

Finishing and polishing in composite resin restorations: from macro to micro

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Abstract: *Some requirements are critical to achieve a composite resin restoration that resembles, in every single aspect, the natural tooth. Steps such as the selection of dental composites used, clinical application as well as finishing and polishing are essential. Careful finishing*

and polishing affect not only aesthetics, but also health. There is a wide variety of drills, polishers and pastes available on the market. Understanding the best sequence and the correct application of those products are essential to achieve the desired surface. By means of analyzing two clinical

*cases and carrying out a comparative analysis in scanning electron microscopy, it was observed that a smooth surface achieved after finishing and polishing leads to less biofilm development and less staining. **Keywords:** Finishing. Polishing. Composite resin. Bacterial biofilm. Longevity.*

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» Patients displayed in this article previously approved the use of their facial and intraoral photographs.

Introduction

The high number of tasks performed in clinical practice end up rendering some procedures mechanical and undervalued. The literature on adhesive procedures, color determination and optical properties of material is quite extensive. Nevertheless, important procedures—which sometimes are rendered as trivial—may compromise restorative outcomes over the years.

In the present study, a few aspects related to surface smoothness, finishing and polishing of previous restorations are analyzed in depth.

Firstly, it is important to understand the purpose of polishing procedures: they consist of making surfaces smoother. This is an advantage, since it interferes in biofilm buildup over teeth and restorations. Biofilm immediately forms over hard surfaces in the presence of organic solutions—for instance, saliva.¹ Molecular bond strength established between hard surfaces and the organic solution causes biofilm to remain over such surfaces.² Once biofilm formation starts, bacteria build up. Over time, they get organized and have their complexity increased, which, within the oral environment, leads to bacterial biofilm. Rough surfaces within the oral cavity cause bacteria to build up twice or three times faster than smooth surfaces.³

Polishing consists of controlled wearing of material surfaces carried out with the aid of instruments with different abrasion abilities.⁴ The process of achieving a smooth surface

by means of polishing depends on the type of material and the technique employed. Patients are able to notice visual differences on surfaces with 0.25 μm to 0.50 μm roughness. However, within the oral environment, surfaces with roughness under 0.5 μm are reported as smooth.⁵ Nevertheless, bacterial adhesion only occurs over surfaces with roughness over 0.2 μm .^{1,5} Smooth, shiny surfaces enhance the esthetics of restorations, but it is worth highlighting that brightness of a given restorative material is associated with the amount of light it reflects, which is attributed not only to surface smoothness, but also to its reflectance.⁶

“Hybrid composites have good mechanical properties and esthetics, but one single long-term drawback: the lack of brightness maintenance.”

Composite resin used on daily practice has considerably changed in comparison to that developed by Bowen,⁸ in 1962. Over the years, the evolution of components that constitute composites—such as load particles, organic matrix and the result of their bonding (silane)—was a process that provided different commercial brands of composite resins with unique characteristics. The following changes have been made: synthesis of new monomers, addition of new components, change

in photoinitiators and decrease in size and amount of load particles. The inorganic matrix has undergone a process of particle decreasing and rounding off, which resulted in smooth surfaces with long-lasting brightness, as well as polishing similar to that of natural teeth.⁷ Additionally, the smoother the restoration surface, the better its optical properties and the lower bacterial biofilm adhesion to it.² Different types of material have different behavior as regards biofilm buildup, which is determined by surface energy. Ceramic has lower surface energy than composite resin, and, for this reason, allows less bacterial biofilm buildup. Similarly, polished resin has lower surface energy than rougher-surface composite resin and, thus, also allows less bacterial biofilm buildup.¹

In anterior teeth, it is key to choose materials capable of blocking light or reflecting it similarly to natural teeth.⁹ The most common options are: hybrid composite, microfilled composite or nanofilled composite. Hybrid composites have good physical properties and esthetics, but one single long-term drawback: lack of brightness maintenance. Microfilled composite, on the other hand, has good light reflectance, finishing and polishing potential, with long-lasting brightness that resembles that of natural teeth; however, it has some limitations as regards its physical properties, which render it contraindicated for areas with high masticatory demand. Nanofilled composite has similar properties to those of hybrid composite, in addition to long-lasting brightness.^{10,11}

From a clinical standpoint, successful restorations are those capable of meeting esthetic demands of color, shape and texture consistent with natural teeth, in addition to those capable

of upkeeping such properties over time. Thus, restoration polishing is critical, as it enhances the optical appearance of material, providing them with good surface smoothness and, as a result, less bacterial buildup. Additionally, a smooth, bright surface enhances esthetics.

