

# Direct anterior resin composite restorations: An update on esthetic techniques

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## Clinical significance

The dentist can use several techniques to esthetically and conservatively restore anterior teeth using resin composite. It is up to the dentist to use a technique, or combination of techniques, to fully exploit the potential of resin composite to produce restorations that seamlessly blend into natural tooth structure.

## Abstract

Direct resin composites have the potential to create natural-looking restorations that can satisfy the needs and expectations of both patients and clinicians. These restorations are the result of the combination of the use of adequate techniques and materials. Unfortunately, some procedures for composite placement are overlooked by the dentist because they can be labour-intensive and skill-sensitive. Several techniques have been described in the literature, including free-handing, stock matrices, injectable matrices, and digitally produced matrices, to facilitate placement and reduce chair time. Selecting the most appropriate technique for any clinical situation can expedite and facilitate the outcome. All techniques have advantages, disadvantages, weaknesses, and strengths; no technique is hassle-free or works in all conditions. Case selection for each technique and the practitioner's ability are the main predictors of success. This article describes and compares different techniques for making predictable direct esthetic anterior resin composite restorations in daily practice.

**Keywords:** composite layering, dental restoration, esthetics dentistry, operative dentistry, anterior restoration

Esthetic patterns demanded by society have stimulated patients to search for dentofacial harmony and improve their appearance. Dentistry allows patients to obtain their desired goals and provides them with great smiles.<sup>1,2</sup> One of the most popular materials in dentistry is composite resin. These are used due to their relatively low cost, availability, and bonding efficiency.<sup>3,4</sup> They also offer good predictability, acceptable longevity, and less invasive restoration techniques, and they cost less than indirect restorations.<sup>5</sup> Thus, when restoring anterior teeth, it is up to the clinician to take advantage of the full potential of direct restorations to provide anatomy, function and esthetic results.<sup>5,6</sup>

To achieve the full potential of direct restorations, knowledge of the optical properties of dental tissues and restorative materials in terms of individual characteristics such as chromaticity, opacity/translucency, and restorative techniques is necessary. Appropriate contouring and polishing methods are also primordial to achieve restorations that blend into the tooth structure and defy detection.<sup>6,7</sup> Restoring a tooth to its ideal shape, function, and esthetics with composite resins requires excellent attention to detail and technical proficiency.<sup>8</sup> Due to the rapid advancements in adhesive technology, incorporating composites into tooth structure with minimal or no cavity preparation has become feasible, allowing for a minimally invasive or non-invasive approach.<sup>9</sup>

Before starting treatment, it is essential to adequately address the patient's or parents' desired esthetic concerns during treatment.<sup>10,11</sup> Direct esthetic restorative treatments include diastema closures,<sup>24</sup> recontouring,<sup>3</sup> worn teeth,<sup>26</sup> reduction or elimination of black triangles,<sup>28</sup> fractured teeth,<sup>12</sup> veneers,<sup>13</sup> Class III and IV restorations.<sup>8</sup> Some techniques like free-hand layering of resin composites involve intricate and time-

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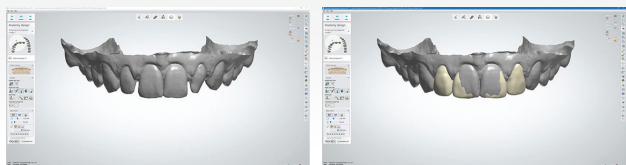


Fig. 1a: STL of maxilla arch.

Fig. 1b: Digital wax-up will facilitate the planning phase.

intensive additive methods on the part of the clinician, as well as highly specialized skills and attention to detail.<sup>14</sup> This is the reason most clinicians may avoid esthetic direct anterior restorations.<sup>13</sup>

