No. 29.

Figure 4. The radiograph reveals a radiolucency on the distal surface of tooth No. 29.

Figure 5. The operative field is isolated with a rubber dam.

Figures 6 and 7. An impression was taken with the clear tray and clear PVS impression material.

A 35-year-old female presented with two chief concerns: temperature sensitivity on the mandibular right second premolars and the desire to have a tooth-colored filling. Upon clinical examination, tooth No. 29 presented wih distal discoloration (Figure 3); radiographs revealed a radiolucent area on its distal wall (Figure 4). The treatment plan called for a tooth-colored restoration utilizing the preoperative occlusal registration technique. After anesthesia, and prior to the placement of a rubber dam, the tooth's surface was cleaned with a plain flour pumice paste without fluoride. Next, the shade was chosen using the Esthet-X shade guide (DENTSPLY Caulk). A2 was the shade of choice for dentin, and T2 was chosen for the enamel shade. An occlusal analysis was then performed with AccuFilm (Parkell) to determine the location of the patient's centric stops. Next, a rubber dam was placed to isolate the lower right quadrant area (Figure 5). A PVS adhesive was applied on a clear impression tray and properly dried. An impression was subsequently taken with the clear PVS (Figures 6 and 7) impression material discussed previously.

Figures 8 to 10. Cavity preparation, caries removal, and finishing of the margins are accomplished.

Cavity preparation was performed with a diamond bur (830L 012 [Komet]) on a high-speed handpiece with copious water flow (Figure 8). Then, caries removal was done with a small, round tungsten carbide bur (H1SE 014 [Komet]) on a contra-angle handpiece (Figure 9). The preparation was refined and modified for the composite restoration. Rounded internal line angles were developed for optimal adaptation of the composite and to avoid any stress concentration at any of the cavity's angles. The cavity margins were then finished and polished by Black's chisel Nos. 77/78 and Nos. 79/80 (Hu-Friedy) and decreasing-grit silicon rubber points (Figure 10).

Figure 11. The total-etch technique was utilized in this case.

Figure 12. Buildup of the interproximal distal wall was accomplished first.

Next, the enamel and dentin were each selectively etched with 37% phosphoric acid (Conditioner 36 [DENTSPLY Caulk]) according to the manufacturer's cementation instructions, rinsed copiously with water, and then dried with a gentle stream of air (Figure 11). A metal matrix band was applied with appropriate interproximal wedges. Prime & Bond NT (DENTSPLY Caulk) was applied following the manufacturer's instructions and cured for 40 seconds (QHL75 [DENTSPLY Caulk]). A small amount of the selected enamel shade (T2) composite resin (Esthet-X) was first applied to build up the distal interproximal wall to transform the class II cavity to a class I cavity configuration (Figure 12). This was accomplished using Compo Sculp instruments (Suter Dental). After the light-curing was completed, the interproximal matrix was removed.

The selected dentin shade (A2) composite resin (Esthet-X) was then anatomically applied in 2 layers to minimize polymerization shrinkage. The first increment of material was layered across the buccal dentinal wall, while the second layer was applied across the lingual dentinal wall. To ensure the presence of the necessary thickness for the enamel shade composite resin layer, the dentin shade layer was kept at a level that was below the dentoenamel junction. In addition, the PVS impression was used to check the height of the material. (Alcohol had been used to wet the impression surface just prior to this step to prevent the composite resin from adhering to the PVS impression material.) The dentin shade composite resin layer was then light-cured. Finally, the enamel shade composite resin was layered, and the PVS impression, again having wetted the appropriate surfaces with alcohol, was seated. A moderate, constant pressure was applied for few seconds, and then the impression was gently removed.

