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Current Concepts for Polishing Anterior Composite Resins

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At the completion of this program the participant will be able to:

- Describe the choices in composite resin restorative materials
- Describe the principles of polishing composite resins
- List and describe instruments used for finishing and polishing composite resins
- List the step-by-step procedure for finishing and polishing composite resins

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CUT ALONG DOTTED LINE

The aesthetic appearance of composite resin is based upon shape, color and gloss of the restoration achieved by finishing and polishing. When composite resins were first introduced in the late 1950s and early 1960s, they were self-cured and macrofilled with large filler particles in the 25-50 micrometer range. In most cases the filler was made of quartz. These composite resins, once contoured, had little surface gloss and the patient sensed they were rough when their tongue touched the restoration. The introduction in the late 1970s of visible light-cured composite resins with smaller filler particles made from synthetic, softer glasses made composites more polishable with improved tooth-like translucency. These restoratives allowed the clinician the ability to provide patients with more natural and esthetic tooth-like restorations in the anterior region. Visible light-cured composite resins had changes in the polymerization chemistry that improved the color stability. Light activation in most cases was initiated when a blue wavelength light with a peak of 460-480 nm was absorbed by a photoinitiator usually camphoroquinone (CQ). The use of CQ combined with an organic amine allowed the chemical reaction to progress so the composite resin hardened. This light-activated reaction eliminated the need for tertiary amines that contributed to unaesthetic color changes of the earlier self-cured composite resins.

In the last decade and a half, manufacturers have introduced a wide variety of composite resins with varied applications in both the anterior and posterior region. For anterior restorations microfilled composites and hybrid composite resins have become accepted as the standard. Microfilled composites offer high polishability with tooth-like translucency, but unfortunately are radiolucent. The high polishability and the ability to maintain their luster of microfilled composites is due to the use of a 0.04 micrometer colloidal silica particles that can be within the polymer matrix (homogenous microfill) or mixed with the polymer matrix, light cured and crushed to make a prepolymer filler that is loaded as an organic filler within the microfilled composite (heterogenous microfill). The small fillers and resin-rich surface allow for high polishability. Microfilled composites are generally loaded to 32-50% by volume, have greater polymerization shrinkage, higher water sorption and a higher coefficient of thermal expansion and contraction than hybrid composites.[1]

Hybrid composite resins combine microfiller particles (0.04 micrometer fumed silica) with microfine glass fillers with an average particle size diameter of less than 2 micrometers. Typically these composites are loaded to 58-75% by volume and are radiopaque. This mixture of fillers accounts for the excellent physical properties with high polishability when compared to macrofilled composites.[2] Regrettably, one problem with hybrid composite resins is their inability to maintain their gloss when exposed to toothbrushing with toothpaste and prophylaxis pastes.[3-6]

Although microfilled composites maintained their gloss, in high stress-bearing areas, microfilled composites they were more susceptible to fracture.[7] There was a need for a highly polishable composite resin with optimal physical properties for use in the anterior and posterior regions.

Recently, a new generation of hybrid composite resin has been introduced. These composites have been categorized as nanofilled with filler particles with a diameter ranging from 0.005-0.1 micrometers. The introduction of nanofillers allows manufacturers to create hybrid composite resins with physical properties equivalent to the original hybrid composite resins, good handling characteristics and higher polishability.[8-12] These nanofilled composites offer an alternative to microfilled composites in their ability to be highly polishable with toothlike translucency.[10-13] Many nanofilled hybrid composite resins have not only the basic shade selection, but offer an extended range of opacities, translucencies with dentin, enamel, incisal shades to allow for building and stratifying a restoration to have a more toothlike appearance. With the current generation of nanofilled composites for anterior and posterior restorations, the clinician can expect good color stability, stain resistance, low wear, excellent polishability and luster retention.[2,8 10-12, 15]