Within the variety of resin composites, monochromatic resin composites, one-shade one-opacity, are probably the most frequently used material for direct procedures. However, in some cases, they fail to replicate teeth that present a gradient of colour from incisal to cervical or present a halo and translucency in the incisal edge.<sup>6,10</sup> To replicate the intricacies of natural teeth, layering various shades and opacities of composite materials are used.<sup>6,7</sup> However, this can be labour-intensive and complicated, and the outcome may suffer improper blending and/or cannot properly reproduce intricacies observed in natural teeth.<sup>10,15,16</sup> Other disadvantages of polychromatic layering include a laborious process, additional cost in materials and maintaining inventory, and more skill, training and practice.<sup>7,16</sup> Moreover, the process of traditional direct restorations is less predictable and more operator-reliant because the clinician needs to contour intra-orally and polish restorations to mimic dental anatomy compared to indirect restorations in which the anatomical shape and finishing are produced in the laboratory.<sup>8</sup> Clinicians tend to favour indirect restorations when multiple anterior restorations are needed, or when a smile makeover is necessary.<sup>17</sup> Thus, the creation of indirect restorations is frequently outsourced to a dental technician, which drives up expenses and delivery times.<sup>8,17</sup>

A diagnostic wax-up is frequently employed to facilitate the planning phase in restorative dentistry. Diagnostic wax-ups can be created both analog and digitally. Wax can be added to change the morphology of the teeth to simulate

the proposed esthetic and function.<sup>18,19</sup> However, with the advancement of dentistry, digital wax-ups have become increasingly popular.<sup>20</sup> This process involves scanning a patient's mouth or a stone model, altering the virtual shape of their teeth using computer software, and then 3D printing the replica.<sup>21</sup> Once the wax-up is completed, it is presented to the patient and utilized to create mock-ups before the final procedure.<sup>22</sup> This helps to understand better and manage patient's expectations and gives them a sneak peek at how the restorations would look in person.<sup>8,22</sup> Wax-ups can fabricate silicone indexes to guide the desired anatomy and obtain proper tooth width proportions,<sup>21</sup> as shown in Figure 1. A restorative plan is then formulated using direct or indirect techniques.

This article describes and compares different techniques for producing predictable direct esthetic anterior resin composite restorations in daily practice.

### Techniques

**Free-hand:** This technique involves the addition of composite layers without the use of any matrix or containing system.<sup>23</sup> It relies on the dentist's ability to manipulate the material in a cavity preparation or to address various issues, such as replacing missing dental tissue in an incisal edge, repairing enamel defects, closing diastemas, or filling small cavity preparations.<sup>13,16</sup> Practitioners may choose between different viscosities of resin composite, some opting for flowable or less viscous materials and some preferring higher viscosity, such as conventional composites.<sup>5,13</sup> Instrumentation varies from using just the tip of the flowable material to injecting and smoothing thin-bladed instruments and brushes for conventional materials.<sup>3</sup> (Fig. 2)

For most free-hand techniques, a conventional mylar strip is necessary.<sup>3,24</sup> These strips aid in composite placement and the common "pull-through" technique,<sup>3,25</sup> which involves pulling material through the interproximal with the mylar strip to fill proximal areas. While effective in skilled hands, this technique can be challenging and impractical for novices.<sup>24</sup> Furthermore, it only works when utilizing very "waxy," non-sticky, firm materials and is contraindicated for flowable and sticky materials.<sup>26</sup>



Fig. 2a: Patient was concerned about the discoloration on the two upper central incisors.



Fig. 2b: Old restorations were removed, and the surface was air-abraded with 50-micron aluminum oxide.



Fig. 2c: Freehand technique used to close the diastema.



Fig. 2d: The final result is at the one-year recall.



Fig. 3a: A Bioclear gauge measures the black triangle between the tooth, the upper right canine, and the lateral incisor.



Fig. 3b: Bioclear matrix try-in. Note using a larger matrix than recommended by gauge.



Fig. 3c: Flowable composite injection.



Fig. 3d: Post-operative result.

The advantages of the free-hand technique include its simplicity and minimal instrumentation and the fact that it does not require high operator skills in small preparations and defects.<sup>3,27</sup> However, when this technique is used to repair significant defects, missing tooth structure, layering with several opacities and chromaticities, or to close diastemas, an operator with high skills is crucial, thus making it inaccessible to most practitioners.<sup>16</sup> Additionally, superb finishing methods are required to produce anatomical features, surface characterization, and gloss to create an imperceptible restoration.<sup>27</sup> In these more significant cases, other matrix techniques may offer several advantages over the freehand technique.