Case report 1

Patient sought dental care in order to have his smile improved, since he was unhappy with the space between his anterior teeth (Figs 1 and 2). Composite resin restorations were carried out by means of the direct technique on teeth #12 to #22, with a view to having incisors reshaped while balancing patient's smile (Figs 3 and 4). Also during the same appointment, soon after composite resin application, a scalpel blade was used to remove excess in the gingiva (Fig 5), thus avoiding potential tissue inflammation. Occlusal adjustment (Fig 6) was performed, and an abrasive strip (middle grain) (Oraltech) was used to remove excess in the interproximal region (Fig 7).

The next appointment was exclusively dedicated to finishing and polishing of composite resin restorations. The procedures were carried out in three stages, described as follows.

Removing excess and enhancing tooth anatomy

Once composite resin had been applied and light-curing carried out, tooth anatomy enhancement was performed. At this point, it is important to check for restoration small anatomical details, namely: even tooth surfaces, gingival contour in the cervical third, contact areas, interproximal embrasures, surface tex-



Figure 1: Initial smile.

Figure 2: Anterosuperior teeth with diastemata, unlevelled gingiva and positioning unfavorable to esthetics.

Figure 3: After isolation and adhesive application, the composite resin was applied.

Figure 4: Immediately after composite application – note that tooth #21 was restored to look like it had been rotated and to disguise unlevelled gingiva in comparison to tooth #11.

Figure 5: Removal of composite excess in the gingival region.

Figure 6: Occlusal adjustment.

Figure 7: Finishing of proximal surfaces with strips.

Figure 8: Demarcation of edges using pencil, to allow easier visualization of reflection angles during finishing.

Figure 9: Basic refinement of tooth with a multi-laminated drill.

Figure 10: Diamond disc used to shape the proximal edges and incisal angles.



ture, among others. Visualization of proximal edges becomes easier with pencil demarcation. Using a graphite lead in the proximal region indicates the most prominent angles (Fig 8) while highlighting the edges. Diamond burs are widely used for finishing on-set. They have become popular due to the wide variety of dental material they are capable of wearing off.³ Those drills have grains varying from 7 to 50 μm , according to the manufacturer. Diamond burs alone are not enough to make patients stop noticing surface roughness, particularly because it can be noticed when ranging from 0.25 to 0.50 μm .^{4,5} Thus, it is necessary to combine diamond burs with a polishing product in order to enhance surface smoothness.¹² Multi-laminated carbide drill is less abrasive than diamond burs; therefore, the former is recommended for finishing from proximal edges to gingival tissue.⁶ Movements should be smooth, with little pressure being applied, taking care not to damage the anatomical details previously created. With the aid of a 12-blade multi-laminated long drill with rounded ends, strategic wear was performed over the restoration, thus providing

the tooth with the desired shape (Fig 9). In the proximal region and incisal angles, the use of a diamond disc (medium grain) is recommended (Fig 10).

