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Cements To Meet The Challenges Of Today's Restorative Materials

Howard E. Strassler, D.M.D., F.A.D.M., F.A.G.D.
Professor and Director of Operative Dentistry
Department of Endodontics, Prosthodontics, and Operative Dentistry
University of Maryland Dental School

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- Describe the management of a crown or bridge that needs to be recemented.
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CUT ALONG DOTTED LINE

e number of choices for laboratory-fabricated restorations has increased signi cantly over the past decade. When choosing laboratory-fabricated restorations, the clinician is faced with a broad choice of options. Clinicians can choose from cast metals, ceramics, metal-ceramic, and CAD-CAM based restorative materials when planning treatment for:

- the replacement of missing teeth with xed or removable partial dentures or implants;
- full-coverage crowns;
- partial-coverage inlays and onlays;
- or restoring the endodontically treated tooth cast post and cores, and prefabricated posts.

When treatment planning, the durability of these de nitive restorations incorporated many factors, including the choice and clinical technique for use of a de nitive cement for nal cementation. Cementation or luting of restorations is an extremely critical phase in the placement of laboratory-fabricated restorations. Before cementation, the tooth must be clean and dried to a level compatible with the cement being used. ere is a variety of adhesive cements that require di erent surface treatments, so it is critical the clinician and chairside assistant understand the requirements and steps required to optimize clinical success with any given cement.


Fig. 1A


Fig. 1B


Fig. 1C

Fig. 1A Preoperative view of the maxillary incisors before crown preparations. **Fig. 1B** Preparations for porcelain-metal crowns. **Fig. 1C** Porcelain metal crowns cemented with resin modi ed glass ionomer cement (FujiCem, GC America)

In the past (and still), the term "permanent" cement has been the catch phrase when describing the use of cement for nal, de nitive cementation of indirect laboratory-fabricated restorations. Unfortunately, the "permanent," as it relates to restorative procedures, is inaccurate and gives our patients a false sense of security and expectation. According the leading textbook on xed prosthodontics, the future trend when describing a cementation in restorative dentistry should focus on the placement cementation so the restoration cannot be removed at a later time. A more proper description of cementation should be "de nitive cementation."[1]

In recent years, with the increase in choices of ceramic restoration types, there has been a shi in the types of cements being used. e most commonly used cements – glass ionomer and adhesive resin – are adhesive to the dentin for full-coverage restorations, and to the enamel and dentin for partial-coverage restorations and porcelain veneers. ese same cements can be used successfully in the cementation of:

- cast metal post and cores;
- ceramic post and cores;
- prefabricated metal posts;
- and resin- ber reinforced posts.

ere is no doubt dental cements are a critical link in the placement of many types of restorations. e treatment procedures for laboratory-fabricated restorations are generally two for most patient treatment visits, with a series of treatment decisions to achieve the nal restoration. In fact, during the treatment of the restorations, a clinician will spend signi cant time with:

- tooth preparation (or implant placement);
- so tissue management;
- making an impression;
- fabrication of provisional restorations;
- for esthetic restorations, the selection of tooth shade;
- and, at a subsequent appointment, try-in and adjustment of the restoration and cementation.

In some cases, the planning of these restorations might involve a diagnostic wax-up to preview and plan the case. ere also may be a requirement of more involved occlusal therapies during the provisional restoration phase. In the course of treatment, cementation of the restoration would be less than 5% of the overall time spent on all the clinical steps.

Even more surprising is that in evaluating the costs for these restorations, whether they be a single crown, inlay/onlay, a more involved multiunit xed partial denture, multiple or restorations for numerous teeth for esthetic reasons (the large porcelain veneer case), the practitioner may be using an adhesive cementation system that has a cost of less than $20. Or, for a single unit, it carries a cost of less than $2. Yet the durability of the restoration is dependent on this cementing agent.

Choosing the wrong cement for the restorative material being cemented or performing a poor technique during cementation of the restoration can lead to pre-

Fig. 2A Maxillary central incisors with cast post and cores. **Fig. 2B** All-ceramic crown with a dense sintered aluminum oxide core (Procera All-Ceram, Nobel Biocare) crowns cemented with resin modi□ed glass ionomer cement (FujiCem, GC America).

mature failure of these costly restorations. at results in costs to the practitioner in laboratory fees and costs to the patient for the restoration. In some cases, it could also be costly to the practitioner's reputation and perception of successes or lack of success with certain procedures.

is article will provide an overview for contemporary cement selection when placing restorations for tooth preparations that meet the challenge of the current restorative materials being used.

