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### RESEARCH ARTICLE

#### FINISHING AND POLISHING OF DIRECT COMPOSITE RESTORATIONS - A REVIEW

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#### Abstract

Contemporary cosmetic dentists are expected to create realistic and seamless restorations that mimic natural tooth structures. Recent advancements in composite resin systems have improved the practitioner's ability to deliver optimal results using chair-side techniques. Many times, the form and function is achieved but the surface of these restorations is not smooth. This might lead to rough or uneven surfaces which over time invite microbial flora leading to an inevitable failure of the restoration. To avoid such failures and to satisfy this patient-driven demand for aesthetic restorations, the use of exemplary finishing and polishing materials is required. These techniques of finishing and polishing helps to achieve the proper form and function of the restoration along with pleasing aesthetics and the maintenance of proper periodontal and gingival health. This article aims to briefly outline finishing and polishing of composite restorations.

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#### Introduction:-

A direct composite restoration is created entirely by the practitioner unlike an indirect porcelain restoration. The clinician determines the color, shape, and contour of the restoration and thereby the final look of the restoration.

Clinicians often consider color to be the main challenge in bonded composite restorations; however finishing and polishing procedures are the main steps that create the shape and texture of the restoration and are equally important. The shape and texture of these restorations impart all the three-dimensional features that natural teeth possess.

Finishing and polishing of dental restorations are important aspects of clinical restorative procedures that enhance both the aesthetic element as well as the longevity of restored teeth.

The process of making the surface smooth so as to enable them to reflect light evenly is known as finishing and polishing. Finishing is the removal of surface irregularities, whereas polishing is the creation of surface layer which can reflect light as good as enamel surface.

The processes of finishing and polishing entail incorporating finer scratches to the surface of the substrate in order to methodically remove the deeper scratches. These step wise wear processes help to achieve a restoration with high gloss, lustre and finish. Finishing and polishing are both wear processes but they differ in intent and degree.<sup>[1]</sup>

Finishing is defined as the transformation of an object from a rough to a refined form. The procedure involves the removal of surface irregularities and shaping the restoration according to functional occlusion.

Polishing is defined as the production of a shiny mirror like surface which reflects light similar to enamel without creating supplemental films by the addition of wax or lacquer.<sup>[1]</sup>

It has been established that rough or uneven surfaces invite microbial flora to flourish on surfaces which eventually lead to periodontal problems. Various authors have determined through literature that bacterial adhesion could be prevented if the surface roughness value is kept under 200nm.

In addition to an aesthetic long standing restoration these procedures also maximize the patients' oral health by reducing the chances of plaque accumulation, recurrent caries, gingival irritation and surface staining.<sup>[2]</sup> Moreover, proper polishing may preserve high surface quality and gloss over time whilst preventing marginal staining and discoloration. These steps additionally reflect light uniformly imparting.

Several steps are followed to achieve aesthetic, natural looking and predictable results while doing a direct restoration. These steps include planning, dental preparation, adhesion, layering followed by finishing and polishing.<sup>[3]</sup>

#### **Advantages of proper finishing and polishing:**

1. Greatly enhances the longevity, durability and long term wear resistance of the restoration
2. Proper occlusions and desired anatomy can be achieved which make the restorations seem seamless
3. Enhanced oral function as food glides freely over occlusal and embrasure surfaces during mastication, minimizing wear rates
4. Polishing the interproximal surfaces will significantly lower patients' risk of secondary caries and periodontal disease
5. A polished surface is more biologically compatible with the gingival tissues reducing gingival irritation, so the health of the gingiva is maintained
6. A smooth surface reduces the likelihood of adhesion, which means that plaque is less likely to accumulate on a polished surface
7. A polished tooth surface increases the reflective and refractive index of the restoration and enhances the optical property of the material to create more natural and esthetic smiles
8. Polished surfaces enhance patient comfort and satisfaction; patients can detect a surface roughness change of less than 1µm by tongue proprioception
9. Finishing also removes the smear layer from the composite. This is surface layer prevented from polymerizing properly by the oxygen.

A highly polished surface of composite is difficult to achieve. The resin matrix and the filler particles of composites do not abrade at the same degree because of a difference in their hardness. The surface smoothness varies with the type of composite resin, owing to the nature of the filler particles.

