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# Finishing and Polishing Today's Composites: Achieving Outstanding Results

A Peer-Reviewed Publication  
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## Educational Objectives

Upon completing this course, the reader will be able to do the following:

1. Know the advantages of bonded composite restorations and factors in their success.
2. Know the procedure by which composite restorations are placed and temporary indirect restorations are fabricated.
3. Understand the importance of finishing and polishing of composites and methods by which this can be achieved.
4. Understand the benefits of using liquid polishers (surface sealants).

## Introduction/Overview

It is estimated that approximately 86 million direct composite restorations were provided to patients in 1999, and over 50 million crowns and bridges where teeth would require temporary resin-based restorations (Table 1).<sup>1</sup> In comparison, when the previous survey was conducted, approximately 47 million direct composite restorations and over 37 million crowns and bridges were placed.

As patient demand for esthetic dentistry has increased, the use of composite resin and resin-based materials for posterior restorations and indirect temporary restorations has correspondingly increased, together with clinical demand for more esthetically-acceptable and long-lasting materials for anterior and posterior composite resin restorations.

Table 1. Frequency of procedures using composite restorative materials

Type of restoration	1999	1990
Direct anterior resin	39.67 million	34.36 million
Direct posterior resin	46.12 million	13.13 million
Indirect resin temporary	50.49 million	37.56 million

Composite resin materials have been available for a little more than four decades. Early precursors included silicate cement-based materials – these required rapid single placement, did not permit sequential filling of the preparation and were chemically cured – as well as composite resin materials that required chairside manual mixing of two components. While resin was an improvement over silicate cement materials, shortcomings included the difficulty of thoroughly mixing equal amounts of the components, the short time available for placement prior to curing, the roughness of the cured material, and the limited range of shades. None of the early composite materials were clinically suitable for posterior restorations; amalgam restorations were clinically superior except where esthetics was the main determinant.<sup>2</sup> Composite resin restorations have evolved rapidly, with the pace of new product development accelerating over the last decade. Advanced composite materials and techniques, new etching and bonding materials, fast curing lights, and new finishing and polishing materials and techniques have all been introduced.

In 1993, composite wear was estimated to be 10% of the wear experienced with earlier-generation composites.<sup>3</sup> A 1997 review of clinical papers reporting on the use of amalgam and composite resin materials for posterior restorations with at least five years of data (and up to 30 years and 10 years of data for amalgams and composites respectively) found that both materials had similar ranges of annual failure rates.<sup>4</sup> Another study found that the failure rates for primary tooth restorations subjected to occlusal stresses were 0 – 15% for composite resin restorations and 0 – 35.3% for amalgams.<sup>5</sup> One study, reviewing the literature since 1990, showed lower annual failure rates for posterior composite resin restorations than for amalgam restorations (2.2% versus 3%).<sup>6</sup> A separate study found an annual failure rate of 0 – 7% for amalgam and 0 – 9% for composite resin restorations.<sup>7</sup> It should be noted, however, that for each of these studies, rates included failure due to secondary caries, fracture, wear and marginal deficiency.

Current composite materials are light-cured; designed to be applied either with a single insertion or by using an incremental (layering) insertion technique; offer a wider range of shades; and are available in macrofill, microfill and hybrid variants. Microfill composite resins include Renamel® Microfill (Cosmedent), Heliomolar® (Ivoclar Vivadent), and Durafill® VS (Heraeus Kulzer). Microhybrid composite resins include Point 4® (Kerr), Esthet-X® (DENTSPLY Caulk), TPH®3 (DENTSPLY Caulk), Vit-I-escence® (Ultradent) and Tetric® (Ivoclar Vivadent).

Contemporary composite materials are esthetically pleasing and more resistant to wear and to occlusal forces and fracture. These materials offer the ability to use finishing and polishing techniques that are designed to optimize esthetics, improve patient satisfaction and comfort, and help reduce marginal leakage, wear and roughness.

