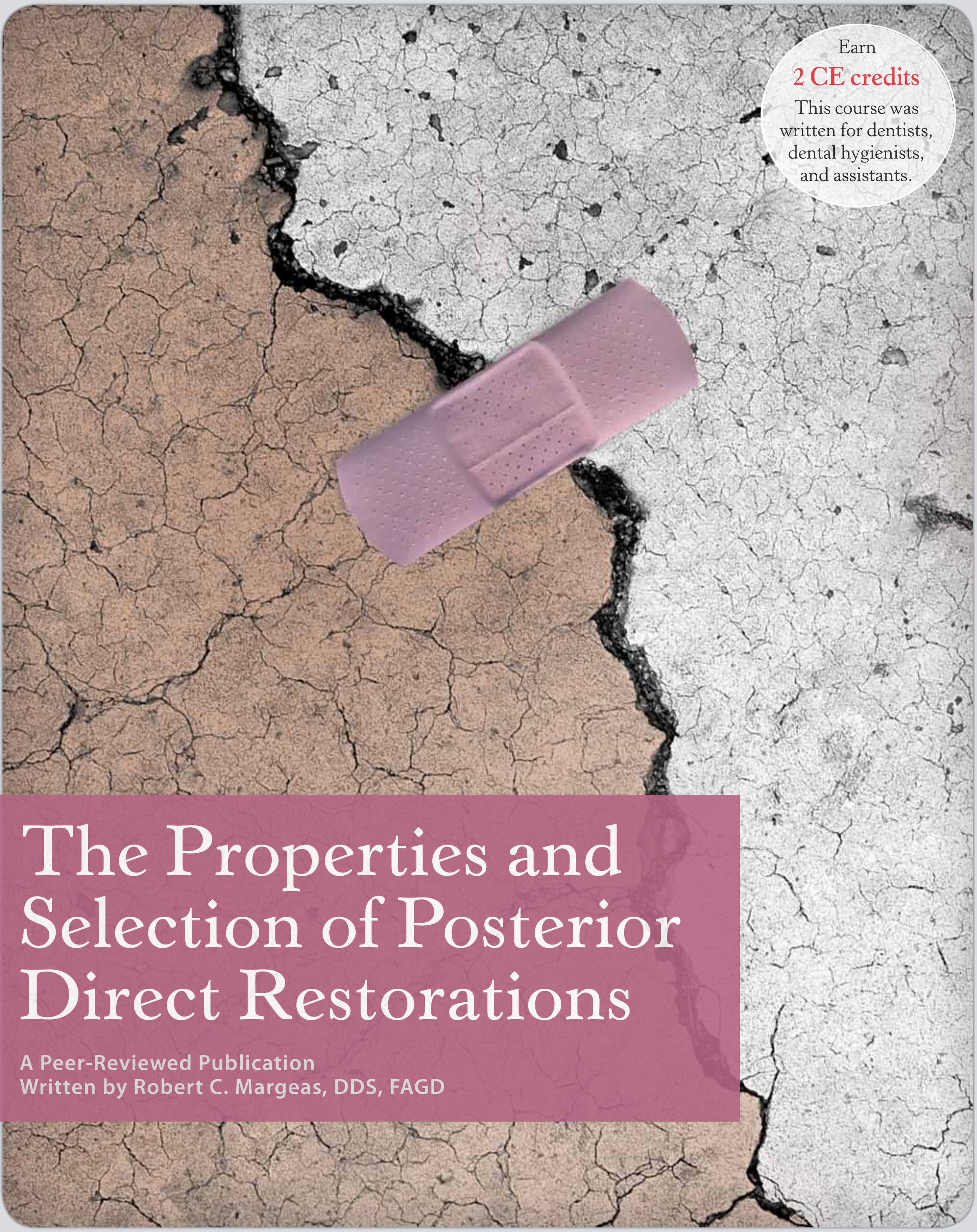

The Properties and Selection of Posterior Direct Restorations

A Peer-Reviewed Publication

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Go Green, Go Online to take your course

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Educational Objectives

Overall goal: The purpose of this article is to provide dental professionals with expanded information on direct posterior composites.