While the selection of the type of cement is important, there are other factors as important for clinical success. Although we would like to believe all restorations returned from the laboratory have a "perfect" t, this is generally not the case. During the laboratory phase of fabrication of cast and ceramic restorations, there are steps that can lead to marginal discrepancies and gaps between the restoration and tooth preparation. Today's contemporary cements provide for excellent marginal integrity to compensate for some marginal discrepancies between the restorative material and tooth preparation.[2, 3, 4, 5] Another inherent aspect of retention of a restoration is the taper of the tooth preparation with di erent cements.[6] In a study by Zidan and Ferguson, the retentive values of the adhesive resin cements for a tooth preparation with a 24-degree taper were 20% higher than the retentive values of the conventional cements (zinc phosphate and conventional glass ionomer) for a tooth preparation at a six-degree taper. e use of resin luting agents yielded retention values that were double the values of zinc phosphate or conventional glass ionomer cement.

One signi cant issue a er cementation is the presence of postoperative sensitivity. It has been reported that conventional glass ionomer cements have higher rates of postoperative sensitivity than other cements.[8] It has also been reported that when following a manufacturer's recommendation, there is little association of postoperative sensitivity between zinc phosphate cement or glass ionomer cement.[9-11]

ere have been recommendations made to decrease the likelihood of postoperative sensitivity a er cementation. at calls for the clinician, during the cementation appointment, to avoid dessication of the dentin surface of the preparation before cementation.[12] Other studies have described the use of desensitizing agents and dentin sealers as part of the cementation process.[13-17]

ere has been concern that certain desensitizing

TABLE 1: RESTORATIVE APPLICATIONS FOR CONTEMPORARY CEMENTS

TYPE OF CEMENT	APPLICATIONS
Conventional glass ionomer	all-metal crowns, □xed partial dentures, porcelain-metal crowns, □xed partial dentures, zirconia substructure (core) all-ceramic metal posts, cast metal inlay/onlay implant-supported crowns, □xed partial dentures
Resin-modi□ed glass ionomer	all-metal crowns and □xed partial dentures, porcelain-metal crowns and □xed partial dentures, zirconia substructure (core) all-ceramic metal posts, cast metal inlay/onlay implant supported crowns, □xed partial dentures
Etch-and-rinse composite resin	all-metal crowns and □xed partial dentures, porcelain metal crowns and □xed partial dentures, zirconia substructure (core) all-ceramic metal posts, cast metal inlay/onlay, implant-supported crowns, □xed partial dentures, □ber posts, porcelain veneers (light cure only), all-ceramic inlay/onlay/crown, composite inlay/onlay/crown, Maryland bridge
Self-etch self-adhesive composite resin	all-metal crowns and □xed partial dentures, porcelain metal crowns and □xed partial dentures, zirconia substructure (core) all-ceramic metal posts, cast metal inlay/onlay implant-supported crowns, □xed partial dentures, □ber posts, porcelain veneers (light cure only), all-ceramic inlay/onlay/crown, composite inlay/onlay/crown, Maryland bridge

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techniques can have a negative impact on the adhesion of di erent cements. e use of a 5% glutaraldehyde sealer[15, 16] or a resin desensitizer/sealer[14, 16, 17] were not detrimental to multistep etch-and-rinse adhesive resin cements or glass ionomer cements. Oxalate desensitizers, however, are incompatible with glass ionomer luting agents.[18]

FACTORS TO BE CONSIDERED WHEN SELECTING A CEMENT

It would be ideal if there was one cement for all clinical situations. One would need a cement that would be easily mixed and go through its setting reaction either quickly for a single crown or inlay/onlay, or could be adjusted to set slower for multiunit, more involved cementation cases. Unfortunately, this "holy grail" of cements is not available. However, there are factors and properties that can be de ned when choosing the best cement for a given situation. Evaluation of a true, all-purpose cement has included quantifying speci c physical properties and handling characteristics.[19-21]

e ideal properties of all-purpose cement include:

- low viscosity for easy seating;
- easy to mix;
- extended working time;
- short setting time;
- lm thickness compatible with complete seating of a restoration;
- insolubility in the mouth;
- high shear strength;
- high tensile strength;
- high compressive strength;
- bondable to the tooth and restoration speci c for the restorative material of the restoration;
- biocompatible with pulp and so tissue (no post-operative sensitivity)
- translucent;
- radiopaque;
- and easy, post-cementation cleanup;

Researchers have evaluated the properties of the variety of cements available in dentistry to try and nd that elusive ideal cement. Currently, within the variety of cements available, that universal cement does not yet exist. However, the manufacturers have been getting closer to providing the practitioner with an all-purpose cementation system.

DENTAL CEMENTS

De nitive cementation cements are classi ed according to chemistry.[19] Water-based cements usually undergo an acid-base setting reaction. In some cases, a slight amount of resin is added to improve workability. Among cements in this class are: zinc phosphate, zinc polycarboxylate, and resin-modi ed (resin-reinforced) glass ionomer cements.

e fastest growing category of de nitive cements is resin-based cements.[22] Resin-based cements include: composite resin cements that are self-adhesive or require an additional bonding adhesive before the cement is placed; and compomer cements. Table 1 lists the clinical indications for each class of cement. is article will focus on the contemporary cements – glass ionomer cements and adhesive composite resin cements.

Each of these categories of cements present challenges for the practitioner in cement manipulation. Within each class, the cements have physical properties allowing for a consistency similar to cementation, and a lm thickness allowing for complete seating of a restoration during cementation. It should be noted there is variability in the handling characteristics of each class of cement and even di erences within the same class of cement.

A recent survey regarding the usage of de nitive xed prosthodontic cements indicated:

- conventional glass ionomers were used 24% of the time;
- resin-modi ed glass ionomers 46% of the time;
- composite resin cements 8% of the time;
- zinc phosphate cement 10% of the time;
- and zinc polycarboxylate 12% of the time.[23]

Fig. 3 Using an automixing tip to place a composite resin cement into a Procera crown. **Fig. 4** Sand blasting the internal surface of a porcelain metal crown.

CUT ALONG DOTTED LINE

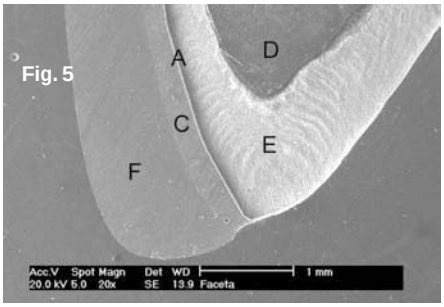

Fig. 5 Interfaces of resin cementation for a porcelain veneer (F = facial-etched porcelain veneer; C = light-cured composite resin cement, RelyX Veneer Cement, 3M-ESPE; A = resin adhesive, Single Bond, 3M-ESPE; E = etched enamel) (SEM courtesy of Luis Sensi, DDS, MS, PhD). **Fig. 6A** Preparations for porcelain veneers and all-ceramic crowns. **Fig. 6B** Porcelain veneers (LUMINEERS, Den-Mat) and all-ceramic porcelain (Cerinate Pressed Porcelain) crowns cemented with light cure veneer cement (Ultra-Bond Plus, Den-Mat).

In most cases, the clinician should not assume cements within the same class are mixed and manipulated the same. It is critical for the dentist and chairside assistant to read the instructions as it relates to dispensing and mixing the material before it is used for cementing the restoration.[1, 18, 23]

GLASS IONOMER CEMENT

Glass ionomer cements are classi ed as either a conventional glass ionomer cements which are water-based without any resin or a resin-modi ed glass ionomer that have approximately 10% resin added to the formula to improve physical properties. Both are adhesive to enamel and dentin via ionic bonding of the glass ionomer to the calcium and phosphate ions of the tooth. It usually takes 24 hours for the nal adhesive values to be attained. Besides being self-adhesive through chemical bonding to the tooth structure, glass ionomers have the additional bene t of leaching uoride to the adjacent tooth structure. at provides protection against recurrent caries. Both types of glass ionomer cements have low solubility.