1. Conventional composites pose a great difficulty in achieving a smooth surface because of the difference in the hardness of the organic and inorganic phases. The resin matrix is soft and the filler particles are hard.<sup>[1]</sup> If the fine grit polishing agents are used, the soft resin abrades away easily leaving the hard filler particles behind. If coarse abrasives are used, the organic and inorganic material is removed leaving rough marks, the unequal surfaces lead to unequal wear thereby disturbing the occlusal harmony and causing TMJ problems further on.
2. Hybrid composites can be polished to a semi gloss state but the surface is somewhat hydrophobic.
3. Microfilled composites can undoubtedly be polished to the highest gloss and are considered esthetically best, amongst all the composites. The surfaces of these restorations are highly smooth and chances of extrinsic stains are minimal.

#### **Procedure for finishing and polishing of direct composite restorations**

A surface finish attained with the use of a plastic matrix band is the most desirable finish for resin restorations, but this is rarely obtainable because of the need for contouring and removal of excess material.<sup>[3]</sup> However, such a surface has high resin content and may yield a surface that is that is less resistant to wear.

Hence, it is advisable to contour the unpolymerized composite with hand instruments, so that the need for removal of large amounts of set resin leading to surface damage are minimized.

The composite resins may be filled directly into the cavity (direct restoration) or may be fabricated outside the oral cavity and cemented into the cavity (indirect restoration).

To obtain adequate surface qualities, a series of procedural steps are conducted such as:

1. Reduction of excess resin cement/gross reduction
2. Contouring
3. Fine finishing
4. Polishing

**Gross reduction is where excess restorative material is removed.**

Contouring includes the reproduction of the size, shape, grooves and other details of the tooth form as well as re-establishing contact with adjacent teeth to a normal and functional form.

Finishing and polishing establishes an even, well-adapted junction between the tooth surface and the restoration and removes scratches to produce a visually smooth and shiny surface.

Once a composite has been cured, it must be finished and polished to produce the final surface. This step removes the air-inhibited layer. This being said finishing and polishing should be delayed for at least 10-15 minutes following the final phase of light curing.<sup>[4]</sup> The restoration must be left undisturbed to allow the resin to completely polymerize. This may aid in reducing surface trauma from the finishing process. Premature finishing may result in an increased risk of initiating micro cracks and accelerated surface wear.

Finishing and polishing steps remove the outer surface of the composite that is resin rich and actually is already a smooth surface. However, this cannot be avoided. The anatomic contours of composites cannot be so well established before curing to avoid reshaping. On the latter procedure, several investigations have shown that removal of the polymer-rich, outermost resin layer is essential to achieving a stain resistant, more esthetically stable surface.

**Direct Composite Restorations:**

Excess composite at the cavosurface margins is scraped away using scalpel blades, such as the No. 12 or 12b, or specific resin carving instruments made of carbide, anodized aluminum, or nickel titanium, are useful for shaping polymerized resins. The use of stainless steel instruments must be avoided, as they tend to leave grey marks on the restoration.<sup>[5]</sup>

The trick to finishing and polishing is to gradually move from larger to smaller abrasive containing agents. This will produce progressively finer scratches on the surface.

The finishing sequence includes diamond burs, followed by polishing discs or rubber polishing discs, points, wheels, and polishing with buffing wheels, brushes and polishing paste.

Polishing can be done using one-step or two step systems such as silicon tips, Sof-Lex disks, rubber cups, polishing pastes, and liquid polishers.

During finishing and polishing, the softer matrix tends to wear away faster than the harder filler particles, resulting in a rough surface. Finishing and polishing is usually done in a brush stroke.<sup>[6]</sup> Each consecutive step in finishing and polishing should be done in perpendicular directions, so that scratch removal is more effective and smoother surface can be obtained.

The instruments used for finishing are:

1. Manual instruments for removing small amount of marginal excesses (Scaler, curette)
2. Coarse (30–40  $\mu\text{m}$ ) and Fine (15  $\mu\text{m}$ ) grit diamond burs for occlusal adjustment
3. Tungsten carbide burs for finishing
4. Finishing strips for proximal surfaces
5. Waxed dental floss for checking

**BURS:**

Prior to finishing and polishing the surface must be contoured and be defect free by using diamond or carbide finishing burs. The 12-fluted carbide burs have traditionally been used to perform gross finishing of resin composite. These finishing burs may be used to develop the proper anatomy for the restoration. The transition from resin to enamel should be slowly smoothed until it is undetectable. These burs can be used dry to better visualize the margins and anatomy being developed but should be used with light pressure to avoid overheating and possibly damaging the resin composite surface. Fine finishing diamonds are also available for finishing resin composite restorations and have been found to impart less surface damage to microfilled resin composites than carbide finishing burs. They are used in a series of progressively finer abrasive particle sizes.