## Direct Composite Restorations

In addition to esthetics, composite resin materials offer several other advantages over amalgam (Table 2). Bonded composite resin restorations enable the clinician to practice minimally-invasive dentistry. It is no longer necessary to extend preparations or to prepare them with classical Black cavity configurations. Unlike with amalgam, composite strength does not rely upon material bulk nor does composite resin rely upon undercuts for retention of the restoration (although bonded amalgam restorations alleviated the need for undercuts).

Table 2. Advantages of composite restorations over amalgam

- Esthetics
- Reduced preparation size
  - No need to extend the width and depth of the preparation beyond caries removal requirements
  - No need for undercuts
- Bonding – unifies material and tooth, and can reduce marginal leakage
- Composite placement can reduce underfilling of margins
- Lower thermal coefficient of expansion



This has positive implications for Class II preparations in particular, as it removes the need for an isthmus of a certain depth or for extension of the box and preparation overall. Due to the ability to truly bond the composite resin to the tooth, with an appropriate technique and choice of materials the composite resin and the tooth are unified and retention is achieved through bonding, minimizing preparation requirements (Figure 1). With appropriate case selection and technique, direct bonded composite resins are also effective in providing direct durable cuspal-coverage restorations where cusps are fractured or missing, thereby reducing the preparation required to replace fractured cusps and giving patients an alternative treatment option to the indirect restoration treatment option.<sup>8</sup>

Bonding can also reduce long-term marginal leakage. In Class II preparations, composite material placement has been shown to result in fewer marginal gaps and underfilled margins compared to amalgam,<sup>9</sup> and composite also has a lower thermal coefficient of expansion – thereby reducing the amalgam-associated risk of cracks developing in the tooth (Figure 2). However, composite placement is more intricate and time-consuming and requires a more exact technique for optimal clinical results and long-term success.

Figure 1. Modified Class II composite prep



Figure 2. Class I amalgam and associated cracks



Factors that influence the success of composite resin direct restorations include the preparation shape, the presence of subgingival margins, the etching/bonding agent used, the

appropriate selection of composite resin material, the placement technique, the light-cure source, and the polishing and finishing technique and materials.<sup>10,11,12,13,14</sup> Composites with smaller-particle filler have been found to have better mechanical strength and wear resistance compared with those containing larger particles.<sup>15</sup> Gaps within the composite bulk have been found to be more common when using a two-layer technique than when using a multilayer incremental insertion technique,<sup>16</sup> and an incremental layering technique was found in one study to result in less microleakage than a single-insertion technique.<sup>17</sup> However, the use of neither single insertion nor incremental insertion has been found to totally eliminate microleakage at margins.<sup>18</sup> Careful placement, finishing and polishing techniques, as well as the selection of appropriate materials, are essential for the success of bonded composite resin restorations.

## Direct Composite Placement and Finishing Technique

### Direct Composite Placement Technique

For both anterior and posterior bonded composite resin restorations, the preparation is extended to remove carious tissue. Once this has been achieved it is not necessary to remove additional tooth structure (one exception is where staining is present, such as old amalgam staining in a posterior, and its removal is deemed necessary to achieve an esthetic result). The preparation is then etched, rinsed and bonded in separate steps, or etched and bonded in one step using a self-etching bonding agent. Composite placement and curing follows, with care being taken not to overfill the preparation, so as to avoid the need for removal of grossly excessive composite prior to final contouring, finishing and subsequent polishing of the restoration.

### Class III composite restorations

Class III composite restorations were placed following separate etching, rinsing and bonding steps (Prime and Bond<sup>®</sup> NT<sup>™</sup>). To achieve an optimal esthetic result, the composite was incrementally layered and internal white tints were placed within the restoration, then overlaid with the main composite shade to provide an esthetic match with adjacent teeth (Esthet-X<sup>®</sup> shade YE, Kerr Kolor Plus White tint).

