The scalpel finishing technique: a tooth-friendly way to finish dental composites in anterior teeth

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Abstract

Optimal results can be obtained on direct restorations by the application of layering procedures that combine the accurate morphological insertion of restorative materials with the knowledge of the optical and mechanical properties of both composite resin and natural hard dental tissue. Even if the finishing procedures on restorations, such as mar- gination (the trimming of margins), are minimized by anatomical layering tech- niques, finishing can still be highly com- plicated due to a number of pre-finishing sequences using specific instruments proposed in the literature, which include finishing burs and abrasive discs. Fin- ishing procedures performed with a scalpel on polymerized direct composite restorations can improve the quality of the final sculptured surface by develop- ing natural contours and characteristics and by removing the excess restorative material at the tooth-structure margin. Enhanced movement control and fine fingertip perception of the surface texture while moving the scalpel blade allow the operator to detect and cut the excess composite material during the margination procedure and to refine the final anatomy. Avoiding the use of finishing burs during finishing procedures on direct composite restorations may save adjacent enamel surfaces from abrasive damage. The composite surface and margins may also benefit from using the scalpel finishing technique, considering the potential risk of excess removal and surface crazing that the improper use of finishing burs could cause to composite material. The purpose of this article is to propose and describe the scalpel finishing technique step by step, as well as to briefly discuss the advantages of its application within the limits of a clinical case report. (Int J Esthet Dent 2015;10:XXX–XXX)
Introduction

The latest composite resins have evolved to become some of the most versatile materials in the science of dental restorations. Available in a wide range of viscosities correlated mostly to filler content, hybrid (microhybrid), microfill, and nanofill/nanohybrid composite formulations offer a choice of different mechanical and physical properties for a variety of clinical applications. These materials are also able to provide some potential additional benefits, such as proper margin adaptation, less structure wear, less long-term staining, and higher surface polishability.

Unfortunately, studies have shown that bonded composite restorations are not only sensitive to certain materials but also to particular techniques. Even if the finishing restorative procedures are minimized by anatomical layering techniques, a composite restoration must undergo proper finishing and polishing procedures once it is placed and fully cured in order to ensure perfect contours and longevity, minimize plaque accumulation, and achieve the expected esthetic results.

Finishing and polishing procedures have to be considered in addition to all the other known parameters relating to the longevity of composite restorations. Improper finishing and overheating caused by repeated polishing have the potential to jeopardize the restoration surface and the marginal integrity of the restoration. Even in the case of minimal mechanical finishing, heat and vibration may damage the surface of the composite and can lead to the formation of microcracks along the material surface and subsurface, which would decrease the longevity of the restoration.

Some studies have shown that the use of diamond finishing burs could lead to crazing and composite loss, creating surface irregularities. Microfill composites can develop microfractures when finished with carbide burs. Although microhybrid composites have been shown to “pluck out” during finishing and polishing procedures, they have also been shown to be more resistant to surface microfractures during finishing procedures when compared to other classes of composites. Nano-filled composites apparently exhibit the lowest incidence of surface defects after finishing and polishing, regardless of the polishing system used.

Excessive removal of composite material can lead to voids and margin defects of the material, as well as to poor esthetics. Marginal breakdown will result in early wear, discoloration, plaque retention, periodontal tissue irritation, and the patient’s tactile detection of the restoration. Clinical and in vitro studies have shown that residual surface roughness of composites can influence plaque retention, which usually results in superficial staining, gingival inflammation, and secondary caries.

Nevertheless, apart from the potential damage to the composite surface that must be considered during these procedures, great caution should also be taken not to overwear sound surrounding tooth structure with finishing carbide or diamond burs and abrasive discs during finishing procedures. Adjacent enamel should be preserved mostly intact, and tertiary anatomy must be created on the composite surface to meet...
and mirror the adjacent enamel, and not the other way around.

Excessively uniform and even brilliant surfaces are mostly found in age-worn teeth. Removing and over-smoothing adjacent enamel structure during excessive or repeated finishing procedures with abrasive instruments can erase the original, beautiful, natural texture of the enamel surface, creating an “aged” tooth aspect particularly on the buccal surfaces of anterior teeth. The natural microtopography of the enamel should be respected and taken into account to achieve more visually pleasing esthetic results.