**Dental matrix systems:** Several commercially available stock matrices are available to the dentist (e.g. Bioclear, Unica and others) to facilitate the placement of composite resins. These matrices (Fig. 3) are appropriate for almost any size and type of restoration.<sup>28</sup> They are inserted under dental dam isolation and positioned between the rubber dam and the tooth.<sup>29</sup> The rubber dam acts as a rubber band around the tooth, sealing it against the tooth, thus preventing excess material from penetrating the sulcus and creating ledges.<sup>28</sup> Additionally, since the composite is polymerized against a very smooth surface, minimal or non-finishing is typically required in the proximal areas. Leaving this highly smooth surface prevents minimal plaque and calculus accumulation.<sup>29</sup>

Monochromatic materials are used with these matrices and involve the injection of a flowable (no light-curing) followed by a conventional viscosity that extrudes the flowable. This process aids in the insertion of material and elimination of voids.<sup>25</sup> The authors prefer heated composites, which can further help their insertion. If a polychromatic restoration is desired, a cut-back approach (also called the window technique) can be employed, involving the removal of some facial composite and its replacement with other opacities and stains to produce halos and incisal translucency.<sup>28</sup> These matrices provide suitable proximal contour, but attention should be paid to plastic matrices that require thickness for stiffness, potentially resulting in open contacts. The facial

and lingual surfaces still need contouring and polishing to replicate anatomical contours and blending, which can be considered a disadvantage of this method.

The Bioclear matrices deserve special attention since they are presented as an excellent alternative for closing black triangles and closing diastemas. These matrices prevent any gingival excess in the interproximal area, which is difficult to access for removal and finishing, but instead extrude any excess onto the facial or lingual, where contouring and polishing are more accessible.<sup>28</sup> The instruments required for this technique are the same as the free-hand technique with the addition of the matrices.<sup>25</sup> When used for black triangles and diastema closures, the clinician can establish the optimal curvature for closing gingival embrasures.<sup>29</sup> The Bioclear black triangle kit comes with a colour-coded gauge inserted into the black triangle or diastema space and then corresponding with colours at the top of the matrix.<sup>28</sup> This allows the clinician to choose the appropriate size and contour matrix.<sup>28,29</sup> In the author's experience, selecting one size larger matrix than the corresponding colour from the colour-coded gauge is better. The matrices are offered in two sizes (big and small) and four curvatures (red, yellow, green, blue), allowing the operator to treat the entire anterior sextant, from canine to canine, in both upper and lower arches.<sup>28</sup> This results in robust and esthetically acceptable outcomes.<sup>29</sup> Patients with substantial midline diastemas often lack interdental papilla, influenced by the distance between the interdental contact point and the alveolar bone crest.<sup>29,30</sup> A previous study indicated that when this measurement is 5 mm or less, the interdental papilla is present in nearly 100% of cases.<sup>30</sup> However, as this distance increases, the likelihood of papilla presence decreases.<sup>30,31</sup> (Fig. 4). To address this, rubber dam isolation is crucial for preventing moisture contamination and facilitating effective gingival retraction.<sup>29</sup> This retraction enhances access to the cervical area, allowing the addition of composite material in spaces previously occupied by gingival tissue.<sup>25,29</sup> This process helps prevent the formation of non-esthetic black triangles and achieves a more aesthetically pleasing result.<sup>28</sup>

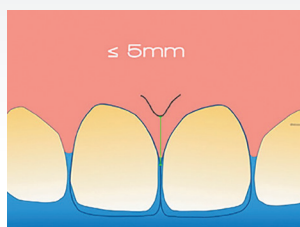


Fig. 4a: Distance between the interdental contact point and the alveolar bone crest 5mm or less will result in the papilla filling the space in nearly 100% of cases.

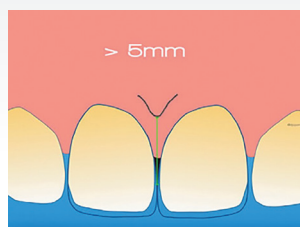


Fig. 4b: Distance between the interdental contact point and the alveolar bone crest exceeding 5mm will result in un-esthetic black triangles.