With the introduction of these composites, manufacturers have also introduced specialized shade guides and recipes to help the clinician choose the mix of shades to use in specialized circumstances like the building on Class IV incisal edge fractures from the inside out and stratified building of completed facial veneers for esthetic bonding. These stratified composite resin placements, using the recipe consisting of the dentin, enamel body shades and incisal shades can be used to restore anterior and posterior teeth. Examples of this philosophy of adhesive bonded composite resin restoration include Filtek Supreme PLUS (3M-ESPE) which includes a comprehensive shade selection wheel that is used once the basic shade is selected from a Classic Vita Shade Guide® (Vident) classical shade guide; IPS Empress Direct (Ivoclar-Vivadent) which utilizes "True-to-Nature" shades with five different levels of translucency and natural fluorescence to mimic a natural tooth in appearance. Shades are selected using the IPS Empress Di-

rect autoclavable shade guide. Esthet-X HD (Dentsply Caulk) uses a similar approach by providing the clinician with a comprehensive shade guide with expanded shades (bleaching shades and some darker shades than the traditional Classic Vita guide) and receipes on the back of the shade guide to select enamel, dentin and incisal shades. Nanohybrid composites are the current state-of-the-art universal anterior and posterior composite resins. These advanced composite resins have been formulated to be more sculptable with minimal slump and very little tackiness for ease of placement.

The final esthetic appearance of any composite resin will be based upon the artistic abilities of the clinician in choosing the correct shade or shades of composite resin to mimic the color and appearance of the teeth and in shaping and contouring the restoration. The restoration's ability to imitate in appearance the tooth and/or adjacent teeth will be based upon the proper use of abrasives to finish and polish the restorative to its highest luster. Research has shown that the technique for polishing composite resin to its optimal smoothness and gloss is product specific and composite resin specific.[10-27] Regardless of composite type, using discs sequentially from coarsest to smoothest produced the smoothest surfaces.

The principles governing the polishing of composite resins are similar to those of dental metals. Unlike metals that have homogeneous alloyed surfaces with a uniform hardness, composite resins have a variable composition of resin matrix and filler particles. In some cases the resin matrix and fillers have different hardnesses. Metals, due to hardness and composition use different abrasive systems and while composite resin finishing systems can be used on metals, metal finishers and polishers should not be used for composites in order to avoid undesirable staining and discoloration. The abrasive particles used to polish composites are material specific. Similar to metal polishing, the sequence of polishing for composite resin progresses from the coarsest abrasive to the smoothest. Finishing and polishing devices and instruments can be classified as:

1. coated abrasives, e.g., abrasive finishing disks and strips;
2. rotary cutting devices, e.g., carbide finishing burs;
3. rotary submicron particle diamond finishing abrasives;
4. reciprocating abrasive tips, e.g., laminated abrasive flat paddles
5. rubberized embedded abrasives, e.g., rubber or silicone rotary points;
6. hand instruments;
7. abrasives suspended in a polishing paste.

No matter which abrasives are selected, the rule of coarsest to smoothest and then physically debriding the surface with a moist cotton roll between abrasives must be followed. For a complete listing of the wide variety of finishing and polishing burs, diamonds, abrasives, strips and pastes for composite resin refer to the Benco Dentist Desk Reference as your resource for these instruments.

The goal for placement of any composite resin is minimal finishing and polishing. While this is not difficult with routine anterior restorations (Class III's and Class V's) for larger more involved restorations (Class IV's and complete facial veneering especially for multiple teeth) there will be significantly more contouring and finishing involved. Typically for these larger restorations, the sequence for finishing and polishing involves gross contouring, shaping with finishing burs and submicron finishing diamonds with a high-speed handpiece followed by additional finishing with abrasive discs and/or rubber points. For long incisal-gingival restorations, narrow, long finishing burs or diamonds with safe-tipped ends afford the ability to establish esthetic form to curved surfaces. While finishing burs and diamonds can be used either wet or dry, these authors prefer using them dry with the dental assistant suctioning the composite "dust" during the procedure. Working with a dry field and a light touch allows me for better visualization of shape and contour of the composite resin surface. Judicious use of coarse and medium grit finishing disks using only small sections of the disk allows the same level of control. Most disks today have smaller metal hubs to avoid marring the composite surface by accidentally hitting the composite with the metal hubs of the disk. Some manufacturers (Shofu and Brasseler) have placed their disks on silicone sheaths that slip over the metal mandrel, totally eliminating the potential of marring the composite resin surface. Additional finishing of facial and lingual surfaces can be accomplished with specialized rubberized polishers in flame, disk and cup shapes. These shapes provide access to the varied contours of the tooth. These are used on a latch-type contra-angle handpiece. It is important whenever using abrasive systems that the surface of the composite resin be physically debrided of composite debris and abrasive debris with a damp cotton roll or gauze. If only an air-water spray is used, some of the abrasive debris will remain on the restoration surface and interfere with attaining the smoothest polish finest abrasive grit with the next step-down instrument.