Figure 3a. Preparations completed

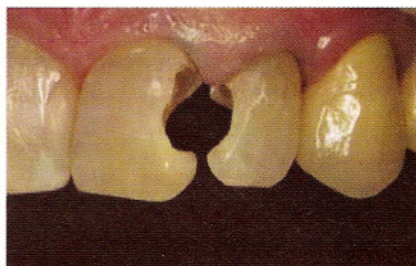




Figure 3b. Etchant applied



Figure 3c. Application of bonding agent



Figure 3d. Final composite layer placement #7



Figure 3e. Final composites with esthetic shade and tints, prior to polishing



### Class II composite restoration

A Class II composite restoration was placed following removal of a defective Class I restoration and interstitial caries. In this case, etching and bonding were achieved in one step using a self-etching bonding agent (Xeno® IV, DENTSPLY Caulk).

The composite was then incrementally layered and cured until the preparation was filled and ready for contouring. As with anterior restorations, overfilling during composite placement should be avoided to minimize contouring and finishing.

Figure 4a. Defective amalgam and caries

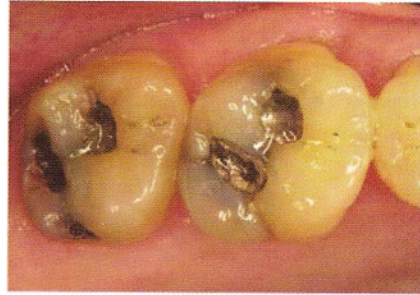


Figure 4b. Application of self-etching bonding agent

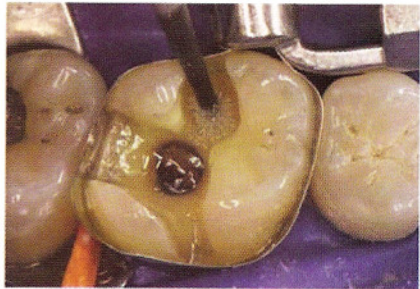


Figure 4c. Syringe application of composite



Figure 4d. Composite placement completed





## Finishing Direct Composites

Available finishing kits containing discs, cups and points include Enhance® Finishing System (DENTSPLY Caulk), Fini™ (Pentron) and CompoMaster™ (Shofu).

These are used in a slow-speed handpiece with a dry field and light intermittent pressure (to avoid the build-up of heat on the tooth as well as deterioration of the finishing material). Depending on the bulk of the composite that needs to be removed, these kits can be used alone or after use of diamond or carbide finishing burs to improve smoothness. Prior to polishing, the finished surface must have its final contour and be defect-free.

The objective of finishing is to contour the composite restoration to its final shape. This process leaves a surface that is still rough and requires polishing to achieve a smooth clinically optimal surface while enhancing the final esthetics and comfort of the restoration for the patient. The smoother the surface, the less opportunity there is for biofilm development on the composite and adjacent tooth margins. Biofilm adheres to rough surfaces more easily than to smooth surfaces, and composite materials have been shown to be colonized by oral bacteria, including *Streptococcus mutans*.<sup>19</sup> Careful technique and selection of product is required for polishing, and inappropriate usage can result in greater surface roughness than existed prior to polishing. Biofilm formation increases if composite surfaces are roughened.<sup>20</sup> Smooth surfaces and margins reduce the risk of biofilm adhesion and maturation, recurrent caries, gingival irritation and staining.

## Polishing Direct Composites

### Polishers

Polishers are available as stand-alone products and can also be purchased conveniently as kits containing discs, cups and points. Polishers are finer than finishing discs, cups and points. Available polishers include PoGo® One Step Diamond Micro-Polishers (DENTSPLY Caulk); Sof-Lex® Superfine polishing discs (3M Espe), which contains aluminum oxide; Astropol® (Ivoclar); Identoflex (Centrix) and Jiffy Polishers (Ultradent). Use of PoGo® has been found to result in less staining following immersion in coffee for seven days than use of a Sof-Lex® brush,<sup>21</sup> and in a separate study comparing Sof-Lex®, PoGo® and Identoflex polishers on hybrid and microhybrid composites, it was found that the smoothest surface was obtained using PoGo® and the hybrid composite.<sup>22</sup>

### Polishing pastes

An alternative polishing technique is to use a polishing cup together with a polishing paste made specifically for composites – such as Prisma® - Gloss™ (DENTSPLY Caulk) for microfilled composites – or a combination of fine and extra-fine pastes for hybrid composites (such as use of Prisma® - Gloss™ followed by Prisma® - Gloss™ Extrafine).