In this article, for the first time, we propose the use of a scalpel blade instead of traditional abrasive finishing burs to remove any overhang of polymerized restorative material, as well as for contouring direct composite restoration margins and refining sculpture details during finishing and before polishing procedures.

**Brief discussion: finishing and polishing**

There is some misunderstanding in the literature, as well as in professional dental language, about the difference between the procedural steps of finishing and polishing. Although they are often mentioned together, these two procedures actually have unique and specific goals. A chronological progression of steps needs to be respected that always starts with gross reduction and contouring and ends with final polishing. Basically, we can divide the 2-step finishing and polishing procedures into 3 main steps: finishing, margination, and polishing.

Finishing, in the dental context, is the generic concept of removing excess material while defining anatomic contours. Margination or recontouring is part of the finishing process. It refers to the removal of the excess, overhanging restorative material at the cavosurface margins, creating a smooth continuity from one surface to another. During the process of margination, both technique and the finishing instruments used have to be carefully chosen to ensure maximum respect for the adjacent dental tissue and structure while reproducing the normal anatomic shape of the restored area. In most cases, dentists use sequential diamond finishing burs to perform the finishing processes of contouring and adjusting.

Polishing refers to the process of smoothing away tiny residual surface defects left behind after finishing and margination.

Our experience has shown that gross reduction, coarse finishing, and margination using a scalpel blade could strategically contribute to a reduction and simplification of finishing steps, leaving a pre-polished surface ready for final polishing (Fig 1a). Due to the dynamics of rotary instruments, damage that is difficult to control could occur on the surface that these instruments touch. The bur’s fast, abrasive action immediately widens the initial area with which it comes into contact, which may result in more material being removed than is desired or is necessary, or in a flatter surface design. When using a static instrument such as a scalpel, due to the operator’s better control of the working speed and
of the amount of surface affected, damage to a hard substrate surface is limited to the area under the blade’s curve. Further, particularly on the composite surface, damage can be controlled and stopped faster and more precisely with a scalpel than when a high-speed rotary instrument is being used.

The scalpel as a finishing instrument

The use of a No. 12B scalpel blade to remove excess or unbounded resin from proximal areas has already been described. In this article, we propose to describe the use of a scalpel (mostly a No. 15 or No. 15C blade) as the main finishing instrument, not only for excess composite removal from areas that are difficult to access, but also as an instrument for cutting composite during finishing. When used on polymerized direct composite materials to define anatomical contours (gross reduction, course finishing, and margination), as well as to refine surface sculpture, the scalpel’s thin blade enables the operator to create complex micro-anatomical details that will lead to better light-reflecting kinetics and tooth-restoration harmonization without damaging the composite surface or adjacent dental tissue. Finishing with a blade compared to a diamond bur will lead to a smoother micro-surface, simplifying and shortening the polishing procedures. Figure 1a shows a SEM image of the microtopographic aspect of a microhybrid composite surface that has been entirely submitted to the action of a No. 15 scalpel blade, positioned at an approximate 30-degree angle to the
composite in a horizontal peeling movement to simulate a gross reduction action. Figure 1b shows a SEM image of the same microhybrid composite, submitted this time to a fine grit red-ring finishing bur (50 µ grit).

As the scalpel blade will only cut composite material when used on a hard tooth surface, it can be considered a material-selective and tooth-friendly finishing instrument.

Case report

Step-by-step description of the scalpel finishing technique

A 17-year-old woman, having just finished orthodontic treatment, consulted for an esthetic solution on her conoid maxillary incisor tooth (or peg tooth) (Figs 2a and 2b).

With a view to the future restoration, the orthodontist had left a symmetric space equivalent to the width of the normal contralateral tooth, distal and mesial to the conoid tooth. The space was maintained (and still is to this day) by means of a fixed wired palatal retention (Figs 3a and 3b).