#### Direct technique with customized prefabricated palatal guides:

This technique requires pre-operative impressions of both arches using polyvinyl siloxane (PVS) to prepare a dental cast and transfer the proposed changes from the wax-up.<sup>4</sup> (Fig. 5) The palatal index, which is an impression of the palatal portion of the tooth or teeth to be restored, is created using a PVS impression material<sup>21</sup> or laboratory silicone.<sup>4</sup> During the restorative phase, the index is seated on the palatal side after placing the adhesive. The composite is placed onto the silicone guide to form the restoration's palatal aspect (palatal/proximal contour and incisal edge).<sup>9,10</sup> Once this palatal increment is light-cured, the silicone matrix is removed, and the remaining part of the restoration can be incrementally built up with resin composite.<sup>21</sup> A monochromatic material can be used to build the remaining of the restoration, or it can be incrementally built with various opacities and chromaticities to imitate dentin and enamel using "dentin- and enamel-like" materials or by adding layers of translucent composite between the lobes.<sup>10</sup> Ultimately, each patient is unique when it comes to selecting the right enamel shade for the final layer.<sup>6,10</sup>

Advantages of this technique include minimal finishing and polishing of the palatal portion and occlusal adjustments because all details were worked out during the wax-up phase before the matrix fabrication.<sup>4,32</sup> The first palatal increment provides a canvas where the dentist can add

the remaining increments to build the restoration.<sup>4,10</sup> This technique is beneficial when multiple restorations are to be placed and when the length of the teeth is going to be increased. Thus, the anterior guidance is dialled in the wax-up.<sup>4,32</sup> Disadvantages include an additional or a longer appointment for impression and laboratory work waxing for future restoration or restorations.<sup>32</sup> A longer appointment is required if a polychromatic restoration is to be placed.<sup>10</sup> This technique still relies on the ability and skill of the dentist to layer composite and to properly replicate anatomical contours as contouring and polishing.<sup>9,10</sup>

**Injectable technique matrices:** One method that offers a fast and easy solution to predictably converting a diagnostic wax-up into composite restorations is made possible by the injectable technique, using transparent silicone matrices and flowable resin composites.<sup>12</sup> (Fig. 6)

This technique significantly reduces the sensitivity of the procedure and the time spent in the chair, delivering accurate and reliable outcomes, particularly when integrated with a digital workflow.<sup>14,22</sup>

With this approach, a wax-up is created, and an impression using a clear PVS material is obtained.<sup>12,22</sup> Access holes are made through the clear PVS index at the incisal edges to insert the tip of a flowable material to copy and transfer the anatomy created by the wax-up.<sup>22</sup> The PVS index is tried in intra-orally to verify fit.<sup>12</sup> The teeth adjacent to the tooth to be restored are covered with polytetrafluoroethylene tape. The tooth to be restored is etched and bonded.<sup>33</sup> The index is inserted. The flowable composite is injected through the access holes, thus replicating the contours created from the wax-up. The remaining teeth are to be restored, so repeat this procedure. Once the index has been removed, the final restorations are polished and completed.<sup>8</sup>

While flow composite restorations may remain more prone to wear or fracture, they can be readily repaired, prolonging the restoration's lifespan.<sup>34</sup> These restorations are nevertheless regarded as contraindicated for stress-bearing areas.<sup>8,22,35</sup>

The main advantage of this technique is that the tooth's anatomy is replicated from the wax-up and does not have to be created by the clinician.<sup>12</sup> A drawback of injecting



Fig. 5a: The patient was unhappy about the appearance of her smile due to a Bolton discrepancy. Patient desires to have a beautiful smile.



Fig. 5b: Use palatal matrix with the proposed changes transferred from the wax-up.



Fig. 5c: Palatal contours built over the palatal matrix.



Fig. 5d: Post-operative results after restoration.



Fig. 6a: Patient requested to build peg laterals to fill the spaces between her teeth.



Fig. 6b: Clear PVS index try-in.