Conventional glass ionomers are provided as a powder and liquid that can either be hand dispensed for mixing on a mixing pad with a cement spatula, or it can be used in a preloaded capsule that is mixed on a mechanical mixer (amalgamator, triturator). e capsule also has a dispensing tip. e cement is syringed using an applicator gun onto the restoration and preparation. e applicator guns are usually manufacturer speci c. When using a conventional glass ionomer cement, the excess cement at the margins should be protected from moisture and drying using a coating agent or an un lled bonding resin. It is advisable not to clear away excess cement until it is fully set.

RESIN-MODIFIED GLASS IONOMER

Resin-modi ed glass ionomer (also called resin-reinforced and hybrid ionomer) is supplied as a powder liquid, paste-paste, or a unit-dose mixing capsule with a dispensing tip. It is easier to mix than the conventional powder-liquid glass ionomer. It also has improved physical properties, while retaining the properties of self-adhesion and uoride release. Some of the resin-modi ed glass ionomer cements provide a dentin conditioner to improve adhesive bonding. Also, you can clear away excess resin-modi ed glass ionomer cement when it reaches the gel stage or a er complete setting. Resin-modi ed glass ionomer cements are less vulnerable to early moisture.

e primary clinical indications for use of either type of glass ionomer cement are:

- all-metal and porcelain-metal restorations (Fig. 1);
- alumina or zirconia core types of all-ceramic restorations (Fig. 2);
- implant-supported crowns and xed partial dentures;
- and metal posts.

is is my primary cement when performing all-metal and porcelain-metal restorations. It is important the tooth is not overly dessicated and dried when using this class of cement. I usually wet the dentin using a microapplicator or a damp cotton pellet so the dentin is slightly glossy with no water pooling of the surface. Also, when glass ionomer cements were rst introduced, there was concern for postoperative sensitivity a er cementation.[7] Other studies have demonstrated that this is not a problem.[8-10]

COMPOSITE RESIN CEMENTS

In recent years, this category has grown signi cantly. Within this class of resin-based luting agents are: adhesive composite resin cements that require a separate adhesive application, and self-adhesive composite resin cements. For the purpose of easier understanding, these categories will be described separately.

In most cases, the indications for these cements are

TABLE 2 PARTIAL LISTING OF CONTEMPORARY CEMENTS

Conventional glass ionomer	Manufacturer
Ketac-cem	3M-ESPE
Fuji I	GC America
Aqua Meron	VOCO
Meron AC	VOCO
Riva Luting	SDI
GlassLute	Pulpdent
CX-Plus	Shofu

Resin-modified glass ionomer	Manufacturer
RelyX Luting Plus	3M-ESPE
RelyX Luting	3M-ESPE
Fuji Plus	GC America
FujiCem	GC America

Etch-and-rinse resin cement (can be dual cure or self cure)	Manufacturer
Infinity	Den-Mat
Resilute	Pulpent
RelyX Arc	3M-ESPE
C & B MetaBond	Parkell
Calibra	Dentsply
Comspan	Dentsply
TwinLook	Heraeus Kulzer
Nexus 2	Kerr Sybron
Nexus 3	Kerr Sybron
Cement-It	Pentron
Lute-It	Pentron
C&B Cement	Bisco
DuoLink	Bisco
Illusion	Bisco
Clearfil Esthetic and DC Bond	Kuraray
Panavia F 2.0	Kuraray
Variolink 2	Ivoclar
Dual Cement	Ivoclar
ParaCem	Coltene Whaledent
Duo Cement Plus	Coltene Whaledent
PermaFlo DC	Ultradent

Self-etch self-adhesive resin cement	Manufacturer
iCem	Heraeus
SmartCem2	Denstply Caulk
MultiLink	Ivoclar
RelyX Unicem	3M-ESPE
MonoCem	Shofu
MaxCem	Kerr
MaxCem Elite	Kerr
Embrace	Pulpdent
Breeze	Pentron
BisCem	Bisco
G-Cem	GC America