Interproximal finishing and polishing is accomplished with gapped finishing and polishing strips covered with aluminum oxide abrasive particles or metal

Figure 1A: Smile view of discolored maxillary anterior teeth due to enamel demineralization occurring during orthodontic trewatment.
Figure 1B: Retracted view of maxiallary anterior teeth.
Figure 2: Long, thin composite resin finishing bur (Brasseler) trimming the facial surface

strips covered with submicron diamond particles. Occasionally, even with the use of a matrix strip, the restoration may bond to the adjacent teeth, literally splinting them together. In these cases, there are specialized accessories that allow the clinician to separate the teeth without damaging the restoration. One can saw the teeth apart using an ultra-thin stainless steel saw blade mounted in a handle (Cerisaw, Den-Mat). This mini-hacksaw and handle allows for total control of the instrument while gently sawing through the interproximal resin. When using a saw, a gingival wooden wedge should be placed to protect the gingival papilla when sawing through. Axis Dental combines a gapped diamond containing metal finishing strip with saw teeth on the strip. Den-Mat uses the same concept as the CeriSaw by placing safesided diamond strips in their CeriSaw handle to finish resin and ceramic veneer interproximal surfaces. Another useful aid to help get through interproximal contacts for access with placement of matrix strips or gapped finishing strips is the Contact Disc® (Centrix). This thin, rigid disk can be inserted from the incisal, occlusal or facial surfaces to force the teeth apart with rapid tooth separation. If there is excess composite resin present, the disk will create space to place a matrix strip for restoration without taking the risk of causing bleeding that a gingival wooden wedge would cause to perform the same task. In the presence of excess composite resin interproximally, the disk will break away excess resin without damaging the restoration. Premier Dental Products has developed a diamond-impregnated thin disk, CompDisk®, that not only creates space with rapid separation but can also be used for interproximal finishing or cleaning interproximal surfaces before the bonding procedure.

There are times after placement of the composite restoration, that margination is best accomplished with a hand instrument or by using a specialized reciprocating handpiece with a flat abrasive paddle. Carbide-tipped hand instruments (Brasseler), restorative knives (Hu-Friedy) or scalpel blades with shapes that allow for access to the restoration margin allow the clinician to remove overhanging restorative material in a more controlled way than with rotary burs or diamonds.[17, 28] Carbide carvers are especially useful for marginating composite resin restorations where slight excesses exist. In hard-to-reach areas such as the interproximal surface at the gingival margin, specialized instruments and devices, e.g., a reciprocating handpiece, Profin™ (Dentatus) with a flat Lamineer™ abrasive tip can be used.[28, 29] Lamineer tips come in a variety of submicron abrasives for finishing and polishing cervical margins of the restoration. The flat tips can also be used to finish and shape facial surfaces and incisal embrasures.

Final polish of the composite resin surface to its most lustrous finish can accomplished using disks with the finest aluminum oxide abrasive. Using a disk will not only smooth the resin surface, but it also heats the surface creating a high luster. This heating of the surface causes the polymer matrix to reach its glass transition temperature. This phenomenon gives the composite resin a glassy appearance. Also, a composite resin can be polished with specialized composite resin polishing pastes which contain either very fine aluminum oxide abrasive particles or diamond particles. This is best accomplished with with foam cups, felt mounted on disks or fine goat's hair brushes. If the surface of the restoration is smooth with no facial lobular form, disks work well. For facial surfaces of composite resins that have anatomic variation of lobular form or striations, composite polishing pastes work best.