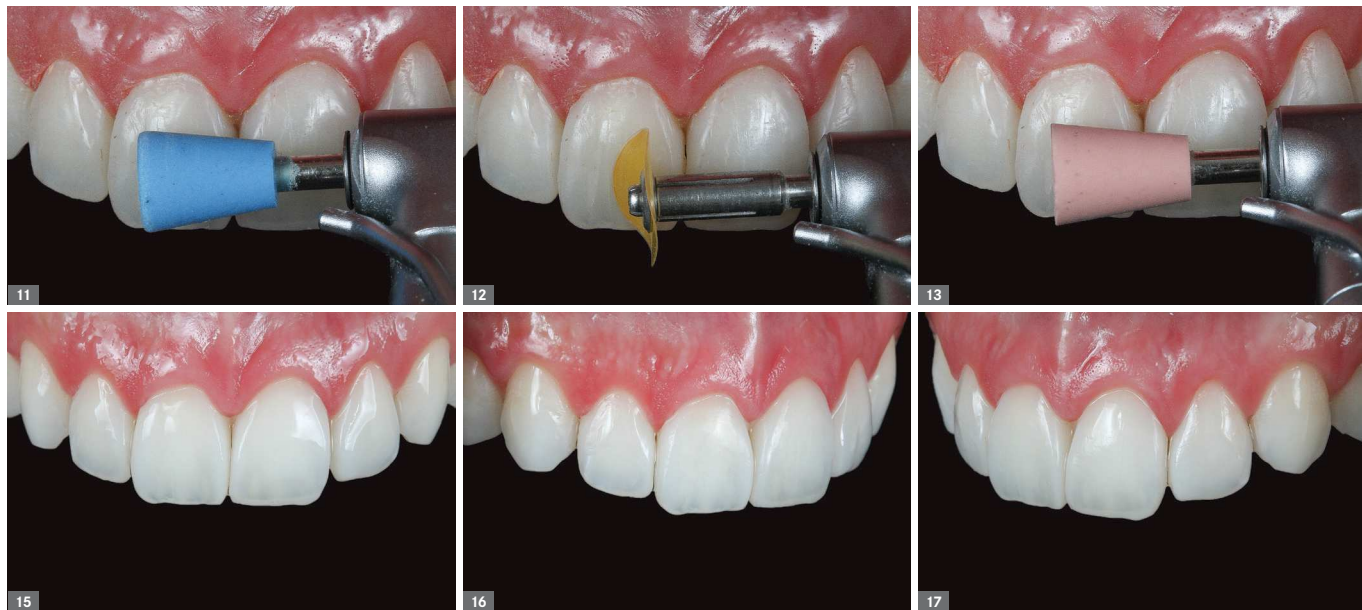
Finishing

Once the shape of the tooth has been established, the finishing procedure will eliminate scratches and marks left during refining and manufacturing the restoration. It is well established that abrasive material should be used in a sequence, with decreasing graininess, from thickest to thinnest. Strips filled with abrasive material, usually aluminum oxide, are the most recommended for the interproximal region; whereas discs filled with abrasive material are recommended for free or convex surfaces.⁶ Abrasive cup-shaped rubber (medium grain) was used to remove imperfections and grooves (Fig 11). Regardless of the system of choice, it is important to have the surface cleaned in between polishing products application. Cleaning should be done with water and, occasionally, cotton or gauze. This procedure aims at removing abrasive remnants

that might negatively affect the sequence of polishing, with the next type of grain.⁴ Surface texture is also important, since younger teeth tend to have a more complex surface, while teeth that have been exposed to natural erosion (older) tend to have a smoother surface. Texture in vertical direction is smoother and reproduces the developmental lobes. Therefore, superfine diamond burs, multi-laminated drills or thick rubber must be used to produce triangular concavities with round edges. On the other hand, texture in horizontal direction reproduces the lines of growth, or perikymata, and are characterized for being more evident in younger teeth. Such lines can be reproduced with scratches performed by means of oscillatory movement of thicker burs.

Polishing

This last stage is responsible for determining restoration surface final brightness and smoothness. The grains of polishing products can be fine or superfine (0.3 to 20 μm).⁴ Brush-like polishing material with bristles filled with silicon carbide, aluminum oxide or diamonds are great alternatives at this point, especially those brushes filled with silicon carbide, since they are capable of polishing areas with limited access, such as grooves, thus enhancing surface brightness without removing the existing texture.⁶ Another excellent alternative is to use diamond paste which might be filled with aluminum oxide (1 μm in size or smaller) or diamond particles (1 to 10 μm in size).



Paste application must be carried out with the aid of felt discs. Rubber cups are commonly used for cleaning purposes; however, they tend to decrease the efficiency of diamond paste. Should the surface to be reproduced be highly smooth, an excellent alternative would be to use the entire sequence of discs filled with aluminum oxide, of which brightness is similar to that produced by a polyester strip filled with light-cured resin.^{12,13} Superfine diamond disc and diamond rubber (Figs 12 and 13) were used, followed by diamond paste applied with a felt disc (Fig 14). The final result is shown in Figures 15 to 17. After a 30-month follow-up, restorations remained shiny and appropriate from a clinical perspective (Figs 18 to 26).

The clinical stages necessary to achieve adequate finishing—with smooth, polished, shiny surfaces—must follow a logical sequence of procedures aiming at progressively wearing restorative material, with a view to eliminating the difference of peaks and valleys on the surface. Thus, more abrasive instruments must be used first, with abrasiveness being gradually reduced to medium and fine, up to instruments with the least cutting power, so as to achieve final brightness (Fig 27). Respecting this logical sequence is key. Using instruments in the improper manner or in the wrong order will result in a slightly shiny surface which will lose its brightness in no time (Fig 28).