Other polishing pastes available include CompoSite® (Shofu) and Luminescence® Plus (Premier Dental). When using a composite polishing paste, it is important to select the paste appropriate for the composite's structure; if there is any uncertainty, the manufacturer(s) of the paste and composite should be consulted.

### Liquid polish

Liquid polishers (surface sealants) are low-viscosity fluid resins that provide a gloss over composite resin restorations, improving final esthetics. A further objective of liquid polishers – “surface sealants” – is to aid in creating a marginal seal, and they have the ability to fill microgaps. Liquid polishers reduce microleakage at composite margins,<sup>23,24,25,26</sup> a beneficial characteristic since poor marginal adaptation and microleakage are the most common causes of composite restoration failure.<sup>27</sup> Studies have found that use of a surface sealant following finishing and polishing reduces surface roughness<sup>25</sup> (Figure 5) and wear compared to control restorations receiving no surface sealant,<sup>29,30</sup> and that less toothbrush wear and maintenance of a smoother surface resulted from use of surface sealant on large-particle composites.<sup>31</sup> Shinkai et al. found 50% less wear with use of surface sealants.<sup>32</sup> Wear reduction through the use of surface sealants has been found to be effective for up to two years.<sup>33</sup> Surface sealants have also been shown in vitro to help prevent stain penetration and discoloration of composite resins, and to result in greater shade stability (Figure 6).<sup>34,35</sup> Their use can positively influence surface roughness, marginal microleakage, shade stability and wear. The procedure takes only a few seconds of chairside time.

Figure 5a. SEM of surface after finishing

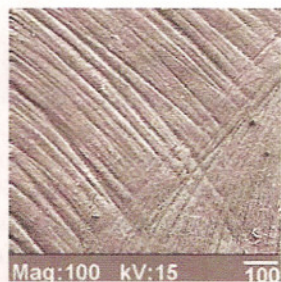


Figure 5b. SEM after polishing (liquid polish)

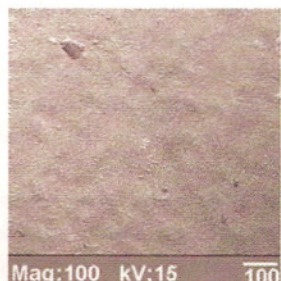
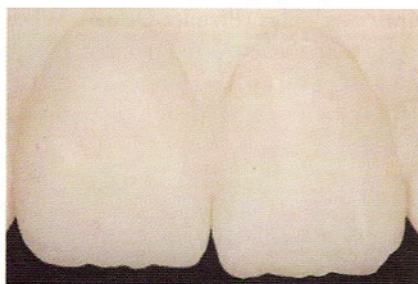
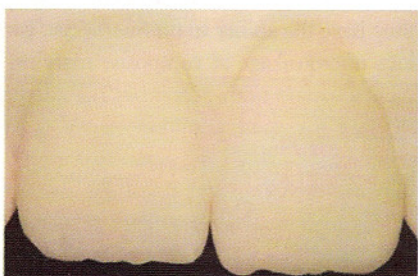




Figure 6. In vitro stain resistance using liquid polisher



Resin-based composite prior to immersion in coffee



Resin-based composite after immersion in coffee



Resin-based composite after immersion in coffee, with prior application of liquid polish (Lasting Touch™)

Liquid polishers can be used as the final step in polishing to impart a high luster, as an alternative to an ultra-fine polishing step and to aid marginal seal. If the clinician is accustomed to finishing only, then liquid polish provides a fast, one-step, patient-friendly procedure that results in a smoother surface and high luster. This is particularly useful if the patient has already undergone a lengthy procedure and is eager to leave. When selecting a liquid polish, consideration should be given to its wear resistance, stain resistance, clarity (clear polish will not alter the appearance of the shade of the finished restoration), ability to fluoresce and delivery system.