CASE REPORT:

A 18-year-old female presented with concerns about the appearance of her maxillary anterior teeth. She had

completed orthodontic treatment to align her permanent dentition. Unfortunately, during treatment, the difficulty in cleaning adjacent to the bonded brackets resulted in demineralization. Although remineralization therapy with a prescription fluorides (Prevident 5000 Plus, Colgate) and the use of a casein phosphopeptides-amorphous calcium phosphate paste (CCP-ACP, MiPaste, GC America, Alsip, IL) was effective, the discolorations on the facial surfaces of #6-11 were aesthetically unacceptable to the patient and her mother.(Figure 1)

During the restorative treatment consultation the patient was presented with two minimally invasive treatment choices—porcelain veneers or direct placement composite resin. Based upon the age of the patient, the recommendation for minimally invasive porcelain veneers was discouraged because of the potential for the anterior teeth to have additional eruption and changes in the height of the free marginal gingiva due to the patient's age. The patient and her parents followed this clinican's recommendation for direct bonded composite resin veneers for #6-11. A diagnostic "wax-up" was not needed because the tooth alignment and tooth shapes were aesthetically acceptable for the patient. In other cases where the patient desires to change tooth shape and position adhesive bonding with composite resin and ceramic veneers can be used as a successful alternative treatment for esthetic correction of the tooth malposition in the anterior area.[30, 31] When the patient accepted treatment, she was scheduled for restoration with a direct placement optimized particle nano-hybrid composite resin (N'Durance, Septodont) to aesthetically veneer the maxillary incisors and canines.

The choice for N'Durance was based upon this clinician's experience with patients that have mouth breathing and leave the surface of the composite resin dry during their normal activities. The desire to have a high luster when the restoration was dry and good polish retention is offered by the unique monomer chemistry of N'Durance based upon dimer acid monomers that significantly reduce polymerization shrinkage, shrinkage stresses and increased the initial double bond concentration of the monomer and the degree of double bond conversion achieved during polymerization.[32, 33] With N'Durance, the use of optimized nano-fillers of Ytterbium Fluoride, Barium glass and silica make this composite easy to distinguish in radiographs and provide for wear resistance similar to existing nano-filled composites.[34-36] With this significantly lower volumetric shrinkage and non-stick formulation with N'Durance, well-adapted composite resin restorations are more easily achievable. Side benefits of this new chemistry include extremely low water sorption and solubility which contributes to color stability (no color shifting), marginal integrity and stain resistance of the composite. A clinical research study evaluating the N'Durance to restore anterior teeth demonstrated excellent clinical results in all the categories evaluated at one year.[37]

CLINICAL PROCEDURE

Before tooth isolation, a shade was selected with a Classic Vitapan® shade guide (Vident, Brea, CA). The patient wanted the teeth to be slightly lighter in appearance. Shade selection finalization was achieved by placing an increment of composite resin in the lighter shade on the right central incisor, shaping it and light curing that increment. Like many of the new generation of nano-filled composite resins, N'Durance has shade choices of regular shades, translucent shades and bleaching shades. Although N'Durance has very little color shift when light cured, some composite resins change their shade significantly when light cured. This color shift occurs during light curing due to the chemistry of the polymerization process. By exposing the composite resin to the light source, a bleaching out of the orange-yellow colored photoinitiator, camphoroquinone, occurs and the material reaches its final shade. Accurate shade selection is a critical step when placing anterior composite resins. The patient was pleased with the lighter shade and was ready for treatment.

The teeth were isolated using lip retractors. Since the tooth shape and alignment were acceptable, as well as, a minimally translucent shade of N'Durance was selected to block out the enamel discolorations, only a minimally invasive preparation of the facial surfaces of #6-11 was needed. The teeth were minimally prepared leaving enamel to a depth of 0.3 mm using the a medium grit flame shaped diamond (Revelation 653-016, SS White Burs) on a high-speed handpiece with water spray. Since there was no need for incisal edge length changes, the incisal edges were not changed.