Veneer cements	Manufacturer
Choice 2	Bisco
Illusion	Bisco
Calibra	Dentsply/Caulk
Variolink veneer	Ivoclar
RelyX veneer	3M-ESPE
UltraBond Plus	Den-Mat
NX 3 (Nexus 3)	Kerr Sybron
Clearfil Esthetic Cement	Kuraray

the same, while the ease of application is different. Adhesive resin cements typically use an etch-and-rinse bonding adhesive. Self-adhesive resin cements, however, eliminate the need for separate phosphoric acid etching and application of a separate resin adhesive to tooth structure before cementation. Also, there is a variety of initiators and packaging that is used to promote the resin polymerization. Composite resin cements are supplied as powder-liquid and paste-paste hand mixing, double-barreled syringe with automixing tips (Fig. 3), and unit-dose dispensing and mixing.

All cements in this category are relatively insoluble compared to other dental cements. They have the highest mechanical physical properties including:

- high compressive strength;
- high flexural strength;
- good fracture toughness;
- low coefficient of thermal expansion and contraction;
- and the highest stiffness of any dental cement.[1, 18, 23]

These cements are based upon the chemistry of direct placement restorative composite resins and are resistant to wear and abrasion.

This class of cement has a more toothlike translucency. In some cases, they are also available in tooth shades to best match the adjacent tooth. Also, adhesion of this class of cement to tooth structure, to etched porcelain, and to sandblasted metal, (Fig. 4) has been demonstrated.[24-27] The interface and bond between etched porcelain and composite resin, when the porcelain has been treated with a ceramic primer (silane), has been described as strengthening the porcelain. It also eliminates the propagation of microcracks and fractures between the porcelain, composite resin, and enamel.(Fig. 5)[28, 29] In terms of handling, composite resin cements:

- have an easy flow;
- spread easily over the surface being cemented;
- are not tacky;
- are polishable;
- and have a chameleon effect with the surrounding tooth structure.

ETCH-AND-RINSE (TOTAL ETCH) ADHESIVE RESIN

The resin cements in this category require a tooth etching with phosphoric acid, combined with the application of a separate resin bonding agent. When bonding to dentin, these cements use adhesive as the bonding interface with the composite cement. The cements can be classified as self-cure (autopolymerizing), dual cure (light and self-cure), and light cure. Self-cure and dual-cure composite resin cements can be used for all cementation applications. Light-cure resin cements, however, should be limited to porce-

CUT ALONG DOTTED LINE

Fig. 7 Cementation of porcelain-metal crown with self-adhesive resin cement (SmartCem 2, Dentsply Caulk) using a Pro□n reciprocating handpiece (Dentatus) with a wooden insert, PDS/MJ2 tip fully seating crown with mechanical force. **Fig. 8** Applying an active force when cementing with contemporary cements and porcelain metal restorations by having the patient bite down on a saliva ejector.

lain veneers and pressable ceramic crowns that allow the curing light to penetrate the porcelain. at's needed to allow photopolymerization of the cement under the translucent veneer or crown. (Fig. 6)

e di erences in the polymerization mechanism are based on the chemical type of initiator. Self-cure composite resin cements use a peroxide amine initiator accelerator. Dual-cure composite resin cements use a combination of amine and photoinitiator. Light-cure resin cements use a photoinitiator only. Self-cure composite resin cements can be used for cementation of all types of indirect restorations. However, due to potential problems with color stability, it is recommended that translucent all-ceramic restorations, all-ceramic crowns, and veneers be placed with light-cure composite cements.[30-32] When using light-cured-only composite resin cements with all-ceramic veneers or crowns, the light curing time should be increased when polymerizing through porcelain thicknesses of 0.5-2.0 mm.[19]

ere has been concern that self-cure and dual-cure composites are chemically incompatible with light-cure only adhesives.[33-38] Currently, changes in the chemistry of di erent systems and the addition of self-cure activators to h-generation adhesives (etch-and-rinse, single-bottle adhesives, e.g., Prime and Bond NT, Dentsply Caulk; Optibond Solo Plus, Kerr) appear to solve this problem. At the current time, it is up to every practitioner to read the instruction sheet to guide them on the use of the resin cement and adhesive supplied with the cement.

ere is not one statement of agreement on the use of self-cure and dual-cure resin cements, and etch-and-rinse and self-etch adhesives. When using a dual-cure resin cement, the light-curing capability o ers the additional bene t of an easy cleanup. e excess resin cement is easily removed from the marginal areas a er light curing. In all cases with any etch-and-rinse adhesive resin cement, care must be taken to inspect and remove excess resin cement. Unlike more traditional cements where the excess can be easily removed with a scaler or curet, a rotary diamond or nishing bur is occasionally necessary to remove set resin cement.