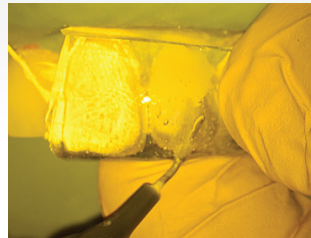


Fig. 6c: Injection of flowable composite.



Fig. 6d: Post-operative result.

flowable composite into space is that because the PVS index replicates the complete wax-up, there will always be a space between the mould and the original adjacent tooth. This space can cause the flowable material to extrude over the adjacent unrestored tooth.<sup>36</sup> Subsequently, this excess can be difficult and time-consuming for teeth to remove. Thus, the technique's benefit of reducing time with a satisfactory result is diminished.<sup>8</sup> A disadvantage of this technique is the creation of cervical ledges, so attention must be paid to polishing and finishing these areas, which requires time, effort, and skill, especially in interproximal areas.<sup>36</sup>

An alternative method for the injection technique involves creating two wax-ups. Each wax-up has every other tooth to be restored, and then two clear matrices are created, one over each wax-up. This technique is usually created with a digital workflow, printing each wax-up.<sup>36</sup> Through an intraoral scan, a digital wax-up can be created, which is retrievable and adaptable since each phase of the process may be changed and reversed as a single shape.<sup>21</sup> Each tooth may remain a single shape once the digital wax-up is complete. This implies that every digitally waxed tooth can be altered or viewed later.<sup>36</sup> This feature offers an unmatched advantage. Compared to standard waxing methods, which leave the models fragile and irreversibly waxed.<sup>8</sup>

The ability to print the models in three dimensions (3D), which is more accessible, less expensive, and more durable, is another benefit of the digital workflow.<sup>21</sup> To ensure appropriate shape and facilitate clinical operations, this sequential digital workflow is essential.<sup>8,21</sup>

The first matrix is inserted into the patient's mouth following the isolation, etching, and bonding steps.<sup>36</sup> To prevent the flowable composite from entering the embrasures and coating the neighbouring teeth and to precisely polymerize it within the limited area of the first wax-up, there must be a tight seal between the waxed and unwaxed teeth.<sup>8,36</sup> After, the procedure is repeated with the second PVS mould.<sup>36</sup> Compared to the traditional injection technique, this approach should prevent excess material from getting over the adjacent teeth.<sup>8,36</sup>

**3D printed matrices:** This is a relative newcomer in the US market, the 3M Filtek matrix (Fig. 7). It is a 3D-printed matrix based on a digital wax-up and is indicated to treat Class IVs, peg lateral incisors, diastema closures, and direct veneers. The clinician sends a digital or analog impression to the manufacturer indicating the purpose for construction, and the manufacturer creates a digital wax-up with proprietary design software. After the dentist approves the wax-up through a portal, the matrix is designed, printed and shipped to the clinician.

The clear matrix is tried on for fitting, removed for adhesive application, and then seated back and locked with a self-locking mechanism. The matrices have windows over every tooth to be restored and interproximal fins to prevent adjacent restorations from bonding together. The windows are then opened, and material is injected into the matrix through these windows. A flowable and a conventional viscosity composite can be used, allowing the traditional material to displace the flowable, aiding adaptation and ease of insertion. Another workflow is to place and cure a flowable composite at the



Fig. 7a: Patient is unhappy about the appearance of his smile and desires to have a fuller smile.



Fig. 7b: Filtek matrix try-in.

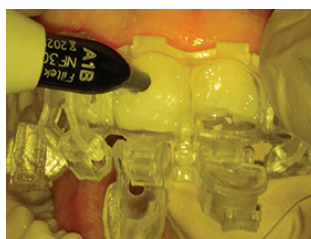


Fig. 7c: Injecting resin composite using the Filtek matrix.



Fig. 7d: Post-operative view of restorations.