Upon completion of this course, the clinician will be able to do the following:

1. Describe the modes of failure, advantages and disadvantages of amalgam restorations.
2. Describe the modes of failure, advantages and disadvantages of composite restorations.
3. Describe the properties of an ideal restorative material.
4. Describe the types of composite materials and recent new materials and their application.

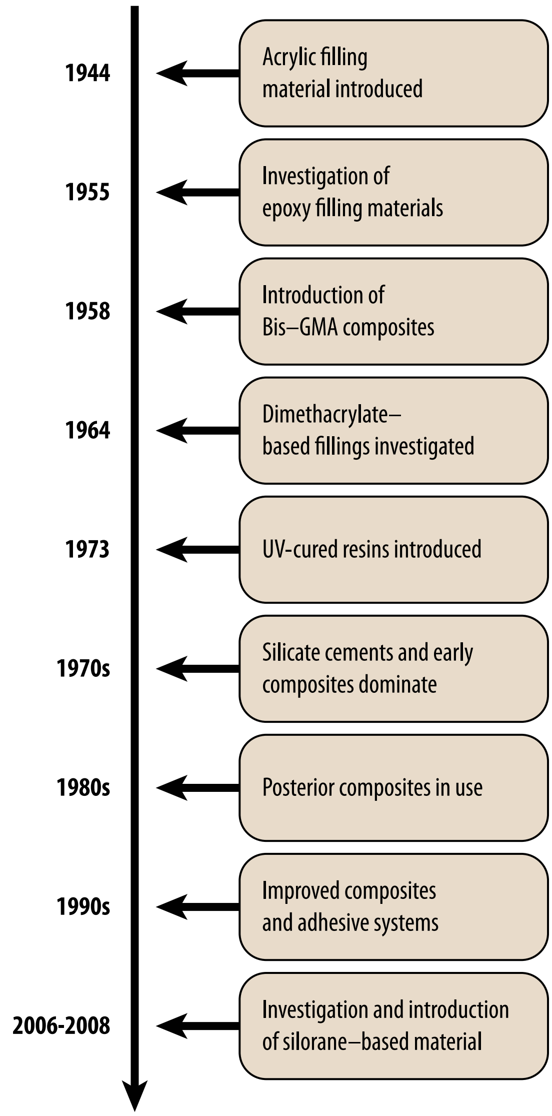
Abstract

Early tooth-colored restorative materials were weak and only suitable for anterior teeth. Over time, composites were developed that offered improved properties enabling their use in posterior teeth where subject to occlusal loading and forces of mastication. Secondary caries is the main reason for failure of both amalgam and composite restorations. Amalgam restorations offer ease-of-use but poor esthetics. In the case of composite restorations, minimizing polymerization shrinkage, wear and discoloration increase the longevity of these restorations. Posterior composite resins offer excellent esthetics, the main driver for patients who prefer composite fillings.

Introduction

Historically, posterior direct restorations involved the use of amalgam. The first modern tooth-colored restorations used acrylic, which was introduced more than six decades ago. Subsequently, silicates and (di)methacrylate materials were investigated. Silicate cements and early composite materials were suitable only for anterior restorations due to their weak physical properties, and the silicate cements needed to be placed in one movement – incremental placement was not an option. Silicate cements had a high failure rate. Old silicate restorations were assessed for longevity in a 1986 study and were found to have an estimated 66% replaced due to marginal discrepancies and lost fillings.[1] Early resin-based composite restorations were an improvement over silicate cements; however, they were self-curing and required mixing of a base and a catalyst for curing, resulting in operator error during mixing and difficulties in timely and accurate placement. In addition, strength, bonding and retention were poor. Light-cured dimethacrylate composite restorations were introduced in the 1970s.[2] By the 1980s, posterior tooth-colored restorations had been introduced, and these have continued to evolve to offer improved physical properties, user-friendliness and esthetics. Bonding systems and techniques have also evolved.