Therapeutic options

A minimally invasive bonded ceramic veneer on a modified prepless tooth intervention was proposed to the patient, considering the expected longevity, optimal esthetic results, and tissue preservation provided by this restoration. Nevertheless, the patient's mother asked for a less expensive and more direct solution.
We then proposed a direct composite bonded restoration with no bur removal of tooth structure (prepless technique) with a prior direct mock-up to guide the layering of the composite material (template technique). Information was given to the patient concerning probable shorter longevity of this type of restoration, considering its large volume, and less predictable esthetic results due to this direct technique when compared to ceramics. Both patient and mother preferred this second solution. Considering the age of the patient and the possibility of repairing composites, and following the philosophy of maximum tooth preservation over a lifetime as proposed in the Therapeutic Gradient, we proceeded with a direct adhesive restoration.

Before enamel dehydration takes place, information for color analyses was noted and preoperative macro pictures were taken (Figs 2a to 3c).

Using the computer’s image tool device, we created a mirror image by horizontally flipping the image of the normal lateral (contralateral) tooth.
that will serve as a reference and projecting it onto the image of the conoid tooth. After redimensioning both images to fit each other, we used the opacity image tool to lower the opacity of the normal lateral so that this tooth image became translucent. This method enables the visualization of the underlying morphology of the peg tooth (Fig 3d) and the previsualization of the position and volume of composite adjunction that will be needed to achieve the desired final morphology. Later, moving the opacity image tool to maximum opacity and having this image on the computer screen next to the chair gives the dentist a constant predehydration view of the color features, as well as a model for macro- and microanatomy reproduction.

A mock-up was prepared using a freehand technique by applying composite directly onto the conoid tooth without any adhesive procedure. A near-symmetrical morphology to the contra-maxillary lateral was achieved (Figs 4a to 4c). Once approved, this outline was registered using a rigid silicone impression that was sectioned by a scalpel into a matrix or lingual template, which served as a guide for the multilayer technique that followed (Figs 4d and 4e).

Following rubber dam isolation, grit blasting of the enamel surface was undertaken (50 µ aluminum oxide particles). No bur abrasion was employed. A total-etch, 2-step adhesive procedure (Optibond Solo Plus, Kerr) followed, and restoration was performed according to the principles.
of the anatomical composite 3D layering technique (Vanini).\textsuperscript{19} Blue pigment effects were used to create the translucent and opalescent effects on the incisal third. The “halo effect” was reproduced with dentinal body composite, and the “cloudlike” white stains of hypomineralization were created with intensive masses\textsuperscript{20} applied on the dentin core, before insertion of the final enamel composite layer. The restoration was then ready for finishing and polishing procedures (Figs 4f and 4g).

**The scalpel finishing technique**
This case was chosen as an example to describe this technique because, as all surfaces of the tooth were implicated, various possibilities and ways of using the scalpel as a sculpting/finishing instrument could be demonstrated. However, in our opinion, there are more indications where this technique can be used to finish partial direct composite restorations.

1. **Initial anatomic definition and gross contour**
The conoid tooth presents a cervical area narrower than a normal lateral incisor.

![Fig 4 (continued) (d) Silicone template: impression of the mock-up. (e) Silicone template in place after removing the mock-up. (f) Palatal wall and first dentine composite increments. (g) Composite restoration roughly completed.](image-url)
Therefore, to develop a natural contour of the emergency profile, additive composite has to be extended slightly into the embrasures on the proximal margins. Transparent matrices applied in the interproximal region to guide the composite insertion tend to give an unnatural profile that is too straight. Recontouring using the scalpel blade starts by removing overhangs (any excessive restorative and adhesive material) present in the gingival interproximal embrasures.

At the same time, the correction of the composite interproximal and cervical flat profile is precisely performed using the point of the blade. The extreme lateral edge of the blade, adjacent to its point, is used to reshape this cervical area by cutting any excess composite to create a rounded, anatomical contiguity of the restoration material with the adjacent dental cervical structure. For this result to be achieved, the blade should be positioned at an approximate 30-degree angle with the surface of the restoration (Figs 5a and 5b). The scalpel should be gripped between the fingers in a pencil grip. A firm, sliding/peeling movement is performed from the composite to the tooth structure, moving as one would
when handling a hand-trimming chisel, to achieve the desired anatomic shape.