While there are many different techniques to restore #6-11 with direct composite veneers, I have found that the following sequence gives me excellent control of the composite shape and widths during freehand sculpting. The teeth were restored, two teeth at a time to control tooth shape and contour. The sequence of restoration was the maxillary central incisors, the right maxillary lateral incisor and canine, and then the left maxillary lateral incisor and canine. Before acid etching, dead soft stainless steel metal matrix, thickness 0.001 inch thick (Pulpdent) was placed as a matrix. For the maxillary central incisors, my experi-

ence has been that using aTofflemire stainless steel rigid matrix (0.002 inch thick) cut into a small rectangular strip placed between the central incisors provides for the correct orientation of the midline to the interpupillary plane. Following the plan for restoration two teeth at a time, the facial tooth surfaces and slightly over the incisal edge were etched for 15 seconds with a 32 percent phosphoric acid etchant and then rinsed with an air-water spray for 15 seconds. The etched tooth surfaces were dried, leaving a slightly frosty appearance to the enamel. A 5th-generation adhesive (Septobond, Septodont) was painted on the facial surface of the etched enamel and then light cured for 10 seconds with a high intensity LED curing light (BluePhase 20i, Ivoclar-Vivadent). The nano-hybrid composite resin (N'Durance) was placed on the facial surfaces of both central incisors and sculpted with a thin, broad plastic filling instrument (PFIAB1, HuFriedy). This instrument allows for smooth shaping of the broad facial areas of incisors. The instrument was lightly wetted with a coating of adhesive resin to prevent the composite resin from sticking to the instrument and pulling away from the enamel surface. The composite resin was light-cured for 20 seconds. After placement of the composite resin on the central incisors, the other teeth were were restored following the sequence described and the same protocol.

FINISHING AND POLISHING:

Many manufacturers provide kits containing finishing burs, diamond abrasives, rubberized abrasives and disks that provide the clinician with an orderly arrangement of finishing and polishing instruments. In these authors' experiences all these kits have merit. There is certainly no one way to finish and polish composite resin but no matter what set of instruments are selected the operator does need to follow the order of coarsest to finest to attain the best finish and polish for composites. For this case, the facial surfaces were contoured using a long, narrow, safe-ended, multifluted finishing bur (ET-9F, Brasseler) (Figure 2) but a submicron diamond abrasive with a similar shape could also be used. The gingival margin was contoured and marginated with a shorter, thin, needle-shaped finishing bur. Other popular choices for shaping facial surfaces of veneers and Class IV's are the Safe-ended series of finishing burs from SS White Burs and finishing burs from Axis Dental. The choice of finishing bur and diamond abrasive is usually a decision made by the practitioner based upon his or her ability to control the instrument without notching the restoration. Finishing burs can have as few as 8 and 12 blades for gross reduction. For finer finishing, 16-bladed and 30-bladed finishing burs are available. Diamond composite finishers usually have diamond particle sizes of approximately 30-40 microns for fine grit, 15 microns for extra-fine

Figure 3: Coarse XT Soflex disk (3M-ESPE) shaping incisal edge. **Figure 4:** Coarse XT Soflex disk (3M-ESPE) shaping incisal embrasure. **Figure 5:** For another case Vision Flex disk (Brasseler) shaping facial and incisal embrasures. **Figure 6:** For another case Profin with "S" type Lamineer tip (Dentatus) shaping facial embrasure. **Figure 7:** For another case safe sided Lamineer tip on Profin reciprocating handpiece, shaping gingival interproximal embrasure. **Figure 8:** Enhance (Dentsply Caulk) finishing cup smoothing facial surface of composite resin.

grit and 8 microns for ultra-fine grit. A thin, brand-new finishing bur can cut too aggressively into a facial surface. I have found that a composite resin finishing bur dulls appropriately after two sequences of autoclaving, thus enhancing control. To further marginate and finish the gingival margin a flame-shaped fine finishing diamond (862-016, SS White Burs) was used because it allows for better access to the gingival margin without marring the root surface of the tooth. The facial surface was also shaped with a coarse XT Soflex disk (#2381C , 3M-ESPE).

The incisal edge was shaped and the length determined using a pop-on mandrel with a coarse disk (Soflex XT disk, 3M-ESPE)(Figure 3). The best technique for shaping the incisal edge is to have the patient seated in an upright position that mimics how the incisal edges are visualized. The disk should be oriented with a slight lingual inclination following the chisel shape of the incisal edge of an intact incisor. The incisal embrasures and facial embrasures were established using a the same disk. (Figure 4) Thin, flexible diamond disks can also be used, e.g., the Vision Flex Disc, Brasseler) (Figure 5) These areas can also be shaped with a reciprocating handpiece, Profin, and an "S" series knife edge Lamineer tip (Figure 6). Once shaped the areas were finished using successively smoother disks from a medium to fine and to finest grit.