Figure 1. Introduction of tooth-colored restorations



The trend over the last decade has been placement of an increasing number of posterior composite restorations and a decreasing number of amalgams. By 1999, at least 39% of direct posterior restorations were composites, compared to at least 11% in 1990 (in both cases, for the purposes of trend analysis, conservatively making the assumption that all amalgam placements estimated in the ADA surveys were posterior restorations) (Table 1).[3]

Table 1. Trends in posterior composite placement

	1999 Number placed	% age of total	1990 Number placed	% age of total
Posterior composites	46,116,300	39.38%	13,130,200	11.68%
Amalgams	70,994,700	60.62%	99,256,900	88.32%

Clinician needs and patient demand for esthetic dentistry continue to drive these trends as well as development of products for restorations with improved physical properties and esthetics.

Ideal Restorative Material

The ideal posterior restorative material should exhibit a number of features (Table 2). It should be dimensionally stable, with no expansion or shrinkage either during placement or subsequent to placement, and without any wear following placement. It must also offer sufficient compressive and flexural strength – in the case of posterior Class I and II restorations, it must resist both occlusal forces and the forces of mastication. Neither the material nor the tooth should be subject to stress during loading of the material and/or tooth. Biocompatibility is important – the material should neither deteriorate intraorally nor result in any toxic, teratogenic or other iatrogenic effects. Ideally, the restorative material should offer antibacterial properties against oral bacteria, and preferably should be bactericidal. It should be user-friendly, offering an appropriate operating time and ease of placement. Finally, the material should also be esthetically pleasing to the patient and be color-stable and stain-resistant.

Table 2. Ideal Restorative Material Properties

Dimensionally stable	Cost-effective
Resistant to forces and stresses	Biocompatible
Wear-resistant	Bactericidal
Retentive and adhesive to the tooth	Esthetically pleasing
Requires minimal tooth preparation	Color-stable
Easily placed	Stain-resistant
Requires minimum time to restore	

The ideal restorative material does not exist, although material developments have significantly improved how closely products approach these parameters.

Direct Restoration Longevity

Annual failure rates for different materials have been examined in a number of studies. Some studies have found ranges of 0%-7% for amalgams, 0%-9% for direct composites and 1.4%-14.4% for glass ionomer cements in posterior stress-bearing restorations.[4] A separate, more recent study, involving only two dentists, found comparable failure rates for composites and amalgams assessed as a five-year survival rate.[5] Annual failure rates in a study conducted on restorations predominantly placed since 1990 were 3% for amalgams and 2.2% for direct composites, and it was also concluded that more recent studies demonstrated better results.[6] Failure rates in one study covering restoration placement during the decade up to 2001 found an annual failure rate of 1.1% for amalgams, 2.1% for composites and 7.7% for glass ionomer cements.[7] Reasons for the failure and replacement of restorations include secondary caries, fracture, wear, marginal defects and postoperative sensitivity.

The primary reason for the replacement of direct restorations has been found to be secondary caries irrespective of the restorative material.[8,9,10,11] While it has been found to be difficult to reliably diagnose secondary caries, and the condition is responsible for the majority of restoration replacements, the quality of the restoration and the patient's (preventive) home care are important factors in precluding further repeat replacements.[12] It was found in one study that 65% of direct and indirect (5% of total) restorations placed were replacement restorations, with secondary caries the most frequent reason given, regardless of material used.[13] The longevity of restorations depends on clinical technique, materials and patient care.