It is very important to always ensure and maintain a stable fingerhold on the tooth while handling the scalpel. One should grip the instrument as close as possible to the blade (Figs 6a and 6b) to ensure stability and to prevent the blade from accidentally slipping onto the adjacent soft tissue.

2. Gross reduction and margination
Margination starts by applying the same firm, continuous, sliding/cutting movement of the blade. Excessive composite material is removed by peeling. A smooth composite–enamel margin transition is achieved by sliding the blade so that the lateral cutting part of its tip is always in contact with the interface between restoration and tooth (Fig 7). The enamel surface will “guide” the blade. As the scalpel will not cut the enamel, any roughness or overhanging composite and non-bonded material still present on these margins will be trimmed away.

The adaptation of the margin is achieved by smoothly sliding the edge of the blade. There should be no remaining gaps or excess. At this point, the macro-anatomic contour of the tooth can be reconfirmed or refined. A straighter mesial profile and rounder distoincisal outline can be slightly redefined by the blade. Also, some corrections to the V-shape openings of mesio- and distoincisal angles (Fig 8) can be precisely performed using a No. 15 scalpel blade without destroying the convex form of the tooth’s outline or endangering the surface of the adjacent teeth, or the contact surface in the case of interproximal areas.

3. Surface vertical anatomy
Width illusion is key when it comes to symmetry in restorations.21 The perception of the width and length of a tooth largely depends on the position, form, and cervical convergence of the two buccal vertical transitional line angles. Normally, these features have already been defined and sculpted during the composite build-up stage, taking into account symmetry with the contralateral tooth. Despite this, some corrections to the convex anatomic aspects often have
to be made during the finishing stages of the restoration.

In classical finishing technique, corrections to the form and position of ridges and lines are usually performed using fine grit diamond finishing burs. With the scalpel finishing technique, we suggest the use of a No. 15 scalpel blade for this procedure. These line angles can easily be pushed and replaced more distally or medially with the blade by using vertical cutting/peeling movements (Figs 9a and 9b). Rounding or accentuation of the profiles of the angles can be obtained by scratching vertically or horizontally with the blade (Figs 9c and 9d). An unwanted over-homogenization on the profile of the transition line crest may be easier to avoid using a blade rather than a finishing bur, where, in the latter case, the homogenization occurs all at once (Fig 9e).

Figs 9a to 9e  Repositioning and refining transition line angles.
Figs 10a to 10f  Defining facial macroanatomic limits of eminences of rounded mamelons and creating asymmetric details, as observed in natural enamel topography. The point of the scalpel is very useful for reproducing the smooth grooves.
4. Other macrogeographic aspects and the incisal shape

The profile of the incisal edge and the delicate shape of the rounded eminences of the mamelons are accentuated in symmetry with the collateral tooth (Figs 10a and 10b). The fissure-shaped edge (reunion of developmental lobes) between the mamelons is worked on with the blade’s fine point, finding its contiguity on the vertical fine grooves (Figs 10c and 10d). Shallow, smooth depressions can be seen between the lobes on the buccal face of the tooth. Those features may be sculpted using the round part of the blade (Fig 10e). The incisal third profile is slightly rounded by the blade, producing a minimal incisal “plane breakdown” on the buccal surface (Fig 10f).

5. Palatal anatomic aspects

Palatal anatomic aspects can be corrected using either rotary football-shaped diamond or carbide burs. Ordinary scalpel blades are not sufficiently small or rounded enough. It may take more time, particularly for beginners of this technique, to refine concavity sculptured lingual aspects of tooth anatomy. The palatal surface is a region that is difficult access, with some teeth presenting very pronounced concavity. The palatal finishing of this lateral was all done using a scalpel (Fig 11) and discs, but a combined technique with rotary round-shaped abrasive points or burs could also be necessary. Scalpel blade No. 12B can be useful to access some palatal areas, such as interproximal palatal embrasures and cervical ridges adjacent to the gingival area.