One of the most difficult areas to access when finishing any aesthetic restoration is the gingival interproximal margin. Finishing strips do not work well due to the difficulty of attempting to access these margins. In this case, the Profin™ with a Lamineer™ tip was used in the gingival interproximal areas because it afforded a fine control that the reciprocating handpiece allows with its back and forth motion to safely finish and polish the root surfaces without fear of notching. (Figure 7) Finishing burs on a high-speed handpiece, if not used correctly, can easily notch a root surface. Even the thinnest of finishing burs or submicron diamonds are rounded and can notch root surfaces. The Lamineer tips are safe sided and come in decreasing diamond abrasive grits to finish and then polish the gingivoproximal surfaces.

There are times when a rotary instrument or even a reciprocating instrument does not have complete access to the interproximal surface. For these special situations, a hand instrument allows for fine control, precision placement and effective removal of excess composite resin. Hand instruments for this use include carbide-tipped composite instruments (with specialized shapes to access different tooth surfaces), composite carving knives and a #12 scalpel blade.[28]

The finishing and polishing of the interproximal surfaces of composite resin restorations require the same attention given to accessible surfaces. Care should be taken not to aggressively finish interproximal surfaces by removing excessive composite resin, resulting in an open proximal contact. Interproximal strips can be used to shape and contour the interproximal contact thus maintaining the proximal contact. When using finishing strips, always proceed from medium abrasive grit to fine grit to the finest grit strips. Gapped finishing strips work best as they allow the operator ease of placement between the teeth. If there is difficulty getting the strip through the contact, this can be accomplished using a plastic filling instrument to rapidly separate the teeth and then sliding the finishing strip below the interproximal contact area. If the operator wants to use a diamond-abrasive gapped strip, (e.g.,Open centered lightening strips, Miltex), additional care must be taken to not remove tooth structure when finishing the interproximal areas. These diamond impregnated strips work well in removing stain on interproximal tooth surfaces before the bonding procedure.

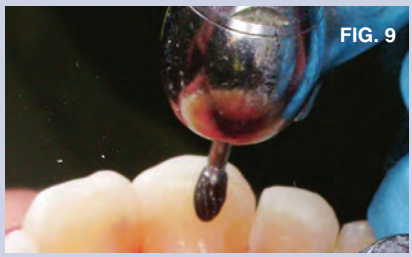

Figure 9: Egg-shaped finishing bur (SSWhite Burs) marginating and shaping lingual surface of composite restoration.

Figure 10: Goat's hair polishing brush (Ultradent) with composite polishing paste bringing the composite resin to a highly polished surface.

Figure 11: Completed restorations smile view (N'Durance Dimer Nano-hybrid, Septodont)

Intermediate finishing of the facial surface was accomplished with a cup-shaped, rubber finisher, e.g, Astropol, Ivoclar-Vivadent; Jazz, SS White Burs, and Enhance, Dentsply-Caulk. For this case, a cup shape (Enhance) affords access to the gingival facial margin and contours to the facial surface.(Figure 8) If lobular facial form is desired in the restoration, this can be accomplished once the facial surface has been smoothed by using a disk-shaped rubberized abrasive. The lingual surface was finished with an egg-shaped finishing bur (SS White Burs)(Figure 9). The surface was then smoothed with a flame shaped point (Jazz, SS White Burs). Occlusion was checked before the final polish was completed.

The final polish was accomplished with a composite resin polishing paste (Sparkle, Pulpdent) using a goat's hair polishing wheel (Jiffy® Goat Brush, Ultradent) (Figure 10). Foam cups (Luminescence™, Premier Dental Products and Enhance foam cups, Dentsply-Caulk) can also be used effectively with composite resin polishing pastes. Another technique for attaining a smooth, high luster is using the finest grit aluminum oxide disk available or the finest grit of rubber polishing point. Running the finest abrasive disk or rubber point above 18,000 RPM creates a highly lustrous surface. This is due to both the polishing effect of the disk and the fact that the disk heats the resin surface, creating a glassy appearance. Interproxmal areas can be further polished with small width gapped fine abrasive finishing strips or composite resin polishing paste on a Lamineer plastic polishing tip (Dentatus) with the reciprocating handpiece. The patient was pleased with the final result. (Figure 11)