Figure 2. Marginal degradation of amalgam

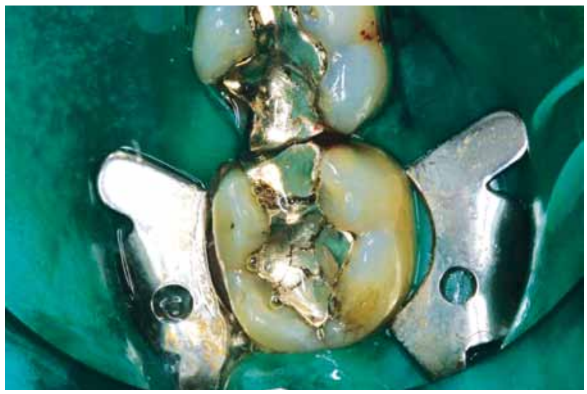


Figure 3. Secondary caries

Amalgam Restorations

Amalgam has been found to be a cost-effective restorative material and to offer good longevity in studies of up to a more than 20-year period.[14] Amalgam restorations are less technique-sensitive than composites, less sensitive to the presence of moisture and easier to place. They require less time to place than direct composites; an estimated 2.5 times more time is required for composite placement.[15] While improved materials and light-curing options may have reduced the time required for composites, more chairside time is still required than with amalgams. Amalgam is also bactericidal, which helps to reduce bacterial colonization and biofilm formation.[16,17]

Bulk fractures and marginal degradation have been found to be the main material factors in the replacement of amalgam restorations.[18] Bulk fracture rates have been found to be similar with or without bonding of amalgams in large restorations, although smaller restorations benefit from bonding.[19] Bonded amalgam restorations have been found to offer support of undermined enamel equal to that of composites, but inferior marginal adaptation.[20] Creep-fatigue may be a major factor in marginal fracture of amalgam restorations.[21] Amalgam restorations are subject to expansion, which can result in cuspal stress over time, depending upon the design of the preparation and/or the location of the initial lesion. Expansion of amalgam results from internal phase changes over time, that must be relieved to reduce stress – it is believed this occurs as a result of creep of the amalgam from the confines of the restoration and its subsequent extrusion. On the other hand, development of a reduced amalgam-tooth margin interface gap size over time and improved marginal seal may occur due to such creep.[22]

Amalgam restorations require more tooth preparation than composites, and careful disposal of the mercury-containing amalgam is mandatory. The poor esthetic results provided by amalgams are a major concern for patients, and amalgam staining of the tooth over time further compromises the appearance. Corrosion is also an issue. Poor esthetics with amalgam is the main reason why patients increasingly prefer the use of direct posterior composites as well as tooth-colored indirect restorative materials and techniques.

Table 3. Modes of failure, advantages and disadvantages of amalgams

Modes of Failure	
Secondary caries Bulk fracture	Marginal degradation Expansion and cuspal stress
Advantages	
Ease of use Cost-effective	Can be bonded Bactericidal
Disadvantages	
More tooth preparation Poor esthetics	Corrosion Mercury disposal

Composite Restorations

Material failures accounted for more replacements of composites than amalgams in a review of surveys of dentists across the United States, Scandinavia and the United Kingdom from the 1980s and 1990s. These failures included bulk fracture, marginal degradation, discoloration and loss of anatomic shape.[23] Nonetheless, the main reason for replacement is the same as for amalgam restorations – secondary caries. In addition, composite restorations have improved over time, and recent studies have shown longevity to more closely reach the longevity of amalgams (albeit over a shorter tested time span).

Table 4. Modes of failure, advantages and disadvantages of composites

Modes of Failure	
Secondary caries Bulk fracture Marginal degradation	Discoloration Loss of anatomic shape and wear
Advantages	
Less tooth preparation Effective bonding	Excellent esthetics No expansion over time
Disadvantages	
Technique-sensitive Increased chairside time	Polymerization shrinkage Increased bacterial adhesion

While amalgams expand over time, composite restorations are subject to polymerization shrinkage. This is regarded as the largest problem associated with composite use.[24] Polymerization shrinkage results in stresses that can lead to enamel cracks, marginal degradation and microleakage, and postoperative sensitivity. Other associated problems include potential debonding of the tooth-composite interface.[25] Polymerization shrinkage occurs due to the affiliation of the resin molecules with one another and the formation of chemical bonds that reduce the material's bulk. Shrinkage and occlusal loading of composites result in cuspal deflection, which results in enamel cracks and hypersensitivity. The amount of deflection has been found to be greater in larger restorations (MODs) than smaller ones (MOs).[26] The amount of shrinkage and resulting stresses also varies with the composite filling material used.[27,28] It is influenced by the material's flow, chemistry and curing dynamics, and the size and shape of the preparation. The intensity and duration of light curing have been found to affect polymerization shrinkage.[29] Shrinkage can be reduced by increasing the amount of filler in composite restorative materials, as well as by having pre-polymerized clusters in the material.[30] A recent study by Bouillaguet et al. found that cuspal deflection (tooth deformation) was statistically similar for conventional hybrid composites and flowable composites.[31]