### Polishing Techniques

The following cases show the procedure and final restoration using various combinations of finishing and polishing techniques.

#### Case 1. Finishing and polishing with Enhance, PoGo®

This Class IV composite resin restoration was finished using Enhance® followed by PoGo®. Following use of Enhance® for

finishing and contouring, PoGo® was used to polish, imparting a high luster (Figure 7).

Figure 7a. Restoration after finishing



Figure 7b. Polishing with PoGo® cup

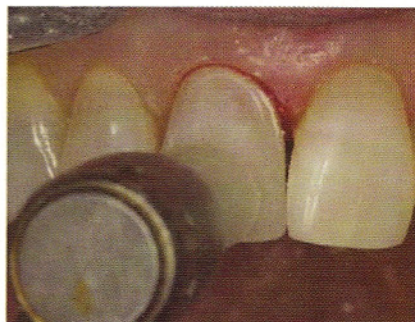


Figure 7c. Polishing incisally with PoGo® disc



Figure 7d. Final restoration after finishing and polishing





## Case 2. Finishing and polishing with Enhance®, Lasting Touch™

Teeth numbers 9 and 10 are shown with newly-placed Class III composite resin restorations. These were finished using finishing burs, followed by Enhance®.

For the polishing procedure, the composites were first etched, followed by paint-on application of the liquid polish. This provided a smooth, reflective surface and imparted a high luster.

Figure 8a. Restorations following finishing



Figure 8b. Application of etchant



Figure 8c. Application of liquid polish using a rubber tip

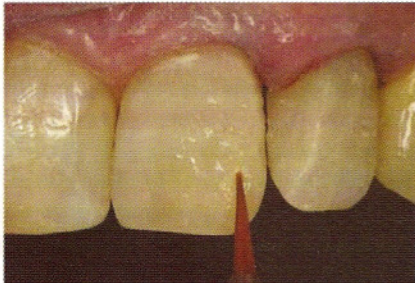


Figure 8d. Final polished restorations



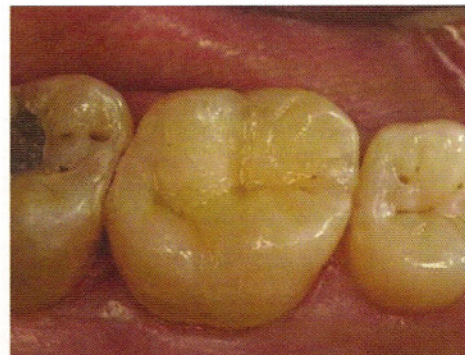
## Case 3. Final finishing and polishing with fine diamond polishing points, followed by liquid polish

This Class II composite resin restoration was finished using fine diamond finishing points, followed by liquid polish to impart polish and luster. As before, the restoration was etched, rinsed and dried prior to application of the liquid polish.

Figure 9a. Finishing the restoration



Figure 9b. Polished restoration



## Indirect Temporary Restorations

Indirect composite resin temporary restorations serve one of two purposes: as a temporary restoration while a permanent prosthesis (crown or bridge) is being fabricated, or as a longer-term temporary restoration during oral rehabilitation prior to either fabricating a final restoration or assessing and determining appropriate definitive treatment. Available resin-based materials for temporization include PreVision® CB (Heraeus Kulzer) and Integrity® (DENTSPLY Caulk). The temporary must have appropriate shape and contours, an emergence profile that aids soft-tissue conditioning, smooth margins, an acceptable shade and a smooth surface. These will help maintain (or improve) gingival health and patient comfort, and will reduce the ability of biofilm to adhere and mature (Figure 10).