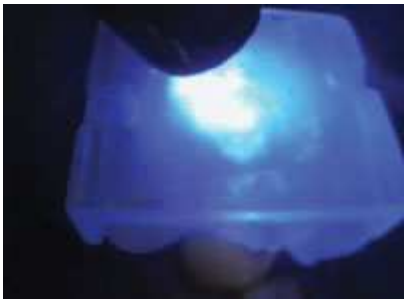
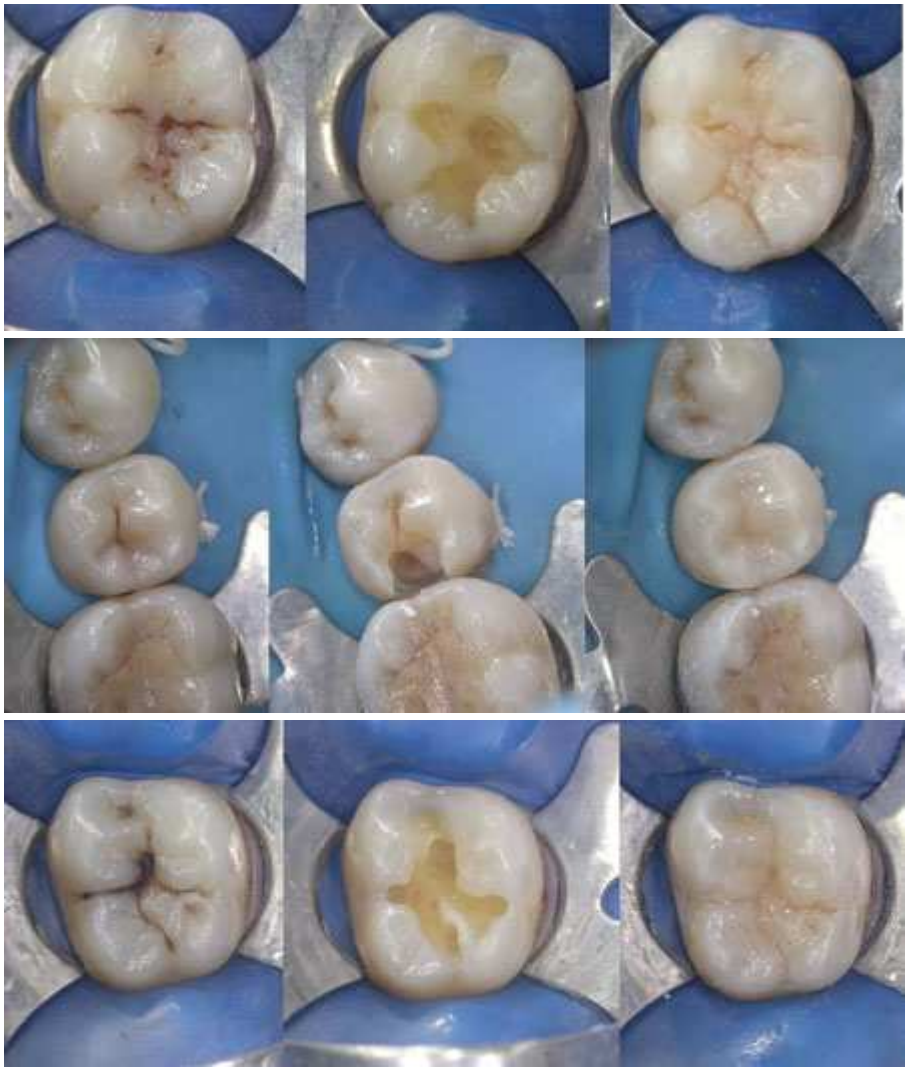


Figure 13. The enamel layer is light-cured through the impression tray/PVS matrix material for one minute.

Figures 14 and 15. Note the excellent marginal adaptation and aesthetic integration of the restoration.

Any excess composite resin that was squeezed beyond the cavity margins by the PVS impression was then carefully removed by CP6 and CP8 instruments (Safident) before the material was to be fully polymerized. The restoration was checked again to make certain that there were no material voids. In this case, there were no deficiencies noted, and a light source was applied through the impression tray and PVS material for one minute to cure the enamel shade composite resin layer (Figure 13). After removing the impression, additional polymerization was delivered for 3 minutes: 1 minute each from the lingual, occlusal, and buccal aspects. This was done to obtain the highest degree of polymerization conversion in the deepest layers of the composite resin material. Next, the restoration was checked again to evaluate the need for shaping and finishing. Finally, the occlusion was checked with AccuFilm II (Parkell). This step revealed that no occlusal adjustment was necessary. The finalized restoration demonstrated good marginal adaptation and excellent aesthetic integration into the patient's existing dentition (Figures 14 and 15).

CONCLUSION



Figures 16 to 18. Photos of 3 additional case examples utilizing the technique described by the authors. Preoperative photos on the left.

It is the authors' opinion that this interesting technique enables clinicians to obtain predictable and aesthetically pleasing composite restorations. Furthermore, the technique proposed in this article has a fast learning curve and makes it easier to restore a tooth with composite resin-based materials. Functionally, restorations placed with this technique have shown to be more consistent in the authors' hands compared to those done via the traditional freehand technique. Another great benefit of this technique is that the use of the clear PVS matrix eliminates the oxygen inhibition at the surface of the enamel layer. This allows for a higher degree of polymerization,

improving the final mechanical properties of the surface layer of the restoration. In most cases, occlusal adjustments after resin-composite polymerization are not necessary, adding additional benefits to the surface quality of the restoration. The opportunity for the clinician to express his or her artistic ability is somewhat reduced with this technique; however, the chance to accurately reproduce the patient's natural morphology instead of an arbitrary one, above aesthetic considerations, can possibly lead to less wear of the composite. As emphasized previously in this article, studies have shown that the lack of correlation between anatomical occlusal morphology and occlusion was suggested to be one of the main causes of wear in composite. From morphological, functional, and aesthetic points of view, this technique can provide the patient with predictable composite resin restorations (Figures 16 to 18).

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