Table 5. Potential effects of polymerization shrinkage

Enamel cracks
Marginal degradation
Microleakage
Postoperative sensitivity
Debonding of tooth-composite interface

Composite restorations generally offer poor antibacterial properties compared to amalgam. One in vitro study found a minimal antibacterial effect with composites that lasted only a few days. It was suggested that this might explain the greater biofilm growth seen on composites compared to amalgams.[32] A second study assessed the behavior of three different composites in the presence of three common oral bacteria (S. mutans, S. oralis and A. naeslundii) for up to 35 days and found that the bacteria colonized the composites in a matter of hours and formed deep biofilms. The study also found, using scanning electron microscopy, that the poly-acid modified composite demonstrated surface damage and roughness.[33] Fluoride-releasing composites appear to offer no benefit over nonfluoride composites.[34]

While polymerization shrinkage in particular and biofilm formation on the surface of the restoration are disadvantages of composites compared to amalgams, composites still offer several advantages over amalgams – superior esthetics, no expansion over time, as well as highly effective bonding systems for adhesion and retention that enable minimal preparation and improved tooth structure preservation. From the patient's perspective, the most obvious advantage of composite restorations is esthetics. Improved color stability, luster and stain resistance have further improved esthetics as composites have evolved. Improvements in handling and user-friendliness continue to be developed since the introduction of a choice in bonding agents and unit doses, and recent developments are aimed at overcoming the physical weaknesses of composites.

Recent Composite Material Developments

Composites have been modified to provide greater physical and biological properties. Biofilm-formation reduction has been tried by modifying composites as well as dentin bonders, such as by including glutaraldehyde in the dentin bonder or incorporating an acidic property.[35]

Recent investigations have included researching novel posterior composite materials with the objective of finding materials that offer reduced polymerization shrinkage and improved esthetic stability. Silsesquioxane (SSQ)-based nanocomposites have been found in in vitro testing to offer reduced polymerization shrinkage and rigidity, offering potential solutions for stresses and clinical issues associated with shrinkage.[36] Similarly, oligomeric thiolene-based materials have been found in in vitro testing to exhibit up to 92% less polymerization stress compared to conventional dimethacrylate-based composites.[37] A recently developed composite material based on silorane has been used and tested clinically and has been found to result in reduced polymerization shrinkage and stresses.[38]

Silorane-based Posterior Restorations

Silorane-based posterior composite material has been found to reduce polymerization shrinkage and associated stresses,[39] which would also reduce microleakage and postoperative hypersensitivity while demonstrating other physical properties comparable to leading composites in in vitro testing.[40] Shrinkage is decreased due to the material's chemical composition and polymerization dynamics. Silorane is derived from the combination of siloxane and oxirane and has a compact ring structure (Figure 4a) that unlinks during polymerization. When polymerization shrinkage begins, the silorane ring simultaneously opens up and compensates for material shrinkage by expanding its molecular volume and bulking up the material. Shrinkage has been found to be less than 1% using this material (Figures 4b–d).[41] An initiator included in the material starts the ring-opening process in a controlled manner and, according to the manufacturer, increases operating time.

Figure 4a. Silorane molecule

Figure 4b. Application of primer

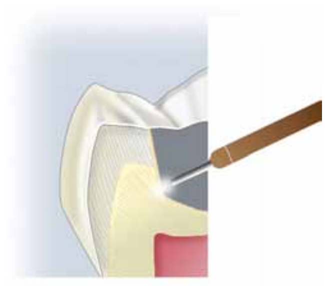
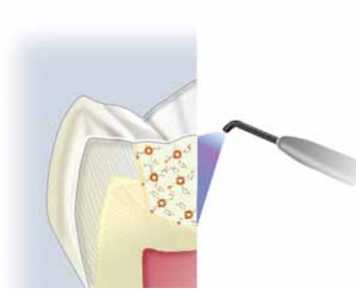