Table 1

| Techniques   | Advantages  | Disadvantages  |
|--|---|--|
| <b>Freehand</b>  | <ul style="list-style-type: none"> <li>• No need for matrix or containing system.<sup>23</sup></li> <li>• Minimal instrumentation.<sup>3</sup></li> </ul>   | <ul style="list-style-type: none"> <li>• Needs dentist's ability and experience.<sup>16</sup></li> <li>• Impractical for novices.<sup>24</sup></li> <li>• Time consuming.</li> </ul>   |
| <b>Dental matrix systems</b>   | <ul style="list-style-type: none"> <li>• Appropriate for almost any size and type of restoration.<sup>28</sup></li> <li>• Prevents creation of ledges or residual material.<sup>28</sup></li> <li>• Minimal or non-finishing is required in proximal areas.<sup>29</sup></li> <li>• Good proximal contour. Best alternative to close black triangles and diastemas.<sup>25</sup></li> </ul> | <ul style="list-style-type: none"> <li>• Matrices that require thickness for stiffness potentially result in open contacts.</li> <li>• Facial and lingual surfaces need contouring and polishing to replicate anatomical contours and blending.</li> <li>• For polychromatic restoration, a cut-back approach must be applied.<sup>28</sup></li> </ul> |
| <b>Direct technique with customized lingual prefabricated matrices</b> | <ul style="list-style-type: none"> <li>• Minimal finishing and polishing of the lingual portion and occlusal adjustments.<sup>32</sup></li> <li>• Beneficial when making multiple restorations and when the length of the teeth will increase.<sup>32</sup></li> <li>• Allows layering for polychromatic restorations.<sup>10</sup></li> </ul>  | <ul style="list-style-type: none"> <li>• Need of waxing the future restorations.</li> <li>• Polychromatic restorations require longer appointments.</li> <li>• Relies on the ability of the dentist.</li> </ul>  |
| <b>Injectable technique</b>  | <ul style="list-style-type: none"> <li>• Decreases technique sensitivity of the procedure and the time in the chair.<sup>14</sup></li> <li>• Anatomy of the tooth is replicated from the wax-up.<sup>22</sup></li> </ul>  | <ul style="list-style-type: none"> <li>• Contraindicated for stress-bearing areas.<sup>35</sup></li> <li>• Cervical ledges may be created with this technique, requiring extra time for finishing.<sup>3</sup></li> </ul>  |
| <b>3D printed matrices</b>   | <ul style="list-style-type: none"> <li>• Interproximal fins prevent adjacent restorations from bonding together.</li> <li>• Matrices are easy to insert.</li> <li>• The composite does not bond to the matrix.</li> <li>• Predictable results are obtained.</li> </ul>  | <ul style="list-style-type: none"> <li>• Need of two appointments.</li> <li>• Cost of the matrix.</li> <li>• Need to make final contouring and polishing.</li> </ul>   |

margins to help minimize the potential for voids, light curing, and inserting the conventional material. The windows are closed, and excess material is extruded through vents on the doors. The composite is polymerized through the clear matrix upon removal of the excess material. The composite does not bond to the matrix because the manufacturer coats the matrix with an isolating film.

From the authors' point of view, this technique's advantages include reproducing anatomical proximal contours well through the fins in the matrix. It allows treating multiple teeth at a time, and predictable results are obtained. Disadvantages include two appointments, the cost of the matrix, and, in some cases, the practitioner needing to produce the natural contours through contouring and polishing, which increases appointment duration.

### Summary

Continuous advancements in techniques, materials, and technology have created esthetically pleasing restorations using composite resins. An essential characteristic of composite resins is their ability to emulate dental characteristics. However, the primary reasons for failures in anterior teeth are typically recurrent decay, chipping and colour discrepancies, issues often remedied through repair

and polishing. When properly planned and carried out, the proposed techniques can improve marginal precision, yield a highly esthetic and functional immediate solution, and facilitate an easy workflow through free-handling or reproducing a diagnostic wax-up through matrices. Additionally, the combinations of techniques can be easily incorporated to facilitate composite restorations.

All the previously described techniques are conducive to obtaining excellent esthetic functional restorations. However, each clinician needs to choose the composite material according to their liking regarding handling ability, chromaticities, opacity, and translucency, along with the techniques presented in this article.

### References

The full list of references 1-36 is available from: [ursula@moderndentistrymedia.com](mailto:ursula@moderndentistrymedia.com)

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