Some commercially available finishing carbide and diamond burs are:

1. ET burs(Komet)
2. BluWhite finishing burs(Kerr)
3. Midwest finishing burs(Dentsply)
4. ET diamond(Brassler)
5. T & F Hybrid points(Shofu)
6. TDF (Axis dental)
7. Two striper diamonds(Premier)
8. RAPTOR

**DISCS:**

Finishing Discs help to perform finishing with more precision and safety as compared to burs. They help contour and finish curved surfaces such as labial proximal line angles, lingual marginal ridges, cervical areas, incisal edges, shaping and finishing of incisal corners, finishing and polishing of labial surfaces. They are also excellent for contouring and finishing of posterior marginal ridge areas, and for lingual and buccal surfaces. Dry finishing with discs used in sequence is reported to be superior or equal to wet finishing for smoothness, hardness and color stability.<sup>[7]</sup> However, dry finishing tends to clog disks with abrasive particles and makes the disks work less efficiently. Most discs use aluminium oxide or silicon carbide as the abrasive which is adhered on a plastic backing.

Sof-Lex Finishing and Polishing Discs- The original Sof-Lex finishing and polishing discs are made from a urethane coated paper that gives the discs their flexibility. The system is comprised of four individual aluminum oxide grits ranging from coarse to superfine. The discs are available in three sizes; 13mm (1/2 inch), 9mm (3/8 inch), and a 16mm (5/8 inch) size with a square brass eyelet. The four-Disc Grit Sequence are as follows:

1. **Coarse**—This grit is used in conjunction with multi-fluted finishing burs for gross contouring and shaping. The coarse disc makes it easy to blend the composite into the tooth surface, eliminating the white line and raised margins.
2. **Medium**—The medium grit should be used to continue smoothing the restoration surface. Medium grits remove any remaining imperfections and marks.
3. **Fine**—This part of the grit sequence is where polish really starts to shine. The fine grit helps remove the smallest imperfections while adding a nice luster to the restoration.
4. **Superfine**—The superfine grit further refines the surface smoothness attainable to create a highly polished restoration.

## Sof-Lex polishing discs, 3M ESPE



1. Sof-Lex XT Finishing and Polishing Discs - The Sof-Lex XT (extra thin) finishing and polishing discs are made with a polyester film which is one third the thickness of the original paper discs. The thinner discs are slightly stiffer and allow more precise refinement of embrasures. These discs also have four individual aluminum oxide grits, ranging from coarse to superfine. They are available in two sizes, 13mm (1/2 inch), or 9mm (3/8 inch).
2. Flexidisc Mini and Flexidisc (Cosmedent) - Studies have shown that they produce higher shine on the surface than Sof-Lex or Sof-Lex XT.
3. Super –Snap (Shofu) -They are available with a protected mandrel so the chances of marring the restoration are significantly reduced.
4. Visionflex (Brasseler)
5. Esthetic Polishing System (Brassler)
6. Fini (Pentron)

**Finishing Strips -**

These strips are available in metal and plastic backing. However for composites plastic backing ones are typically preferred.

1. Sof-Lex Finishing and Polishing Strips -The design of the Sof-Lex strips allows for easy interproximal finishing. The strips are made of plastic and are coated with an aluminum oxide abrasive. Sof-Lex strips are free of any abrasive coating at their centers for easy interproximal insertion. Each strip contains two different grits; a coarse/medium, or a fine/superfine. They are also color coded similar to the discs. The coarser grit on each strip is a darker color than its opposing side.
2. Flexistrip (Cosmedent)- They are available in 4 grits. They are available in an ultrathin version to increase their flexibility and to help pass through contacts without peeling off the abrasive from the mylar backing.
3. Epitex (GC)- They are by far the thinnest strips available (0.05mm). Easy passage through contacts is possible and there is no stripping of silicon carbide abrasive during insertion. These cause less tissue trauma.
4. Diamond strips- Diamond strips help start the inter- proximal finishing process while maintaining the integrity of the interproximal contact. A larger-grit (45- $\mu$ m strip) should be used for interproximal stripping of natural teeth or for gross removal of material, and smaller grits (15  $\mu$ m and 30  $\mu$ m) should be used to start interproximal polishing.