Figure 4c. Silorane-based material in preparation after separate applications and curing of both primer and adhesive

Figure 4d. Light-curing of silorane-based material opens silorane ring structure, reduces shrinkage



In vitro testing has found lower polymerization shrinkage and reduced polymerization stress and tooth deformation compared to leading methacrylate-based conventional and flowable composite resin materials.[42,43,44] At the same time, adhesion and shear bond strength have not been compromised, and reduced shrinkage helps preserve the tooth bond-composite adhesive interfaces. Other desired physical properties, such as compressive and flexural strength, have been found to be similar to those of leading composite materials. The silorane-based restorative is a microhybrid composite that contains fine silane-coated quartz filler with yttrium fluoride for radiopacity. Bacterial adhesion of common oral bacteria has been found to be reduced in in vitro testing using silorane-based composite, associated with its hydrophobic chemistry.[45] One-year clinical testing has found good clinical performance using this new material compared to other posterior composite material.

Case Study

The case shown here demonstrated the use of posterior composite material (Filtek LS restorative) in the restoration of a carious upper left first bicuspid. On examination, a distal lesion was identified (Figure 5a). A rubber dam was placed prior to the DO preparation.

Figure 5a. Distal lesion in upper left first bicuspid

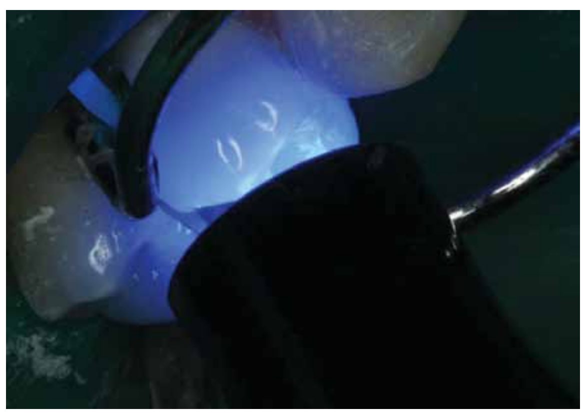
Figure 5b. Rubber dam placement prior to preparation

Figure 5c. Cavity preparation, matrix and wedge placed

After the matrix and wedge were placed around the distal box, a thin layer of self-etching primer was placed on the dentin in the preparation using a microbrush for 15 seconds, dispersed using air, then cured for 10 seconds. The primer has a pH of 2.7, produces mild etching and increases the hydrophobicity of the area prior to placement of the adhesive.

Figure 5d. Self-etching primer placed

Figure 5e. Curing of self-etching primer



The next step is to place a thin layer of the adhesive in the preparation over the cured primer, and to light-cure the adhesive for 10 seconds before placing any composite material in the preparation. This restorative is highly hydrophobic and the adhesive must function as a bridging mechanism between the primer and the composite. Only the LS System Adhesive Self-Etch Primer and Bond are compatible with Filtek LS restorative chemistry (the use of other primers and adhesives is contraindicated).

The composite shade is selected and injected first as a 2 mm increment in the distal box, where it is condensed using a #9 Garrison. The remainder of the void is filled by injecting more composite, taking care not to overfill the area, and the #9 composite instrument is used to remove flash prior to light-curing the composite for 20 seconds (note: plasma lights, lasers and other high-power curing lights should not be used with this restorative). A long working time under operatory light aids detailed shaping and flash removal prior to curing.

Figure 5f. Injecting distal box with restorative

Figure 5g. Condensing composite with #9 Garrison

Figure 5h. Flash being removed from filled preparation prior to curing

Figure 5i. Cured composite after removal of matrix and wedge

Figure 5j. High polish created using Jiffy® polisher

Figure 5k. Final polished restoration

After removal of the matrix and wedge, the restoration is polished using a Sof-Lex™ disk (Ultradent) to remove any flash and a Jiffy® Polisher (Ultradent) is then used to create a high shine. The final restoration using the low shrinkage posterior composite offers excellent esthetics and function.