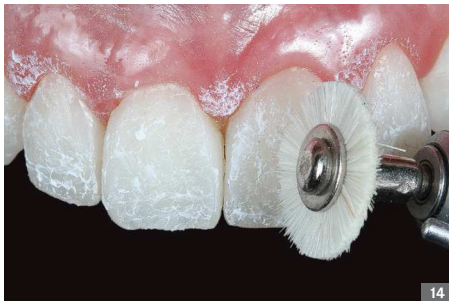


Figure 11: Finishing with rubber (medium grain).

Figure 12: Thin diamond disc used for surface polishing onset.

Figure 13: Diamond rubber (thin grain) in use.

Figure 14: Felt disc applied with diamond paste for final brightness.

Figure 15: Immediately after the end of finishing and polishing.

Figure 16: Right lateral view.

Figure 17: Left lateral view.



Figure 18 to 26: After a 30-month follow-up, note natural canines surface (13 and 23) compared to restored teeth surfaces (12, 11, 21, 22).

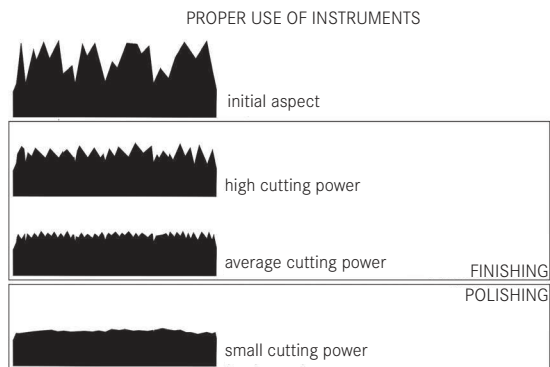


Figure 27: Schematic diagram depicting the appropriate use of finishing and polishing instruments, relative to restoration surface. The initial restoration not subjected to finishing is irregular, with pronounced peaks and valleys. Instruments with high and medium cutting power used during finishing remove higher peaks, leveling them with the valleys. Instruments with small cutting power render the surface regular, even and smooth, without pronounced peaks and valleys.

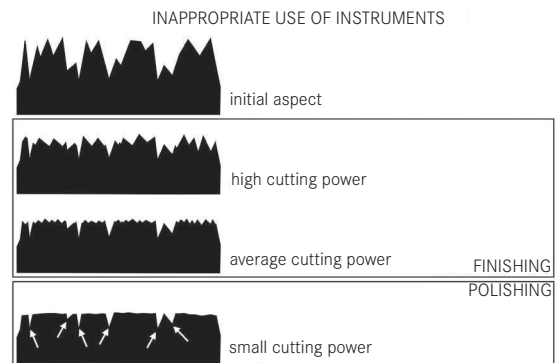


Figure 28: Schematic diagram depicting the inappropriate use of finishing and polishing instruments, relative to restoration surface. Initial aspect with pronounced peaks and valleys. Improper use of instruments with high and medium cutting power does not remove enough material, so as to reach the region of valleys. Even if instruments with small cutting power are used (polishing instruments), appropriate brightness is not achieved because the restoration surface becomes irregular due to the permanence of valleys (arrows).

Monitoring finishing stages with the aid of microscopic images taken on copies acquired during clinical care is highly explanatory, especially with respect to the importance of properly performing each stage of finishing and polishing procedures.

Case report 2

Young patient arrived at the dental office reporting tooth fracture caused by a fall. Upon clinical and radiographic examination, the patient was diagnosed with tooth fracture at

the distoincisal angle of tooth #11, which affected both enamel and dentin (Fig 29). Due to pulp vitality, the treatment of choice was to perform direct restoration with composite resin (Fig 30). Once composite had been applied and light-cured, without any instruments touching its surface, SEM images were acquired (Figs 31, 32 and 33), which revealed irregular composite surface with porosities. The sequence of finishing and polishing procedures was applied (Fig 34). Subsequently, new SEM images were acquired, revealing a smooth, regular surface (Figs 35, 36 and 37).



Figure 29: Initial appearance of teeth # 11 and #21. Note fracture at the distoincisal surface of tooth #11.

Figure 30: Immediately after restoration, without finishing.