DISCUSSION:

The clinical success of finishing and polishing techniques can best be seen during the recall appointments of patient's restorations. While the current generation of composite resins is highly polishable, this may not hold true for all cases. The highly polished surface of resin-rich microfills are still prone to staining[(38)]. The potential staining of composite resin surfaces is directly related to a patient's oral habits including a patient's diet (coffee, iced tea, wine and other alcoholic beverages, cola beverages, tea), as well as other habits (smoking, chew tobacco, and the use of alcohol-containing mouth rinses). The staining due to coffee, tea and smoking arises from the deposition of stain from the offending agent. Alcoholic beverages and high percentage alcohol-containing mouth rinses cause composite staining by softening the resin matrix of the composite resin.[(39-42)] This softened polymer matrix allows the patient to abrade away the matrix leaving exposed filler particles and a slightly roughened composite resin surface susceptible to staining. It has also been demonstrated that acidulated fluorides can have an etching effect on glass filler particles leaving composites rougher as well.[(43, 44)]

Oral maintenance of restorations and oral health can also have an impact on the appearance of composite resins. As stated earlier, high concentration alcohol mouth rinses can soften the resin matrix, leaving the composite susceptible to toothbrush with toothpaste abrasion. Even without alcohol mouthrinses, toothpastes can affect composite smoothness.[(3-5)] For patients with significant staining, some hygienists use air powder abrasive instruments to remove stain. The sodium bicarbonate abrasive powder used to remove tooth stains can significantly roughen composite resin restorations.[(45)] Care must be taken when using these devices.

The gloss of the composite resin contributes to the overall aesthetic appearance of the restoration. It is possible that even following all the recommendations for finishing and polishing composite resins to their highest luster, that outside influences can have deleterious effects on the smooth composite surface. Because of these potential adverse effects, composite resin restorations need to be reassessed for repolishing at every recall. The dental hygienist needs to be aware of potentially damaging effects of the pastes and stain removal devices they use. Also, the dental hygienist should be instructed with techniques for repolishing composite resin restorations using fine abrasive aluminum oxide composite resin polishing pastes and disks.

CONCLUSION:

During the last several years, more polishable nanofilled composite resins have become available with the physical properties of hybrid composite resins. With these new composites have come new polishing systems to include rubberized abrasives. Many of the instruments previously used to finish composite resins are still very useful with the newer composites. In order to attain the optimal finish for composite resins, it is important to follow manufacturer's recommendations. Using a systematic technique from finishing burs and diamonds, abrasive disks, rubberized abrasives and composite resin polishing paste, you should be able to impart an enamel-like luster to your composite resins. Care must be taken to reevaluate these restorations at

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TEST QUESTIONS

1. Usually the photoinitiator used for light-cured composites is
a. silane
b. glass fillers
c. camphoroquinone
d. Bis-GMA

2. Microfilled composites offer high polishability with tooth-like translucency, but unfortunately are radiolucent. The high polishability and the ability to maintain their luster of microfilled composites is due to the use of colloidal silica particles that can be within the polymer matrix (homogenous microfill) or mixed with the polymer matrix, light cured, and crushed to make a prepolymer filler that is loaded as an organic filler within the microfilled composite (heterogenous microfill). The filler particle size of the colloidal silica particles is
a. 0.04 micrometers
b. 0.4-0.9 micrometers
c. 1-3 micrometers
d. 5-15 micrometers

3. A new class of nanofilled composite resins offer the clinician a combination of improved physical properties and
a. better flow to adapt to margins
b. higher polishability
c. expanded shades for improved shade selection and the ability to match incisal, enamel and dentin shades.
d. b and c

4. Nanofilled composites have filler particles with a diameter ranging from
a. 0.005-0.1 micrometers
b. 0.5-5 micrometers
c. 5-10 micrometers
b. 20-50 micrometers

5. All the following are nanofilled composite resins EXCEPT:
a. IPS Empress Direct
b. Esthet-X HD
c. N'Durance
d. Smoothy