SELF-ADHESIVE RESIN CEMENTS

Self-adhesive resin cements are approaching the requirements of a true, all-purpose cement. I would not advise using them with translucent ceramic restorations (pressed ceramic crowns and porcelain veneers) where a color change in the cement could a ect the color of the restoration and there is the need for a separate ceramic primer and adhesive to reinforce the porcelain. However, it can be used for all other applications with:

- zirconia and alumina core ceramics;
- cast metal;
- porcelain-metal (Fig. 7);
- cementation of cast post and cores;
- and prefabricated posts.

ese cements are dual cure and have an easy cleanup at a gel phase.

Many of the cements in this category are available in dual-tube automixing con gurations. Or, in some cases (G-Cem, GC America and Unicem, 3M-ESPE) they are in preloaded capsules that are mixed on a high-speed mixer (triturator). ese cements are especially useful in cementation of ber posts. Unicem (3M-ESPE, St. Paul, MN) provides a special tip for delivering the cement into the root canal for postcementation. Other cements can be placed into root canals for postcementation easily with needle tip-like delivery through Ji y Tubes or Accudose Needle Tubes (Centrix, Shelton, CT). is type of needle delivery has been shown to be more e ective at lling the root canal than a lentulo spiral.[41] Even though these cements are self-adhesive using the mechanisms of the self-etch class of adhesives, e.g., Unicem (3M-ESPE), G-Cem, (GC America), BisCem (Bisco)[39, 40] some cements require a separate primer on the tooth surface before using the cement (MultiLink, Ivoclar).[42] Before using a self-adhesive cement, one should be familiar with the steps required.

CLINICAL TECHNIQUE RECOMMENDATIONS FOR RESIN CEMENTS

Resin cements have been well researched for their physical properties.[5, 42-44] Resin cements bond well to abraded base metal.[27, 45] Research has shown that resin-based cements and also resin-modi ed glass ionomers are thixotropic, meaning that, as viscous liquids, there is a shear thinning of the uid phase of the cement, which takes a nite amount of time to reach an equilibrium.

ese di erent physical characteristics and properties of

these cements in uence the seating of crowns during cementation.[46-48]

Using force allows the cement to ow when seating the restoration completely on the tooth preparation. In fact, sustained seating pressure during luting procedures – up to three minutes – increased bond strength and improved marginal integrity of the interfacial margins.[50] One clinical technique I use to assure complete seating of the restoration (not for ceramic inlay/onlays or pressed ceramic crowns) is to have the patient bite down on a saliva ejector. (Fig. 8)[51] e hydraulic forces needed to completely seat a crown, metal inlay/onlay, CAD-CAM-fabricated ceramic inlay/onlay using a resin-based cement or resin-modi ed glass ionomer require the use of a mechanical advantage.

CONCLUSION

With an increase in the options for materials used for indirect restorations, the choice of which cement to use has become more di cult and confusing for the clinician. Although there is not one cement that ful lls all the needs for all cementation, understanding the di erences between each class of dental cement will contribute to clinical success of the restoration.

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CUT ALONG DOTTED LINE

SELF-TEST

1. All of the following restorations need to be cemented onto/into a tooth preparation EXCEPT:

a. cast metal crowns
b. all-ceramic crowns
c. cast post and cores
d. amalgam restorations

2. Before cementation of a restoration, the tooth must be cleaned and dried to a level compatible with the cement being used. Within the family of adhesive cements, there are different surface treatments and steps that will optimize clinical success with these cements.

a. both statements are true
b. both statements are false
c. first statement is true, the second statement is false
d. first statement is false, the second statement is true

3. While the term "permanent" has been used to describe cementation, in this article, this concept of cementation-placement should focus on cementing a restoration so it cannot be removed at a later time. This article uses the what term to describe this type of cementation:

a. provisional cementation
b. temporary cementation
c. definitive cementation
d. complete cementation