**Sof-Lex Finishing Brush-**

The Sof-Lex finishing brush is made from a thermoplastic polyester elastomer that contains aluminum oxide abrasive particles molded into a shape similar to a prophylaxis brush. The brush itself is detachable from a stainless steel mandrel.

The SofLex Finishing Brush is an easy to use, one-step, reusable brush developed for polishing the concave and convex anatomy found on posterior composite restorations. The soft bristles will conform to the restoration as it travels across the surface resulting in a smooth polished finish.

**Directions for Use-** Place the disc on the mandrel by firmly pushing the eyelet portion onto the mandrel until the disc is secure and does not wobble. The polishing motion should be constant and move from the bulk of the restoration toward the margins. A back and forth movement over the composite/enamel margin is not recommended, as a white line may form.<sup>[7,8,9]</sup> Use light pressure when polishing; let the discs do the work. To produce a smoother, more uniform finish, keep the tooth, restoration, and disc dry while polishing. Avoid touching the composite with the mandrel or disc eyelet because discoloration may occur. This discoloration can be removed by repetition of the finishing steps. Skipping a grit size in the finishing sequence may compromise the quality of the restoration's polish.<sup>[5,10]</sup> It is important to maintain a dry field when using this system. After rinsing, and before proceeding to the next grit sequence, dry the area.

**Impregnated Rubber Points And Cups**

A wide variety of rubber finishing and polishing points and cups impregnated with abrasive materials are available. Like disks, rubber cups and points are used sequentially from coarse to fine grit. The coarse grits may be effective for gross reduction and finishing, while the fine grits create a smooth, shiny surface. The primary advantage of rubber points and cups over disks is for providing access to grooves, desirable surface irregularities, and the concave lingual surfaces of anterior teeth.

Available finishing kits containing disc, cups and points include Enhance finishing system (DENTSPLY Caulk), Fini (pentron) and CompoMaster (Shofu). These are used in a slow- speed hand-piece 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).

Polishers are available as stand alone products and can also be purchased as kits containing discs, cups and points.

The following instruments are used for polishing composites in descending order:

1. Tungsten carbide bur (12 fluted) or diamond point (30–40 µm) for gross removal of excess material.
2. Silicone polishers at slow speed
3. Medium or fine grit finishing discs for proximal areas
4. Silicone brushes with impregnated bristles for polishing pits and fissures
5. Polishing pastes using 3.0 µm brushes followed by 1.0 µm brushes
6. Felt wheel and aluminium oxide polishing pastes

**Available polishers include –**

1. PoGo one step diamond micro-polishers (DENTSPLY Caulk)
2. Sof-Lex superfine polishing discs (3M Espe), which contain aluminium oxide
3. Astropol (Ivoclar)
4. Identoflex (centrix)
5. Jiffy polishers ( Ultradent)

Use of PoGo has been found to result in less staining following immersion in coffee for seven days when compared to the use of a Sof-Lex brush. In a study comparing Sof-Lex, PoGo and Identoflex polishers on a hybrid and microhybrid composites, it was found that the smoothest surface was obtained using PoGo and the hybrid composite.

The following are some of the commercially available polishing systems:

- Enhance PoGo Polishing System:



- Sof-Lex Diamond Polishing System:



- Astropol polishing kit:



- Identoflex Points (Identoflex AG Buchs,Switzerland):



- Ultradent polishing kit:



- One gloss and shofu polishing kit:



- Comprepol Plus © / Composhine Plus © Composite Polishing Kit from Diatech:



- KerrHawe HiLuster Plus Polishing System from Kerr Rotary:





- Diamond Twist Intra-Oral Polishing Kit from Premier Dental Products Company:



- Kerr™ Occlubrush® Polishing System:



- FlexiDiscs, Cosmedent

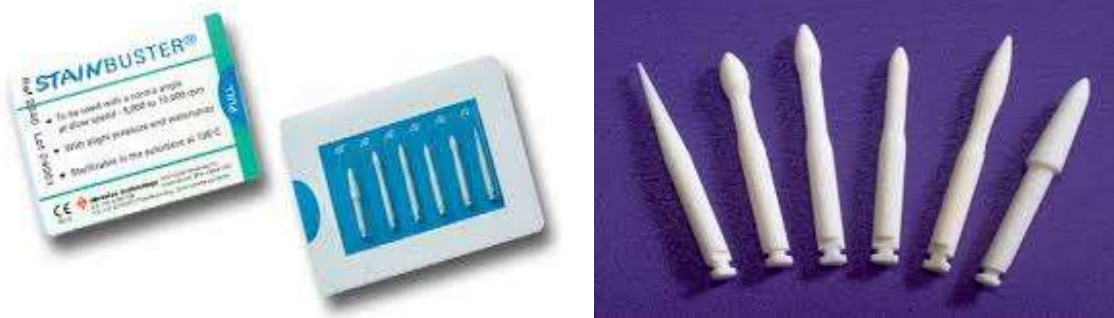


- STAINBUSTER® burs :

StainBuster (Danville, San Ramon, California; and Carbotech, Ganges, France), a latch-type, rotary composite fiber bur that claims will remove residual composite with no damage to either enamel or porcelain.<sup>[3,11,12]</sup>

Removal of residual orthodontic adhesive, periodontal root planing, and stain removal on tooth structure for areas with limited access.

The patent abstract indicates that the structure of the “rod” bur is made up of fibers and optionally a load of particles embedded in a resinous matrix giving the working surface of the rod a continuous abrasive power



- OptiClean™:

OptiClean is intended for removal of temporary cement and debris on tooth preparations before final cementation and therefore replaces other methods of preparation surface cleaning, such as a rubber cup and pumice, or use of hand instruments.<sup>[13]</sup>



**Polishing Pastes-**

An aluminum-oxide polishing paste should be used as the last step in the finishing and polishing process.<sup>[14,15]</sup> Polishing paste with felt discs and points can be used to bring out the final beautiful polish of composites, metals, porcelain, or natural dentition after prophylaxis.

An alternative polishing technique is to use a polishing cup together with a polishing paste made specifically for composites, such as Prima-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).<sup>[16,17,18]</sup>

Other polishing pastes available include CompoSite (Shofu) and Luminescence Plus (Premier Dental).

**Liquid polish** Liquid polishers (surface sealants) are low viscosity fluid resins that provide a gloss over composites resin restorations, improving final esthetics. Objective of liquid polishers is to aid in creating a marginal seal, and they have the ability to fill micro-gaps. Liquid polishers reduce microleakage at composite margins.

Studies have found that use of a surface sealants following finishing and polishing reduces surface roughness and wear compared to control restorations receiving no surface sealant. Shinkai et al. found 50% less wear of the restorations with use of surface sealants.<sup>[6,9,19]</sup>



Hazards during Finishing and Polishing of Composite Restorations :

1. Production of aerosols
2. Excessive rise in temperature: May cause destruction of the underlying resin matrix and loss of filler particles. High temperatures may also damage pulp and produce monomer vapours.<sup>[1,4]</sup>
3. High-speed impact of the instrument may damage the filler particles.
4. Microstructural defects or cracks can extend below the surface.
5. Voids incorporated during the filling process may be exposed, lodging unsightly stains.
6. The edges of the inflexible disks tend to scratch the surfaces and the central metallic mounting hub of certain disks also have a tendency to cut the surface.
7. Composites can be lodged in the oral soft tissues during finishing and shaping procedures, which can lead to persistent chronic inflammation of those tissues.

**Conclusion:-**

This article has outlined the importance of every step of finishing and polishing and the myriad of commercially available products.

In a nutshell, some tips to achieve the best outcome from these procedures include:

1. Avoid premature finishing and polishing.
2. Use copious amounts of water coolant.
3. Find a protocol that works best for you.
4. Practise taking photographs. View these with a 'fresh set of eyes'. For aesthetically demanding cases, you may suggest that your patient re-attends for final refinement and polishing once you have made detailed notes from your photographic records.
5. Avoid coating restorations with agents containing HEMA, as this will increase the risk of stain accumulation.<sup>[19]</sup>
6. Remember that composites do require long-term maintenance, so be prepared to repolish the surface to enhance the aesthetic value.

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