Figure 10a. Completed crown preps

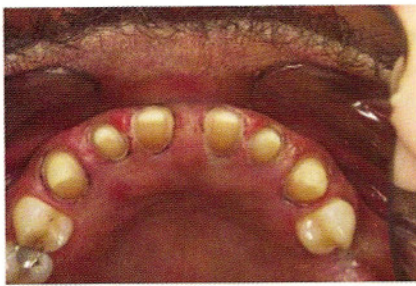


Figure 10b. Placing resin-based material in the impression



Figure 10c. Repositioning the impression with resin in place



Figure 10d. Finishing the indirect restoration

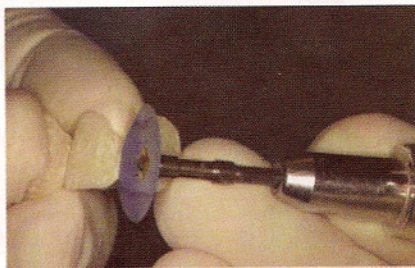


Figure 10e. Indirect temporary cemented in place



## Polishing Indirect Temporary Restorations

Polishing temporary resin restorations provides several benefits – improved esthetics, smoothness and comfort. Reduced staining may also be achieved (more of a factor with long-term temporary use). As with direct composite restorations, polishing can be achieved using polishers, rubber cups and pastes, and/or liquid polishing agents. While ultra-fine polishing and use of a liquid polishing agent would be ideal, due to its temporary nature and the length of chairside time which the patient has already undergone, polishing may typically be minimal or not carried out. In these situations, use of a liquid polishing agent takes only a few seconds and imparts a surface luster that improves esthetics and surface smoothness.

Figure 11a. Application of liquid polish



Figure 11b. Polished temporary (Lasting Touch™)



## Summary

Anterior and posterior composite materials, and resin-based materials for temporary restorations, have evolved greatly since their introduction. Contemporary materials offer strength, reliability and the ability to create esthetic restorations with shading and tinting that matches adjacent teeth. Similarly, recent developments have provided the clinician with several methods for finishing and polishing these restorations – both of which are necessary for optimal esthetic results and the maintenance of oral health.

Polishing techniques available include the use of polishers, pastes and liquid polishers. These can be used in combination. Liquid polishers enhance esthetics, impart a high luster, create a smoother surface and help provide a marginal seal as the final step in polishing. In addition, use of liquid polish as a stand-alone polisher can be advantageous when the patient has already undergone a lengthy procedure; in the case of temporary restorations that might otherwise be finished but not polished, liquid polish provides a high luster and smooth surface in seconds.



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## Author Profile

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Dr. Blank maintains a full-time practice, focusing on cosmetic and restorative dentistry. Dr. Blank has lectured extensively at major dental meetings throughout the U.S., as well as overseas in Germany, Sweden and the Pacific Rim on cosmetic materials and techniques. He is an Adjunct Instructor in the Department of General Dentistry, and guest lecturer for graduate and undergraduate studies, at the Medical University of South Carolina, College of Dental Medicine. Dr. Blank graduated from MUSC in 1989, and is an active member of the American Academy of Cosmetic Dentistry, the Pierre Fauchard Honorary Society, the American Dental Association, and the Academy of General Dentistry. In his leisure time, Dr. Blank enjoys traveling, biking, camping and fly-fishing with his family.