6. The restoration's ability to imitate in appearance the tooth and/or adjacent teeth will be based upon the proper use of abrasives to finish and polish the restorative to its highest luster. Research has shown that the technique for polishing composite resin to its optimal smoothness and gloss is product specific and composite resin specific.
a. Both statements are true
b. The first statement is true, the second statement is false
c. Both statements are false
d. The first statement is false, the second statement is true

7. All the following are instruments or devices to finish and polish composite resins EXCEPT:
a. coated abrasives, e.g, abrasive finishing disks and strips
b. ultrasonic scaling tips
c. carbide finishing burs
d. submicron diamond abrasives

8. Gross finishing and contouring can easily be accomplished with
a. finishing burs
b. submicron finishing diamonds
c. coarse and medium grit disks
d. all the above

9. There are times when placing an anterior composite resin that an excess at the gingival interproximal margin needs to be removed. This excess can be removed using
a. a Profin reciprocating handpiece with a Lamineer tip abrasive tip
b. a finishing disk
c. #12 scalpel blade
d. a and c

10. Finishing of interproximal surfaces as described in this article include all the following EXCEPT:
a. gapped finishing and polishing strips covered with aluminum oxide abrasive particles
b. metal strips with submicron diamonds
c. dental floss with zirconia abrasive

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11. Occasionally, when placing interproximal restorations with composite resins, the adjacent teeth may bond together. A technique described in the article to separate the teeth using an intraoral
a. jackhammer
b. router
c. saw
d. hammer

12. To achieve the highest luster for a composite resin, one method for the final step of polishing would be a
a. finishing bur
b. submicron finishing diamond
c. composite resin polishing paste
d. air abrasion

13. Final polish of the composite resin surface to its most lustrous finish can accomplished using disks with the finest aluminum oxide abrasive. Using a disk will not only smooth the resin surface, but it also heats the surface creating a high luster. This heating of the surface causes the polymer matrix to reach its_____.
This phenomenon gives the composite resin a glassy appearance.
a. waxed smoothness
b. glass transition temperature
c. filler mosaic polish
d. polymer matrix interstitial flexure

14. The patient treated with direct aesthetic bonding in this article had tooth discoloration due to
a. tetracycline staining
b. demineralization due to bacterial plaque retained by orthodontic brackets
c. endodontic staining
d. hypoplastic white spots

15. The choice of composite resin to restore the anterior teeth for the patient in the case report is a low shrinkage composite with a high degree of double bond conversion that has a unique composite chemistry based upon
a. dimer acid monomers
b. glyomoners
c. resinomers
d. pleobisphenol dimethacrylate

16. The addition of optimized nanofillers of what type make N'Durance composite resin easy to distinguish in radiographs and provide for wear resistance.
a. Ytterbium fluoride
b. barium glass
c. silica
d. all the above

17. The potential staining of composite resin surfaces is directly related to a patient's oral habits including a patient's diet (coffee, iced tea, wine and other alcoholic beverages, cola beverages, tea), as well as other habits (smoking, chew tobacco, and the use of alcohol containing mouth rinses). The staining due to coffee, tea and smoking arises from the deposition of stain from the offending agent.
a. Both statements are true
b. The first statement is true, the second statement is false
c. Both statements are false
d. The first statement is false, the second statement is true

18. Alcoholic beverages and high content alcohol-containing mouthrinses can make a composite resin susceptible to staining because they
a. cause loss of filler particles through chemical dissolution
b. soften the polymer matrix of the composite resin making them more susceptible to wear and surface roughening
c. cause microfractures in the composite resin surface
d. cause a change in chemical polarity of the composite surface making it more susceptible to attract stain

19. During dental prophylaxis appointments, the dental hygienist can roughen composite resin surfaces making them susceptible to staining by
a. using prophylaxis pastes with a prophylaxis cup
b. using an air-powder (sodium bicarbonate abrasive particle) abrasion to remove surface stains
c. using an acidulated fluoride that can etch glass filler particles
d. all the above

20. The dental hygienist can help maintain the luster and polish of composite resins by
a. polishing the surface with prophylaxis pastes.
b. polishing the composite restorations with fine abrasive aluminum oxide composite resin pastes and disks.
c. cleaning the composites with diamond air abrasion

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ANSWER KEY

1. Ⓐ Ⓑ Ⓒ Ⓓ
2. Ⓐ Ⓑ Ⓒ Ⓓ
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