Figure 31: Teeth and restoration after finishing and polishing.

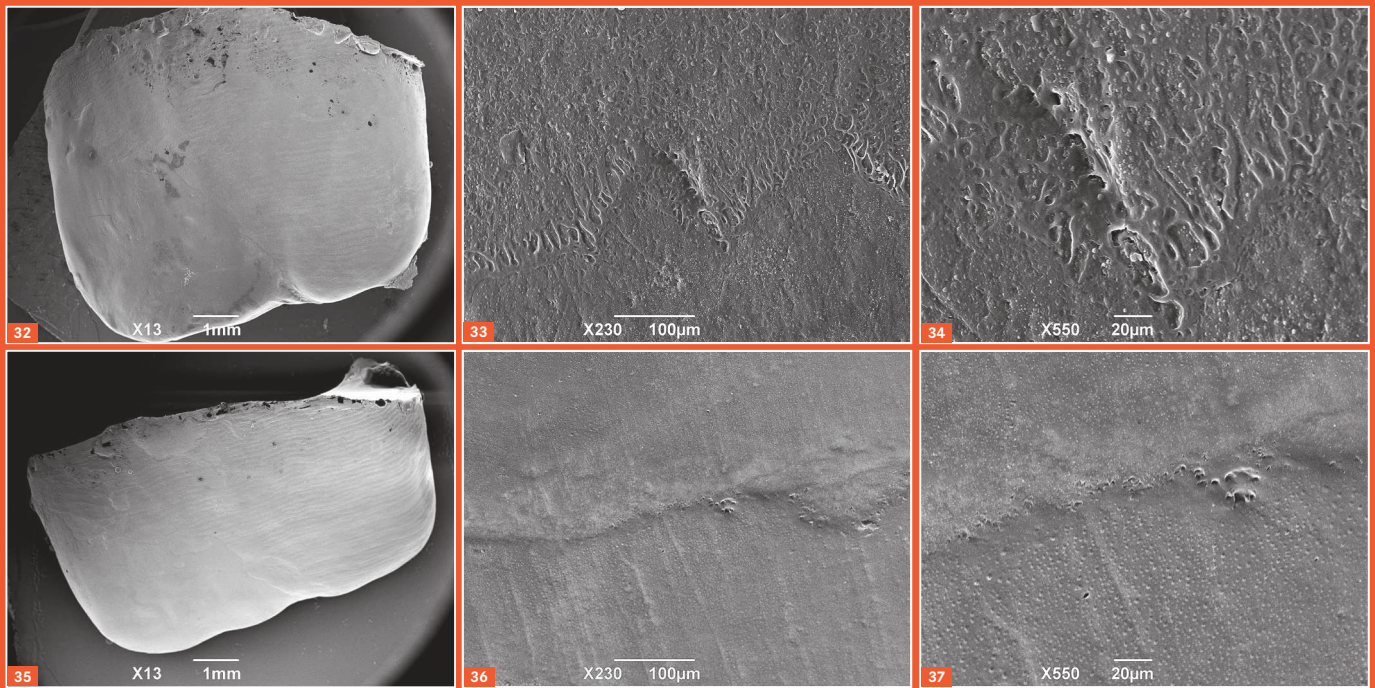


Figure 32: Scanning electron microscopy (SEM) of restoration copy soon after composite application, without finishing and polishing (magnification of 13x).

Figure 33: SEM image after finishing and polishing procedures (magnification of 13x).

Figure 34: SEM image of composite surface without finishing (magnification of 230x).

Figure 35: SEM image of restoration surface after finishing and polishing procedures (magnification of 230x).

Figure 36: SEM image of composite surface without finishing (magnification of 550x).

Figure 37: SEM image of restoration surface after finishing and polishing procedures (magnification of 550x).

Final considerations

Restorations with composite resin require knowledge and respect for critical stages among which are finishing and polishing procedures. Following a logical sequence of instruments with descending abrasiveness is key when the aim is to achieve a smooth, regular surface, since the use of such instruments allows elimination of surface irregularities and grooves. SEM images evince that restoration surfaces not subjected to finishing and polishing procedures have grooves that favor biofilm buildup and bacterial proliferation, thus leading to pigmentation of restorations. On the other hand, SEM images acquired after polishing reveal a smoother, regular surface, which prevents pigmentation.

Therefore, the importance of properly using the finishing and polishing technic reported in the present study should be highlighted.

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