4. According to the study by Zidan and Ferguson, the retentive values of adhesive resin cements of a tooth preparation with a 24-degree taper were what percent higher compared to conventional cements (zinc phosphate and conventional glass ionomer) with a tooth preparation at 6-degree taper:

a. 5%
b. 105%
c. 20%
d. 40%

5. There have been reports of postoperative sensitivity after cementing with conventional glass ionomer cements. In this article, all of the following have been recommended to minimize postoperative sensitivity with glass ionomer cements EXCEPT:

a. avoiding dessication of the dentin surface before cementation
b. using a desensitizing sealer with a 5% glutaraldehyde
c. using of a resin desensitizer/sealer
d. leaving a thin film of provisional cement on the tooth preparation

6. What physical property would be desirable for an all-purpose cement?

a. very soluble in the mouth leading to wash out
b. low compressive strength
c. bondable to tooth and restoration specific for the restorative material of the restoration
d. low shear strength

7. What handling characteristic would be desirable for an all-purpose cement?

a. easy to mix
b. thick and viscous so the patient has to bite down hard to seat the restoration
c. very long setting time
d. very quick working time

8. A water-based cement that undergoes an acid-base setting reaction is:

a. composite resin
b. zinc phosphate
c. dimethacrylate
d. zinc oxide and eugenol

9. The chemistry of resin-based cements is based upon:

a. glass ionomer cement chemistry
b. composite resin chemistry
c. zinc polycarboxylate chemistry
d. zinc oxide and eugenol chemistry

10. Table 1 of this article lists indications for each class of different cements. According to this table, you can cement an all-metal cast crown with:

a. conventional glass ionomer cement
b. resin-modified glass ionomer
c. etch-and-rinse composite resin cement
d. self-etch self-adhesive composite resin
e. all of the above

SELF-TEST (cont'd.)

11. Table 1 of this article lists indications for each class of different cements. According to this table, you can cement porcelain veneers with:
a. conventional glass ionomer
b. resin-modified glass ionomer
c. etch-and-rinse composite resin (light cure)
d. self-etch self-adhesive composite resin
e. all of the above

12. Table 1 of this article lists indications for each class of different cements. According to this table, you can cement a metal post with:
a. conventional glass ionomer
b. resin-modified glass ionomer
c. etch-and-rinse composite resin
d. self-etch self-adhesive composite resin
e. all of the above

13. Table 1 of this article lists indications for each class of different cements. According to this table, you can cement an all-ceramic or composite resin inlay/onlay with:
a. conventional glass ionomer
b. resin-modified glass ionomer
c. etch-and-rinse composite resin
d. none of the above

14. According to a recent survey of usage of definitive fixed prosthodontic cements, resin modified glass ionomer cements were used what percent of the time:
a. 10%
b. 18%
c. 46%
d. 79%

15. Glass ionomer cements adhere to enamel and dentin by:
a. van der Waals bonding
b. ionic bonding
c. mechanical interlocking
d. hydrogen bonding

16. Glass ionomer cements offer the additional benefit of:
a. being extremely translucent
b. allowing for removal of the crown or bridge at a future time
c. leaching fluoride to the adjacent tooth structure which provides protection against recurrent caries
d. being white in color so cleanup is easy

17. The category of composite resin cements refers to what two major categories of resins as it relates to their adhesive properties?
a. adhesive etch-and-rinse and self-etch self-adhesive resins
b. bond-and-go and rinse-and-dry resins
c. light-cure and dark-cure resins
d. photopolymerizable and autocure polymerizable

18. One benefit resin cements have over other types of conventional cements when using them for cementing esthetic restorations is:
a. translucency and in some cases tooth shades
b. opacity
c. blue color for easy cleanup
d. yellow color to match dentin

19. All of the following are classes of etch-and-rinse (total etch composite resin cements EXCEPT:
a. self cure
b. dual cure
c. heat-and-pressure cure
d. light cure

20. Because of the thixotropic nature of resin-based cements and resin-modified glass ionomer cements, this article recommends sustained seating pressure be used for up to three minutes to increase the bond strength and marginal integrity of the restoration.
a. true
b. false

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