6. Palatal sculpture

To finish palatal sculpture, the incisal, slope-like angle on the lingual side is also refined by active sliding movements of the blade, as if peeling the incisal edge while forming an approximate 40-degree-angle slope with the long axis of the clinical crown. Obviously, this incisal slope angle may vary between teeth, depending on variations in crown anatomy and tooth contacts. In this area, the anatomic shape has to be customized to perfectly fit the incisal guidance, including wear, chipping, etc. Normally, due to physiological movements during incisal guidance, the incisal edge presents some worn surfaces. The tooth shown in Fig 10e, as an example, is a young lateral that still presents its rounded slope shapes almost intact.
7. Tertiary horizontal anatomical features
Various other tertiary horizontal anatomical features may also be reproduced employing the scalpel on the facial surface. Refining macro- and micro-surface topographic aspects interferes with the surface reflective behavior of the light, allowing a more diffused type of reflection (Fig 12).

Particularly in younger dentition, the microanatomic aspects, as vertical and horizontal striated lines, produce a more invisible restoration with a natural blended final effect. Customized natural strias (grooves) may be created using the blade in a drawing action.

Buccal face microanatomy may also be effectively created using a combined scalpel and bur technique, or even just finishing with a bur. However, in our opinion, the use of a bur for the finishing steps should ideally be limited to the composite surfaces far from the restoration margins.

Polishing
The restoration was polished using abrasive strips, abrasive polishing discs, silicon carbide polishing brushes, and felts with fine and extra-fine polishing pastes (Figs 13a to 13c). During polishing, softer shapes can easily be obtained with abrasive strips applied directly onto the surface using finger friction (Fig 13d). This procedure results in a more natural look, as if the tooth has been submitted to some physiological wear, such as would result from the use of an abrasive toothbrush.

Results analysis
As can be seen in Figs 14a and 14b, anatomy, characteristics, and surface reflections are in harmony with the adjacent teeth. The maxillary laterals allow for some asymmetry, and small differences between these teeth play an important role in a natural appearance.

When carefully observed (Figs 14a and 14b), one can notice a bulging reflective surface emerging on the center of the buccal face of this restored tooth. Actually, this region corresponds to the original natural convex surface of the conoid tooth, emerging from the center of the restoration, which was left unharmed. If finishing burs were used rather than a scalpel to refine the sculpture on the buccal surface of this tooth, this protruding surface of enamel would end up being flattened by abrasive subtraction during the finishing process. This goes to show how the scalpel technique respects the natural dental tissues (Figs 15a to 15c).
**Figs 13a to 13d** Final polishing procedures.

**Fig 14** (a) Close mesial facial view of the restoration immediately the removal of the rubber dam. A bulging surface is observable on the buccal face of the restored lateral. (b) Front view of anterior tooth, 1 week later.
Conclusions

It is known that finishing procedures can be minimized and better results can be achieved by adding the correct volume of composite material while employing a careful technique to achieve incremental build-up. However, when it is necessary to remove composite material after final polymerization to achieve the desired anatomy and contours, finishing burs have the potential to harm sound surrounding dental tissue. Burs could also jeopardize composite margins and the anatomic detail created on the resin composite surface. To avoid these issues, the scalpel finishing technique can be used to trim and finish composite margins. The following advantages can be potentially obtained using this technique:

- Immediate surrounding enamel is left unharmed by the abrasive process.
- By minimizing the use of sequential diamond finishing burs, particularly on composite margins, less composite material is damaged or unnecessarily removed in this delicate junction area, consequently improving the resistance and longevity of the restoration.
- The technique can simplify the final polishing procedures, leaving a smoother composite surface that is easier to polish immediately after the finishing stage.
- The simplicity and precision of the technique, along with the esthetic results that can potentially be achieved, make it a reasonable and safe alternative to the use of final finishing burs.
- Apart from the predictability and time-saving factors, the technique could be considered a minimally invasive
dentistry approach for the finishing of direct composite restorations.

In our opinion, the scalpel finishing technique is an accessible way of finishing composites that could be proposed as an everyday dental office method that embraces the principles of minimally invasive dentistry, ensuring maximum respect for dental tissues while optimizing and simplifying finishing procedures.

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Disclosure statement

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