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## Questions

- It is estimated that approximately \_\_\_\_\_ direct composite restorations were provided to patients in 1999.
  - twenty million
  - thirty-six million
  - seventy-five million
  - eighty-six million
- Early precursors of composite resins included \_\_\_\_\_.
  - silicate cement-based materials
  - composites with two components that were manually mixed
  - acrylic with four components that were titrated
  - a and b
- None of the early composite materials was clinically suitable for posterior restorations.
  - True
  - False
- Advances in composite resin materials and techniques have included \_\_\_\_\_.
  - new bonding materials
  - fast curing lights
  - new finishing and polishing materials
  - all of the above
- Bonded composite resin restorations \_\_\_\_\_.
  - enable the practice of minimally-invasive dentistry
  - remove the need for undercuts for retention
  - are inferior to bis-GMA
  - a and b
- Direct bonded composite resins can be effective in providing direct durable cuspal-coverage restorations.
  - True
  - False
- Compared to amalgam, bonded composite Class II restorations have been shown to \_\_\_\_\_.
  - result in fewer marginal gaps
  - result in fewer underfilled margins
  - have a lower thermal coefficient of expansion
  - all of the above
- Compared to amalgam, placement of composite restorations \_\_\_\_\_.
  - is simpler and quicker
  - is more intricate and requires a more exact technique
  - requires less bonding agent
  - none of the above
- Composites with larger-particle filler have been found to have better mechanical strength and wear resistance compared with those containing smaller-particle filler.
  - True
  - False
- Etching and bonding can be carried out \_\_\_\_\_.
  - in one step
  - in two steps
  - anytime and are not necessary
  - a and b
- Studies have found that an incremental layering technique for composites results in \_\_\_\_\_.
  - less microleakage than a single-insertion technique
  - fewer gaps in the composite bulk compared to a two-layer insertion technique
  - total elimination of microleakage at the margins
  - a and b
- If care is taken not to overfill preparations while placing composite, \_\_\_\_\_.
  - no finishing will be required
  - less composite will need to be removed prior to finishing and polishing
  - there will be space for contraction
  - b and c
- Finishing of direct composite restorations can be achieved using \_\_\_\_\_.
  - finishing cups, discs and points
  - diamond finishing burs
  - carbide finishing burs
  - all of the above
- The finished surface of a composite must have its final contour and be defect-free prior to polishing.
  - True
  - False
- Polishers for composites are available as \_\_\_\_\_.
  - polishing discs, cups and points
  - polishing pastes
  - liquid polishers
  - all of the above
- A smooth, clinically optimal composite requires that the surface be \_\_\_\_\_.
  - plasticized
  - polished
  - enhanced with fluoride varnish
  - all of the above
- Smooth surfaces and margins reduce the risk of \_\_\_\_\_.
  - biofilm adhesion and maturation
  - recurrent caries
  - gingival irritation
  - all of the above
- When using a composite polishing paste, it is important to \_\_\_\_\_.
  - use water as a coolant
  - use a high-speed handpiece and bur
  - select the paste appropriate for the composite's structure
  - none of the above
- Liquid polishers are also known as \_\_\_\_\_.
  - surface sealants
  - cavity varnishes
  - surface degradants
  - all of the above
- Liquid polishers \_\_\_\_\_.
  - provide a gloss over composite resin surfaces
  - aid in creating a marginal seal
  - have the ability to fill microgaps
  - all of the above
- Poor marginal adaptation and microleakage are the most common causes of composite restoration failure.
  - True
  - False
- Use of a surface sealant following finishing and polishing \_\_\_\_\_.
  - reduces surface roughness
  - reduces wear
  - improves esthetics
  - all of the above
- \_\_\_\_\_ found 50% less wear with use of surface sealants.
  - Black et al.
  - Shinkai et al.
  - Brannstrom et al.
  - None of the above
- Liquid polishers can only be used after an ultra-fine polishing step.
  - True
  - False
- Indirect temporary restorations \_\_\_\_\_.
  - can be polished using a liquid polisher
  - may be intended for short-term use while a crown or bridge is being fabricated
  - may be intended for use during oral rehabilitation
  - all of the above
- A smooth surface on a temporary restoration \_\_\_\_\_.
  - helps to improve patient comfort and to maintain gingival health
  - is not important given that the restoration is temporary
  - might weaken the temporary restoration
  - a and c
- Composite material has been found to be colonized in the intraoral environment by \_\_\_\_\_.
  - diphtheroids
  - anthrax
  - Streptococcus mutans
  - none of the above
- Several polishing techniques are available and can be used in various combinations.
  - True
  - False
- Composite resin restorative materials have been available for \_\_\_\_\_.
  - a little over two decades
  - a little over four decades
  - a little over fifty years
  - more than sixty years
- Contemporary composite materials offer \_\_\_\_\_.
  - strength and reliability
  - the ability to create esthetic restorations
  - quicker placement than using amalgam
  - a and b