Case Study

The second case here shows replacement of a degrading and fractured amalgam restoration with a silorane-based posterior composite. After preparation and application of a liner, the primer and adhesive were separately applied and separately cured. The restorative material was then injected, condensed and light-cured prior to finishing and polishing the restoration.

Figure 6a. Fractured, degrading amalgam

Figure 6b. Preparation with liner mesially

Figure 6c. Application of primer

Figure 6d. Application of adhesive after primer was cured

Figure 6e. Finished restoration

Summary

Increasingly, composites are being placed in preference to amalgams in large part due to patient demands for esthetics as well as the clinical desire to do minimal preparation where possible and provide patients with bonded, esthetic restorations. Since their introduction, the properties of composites have improved dramatically. Amalgam and composite restorations both have advantages and disadvantages. While amalgam restorations fail by secondary caries and are subject to expansion, composite restorations fail by secondary caries and are subject to shrinkage. Recent developments and investigations of materials are aimed at reducing polymerization shrinkage of composites to increase the longevity of these restorations and reduce the potential for failure.

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Author Profile

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Dr. Robert Margeas currently serves as Adjunct Professor in the Department of Operative Dentistry at the University of Iowa College of Dentistry. He is also the Clinical Director and Instructor at the Center for Esthetic Excellence, Chicago, IL. Dr. Margeas has published numerous articles on esthetic dentistry and is a highly sought after international lecturer on the subject. His credentials include board certification by the American Board of Operative Dentistry and he is a Fellow of the Academy of General Dentistry (AGD). Dr. Margeas is a consultant in Oral Health matters for the country of Canada. He maintains a very successful private practice, with a focus on comprehensive esthetic restorative dentistry, in Des Moines, IA.

Disclaimer

Dr. Margeas has been a speaker on behalf of 3M ESPE as well as other composite manufacturers.

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1. Historically, posterior direct restorations involved the use of _________.
   a. filaments
   b. amalgams
   c. composites
   d. all of the above
2. Old silicate restorations were found in a 1986 study to be replaced due to _________ and _________.
   a. expansion, microleakage
   b. expansion, lost fillings
   c. marginal discrepancies, lost fillings
   d. expansion, contraction
3. Posterior tooth-colored restorations had been introduced _________.
   a. by the 1960s
   b. by the 1970s
   c. by the 1980s
   d. none of the above
4. By 1999, at least _________ of direct posterior restorations were composites.
   a. 39%
   b. 49%
   c. 59%
   d. 69%
5. The ideal posterior restorative material should offer _________.
   a. ease of placement
   b. biocompatibility
   c. appropriate flexural and compressive strength
   d. all of the above
6. Posterior Class I and II restorations must resist _________ and _________.
   a. occlusal forces, buccal forces
   b. occlusal forces, forces of mastication
   c. buccal forces, forces of dysphagia
   d. none of the above
7. Annual failure rates in a study of direct posterior restorations predominantly placed since 1990 were _________ and _________.
   a. 2% for amalgams, 4.5% for composites
   b. 1% for composites, 3% for amalgams
   c. 3% for amalgams, 2.2% for composites
   d. none of the above
8. Following recent developments, the ideal restorative material _________.
   a. will never exist
   b. now exists
   c. has yet to be found
   d. none of the above
9. The quality of a restoration and the patient's (preventive) home care are important factors in precluding _________.
   a. gingivitis
   b. replacement of restorations
   c. gingival grafts
   d. none of the above
10. The main material factors in the replacement of amalgam restorations have been found to be _________ and _________.
    a. bulk fractures, marginal degradation
    b. polymerization shrinkage, microsopic fractures
    c. bulk fractures, polymerization shrinkage
    d. all of the above
11. The longevity of restorations depends only on _________.
    a. clinical technique
    b. the material
    c. the policy
    d. none of the above
12. Bonded amalgam restorations have been found to offer support of undermined enamel equal to that of composites, with _________.
    a. superior marginal adaptation
    b. inferior marginal adaptation
    c. inferior obtusion
    d. none of the above
13. Creep-fatigue may be a factor in _________.
    a. marginal fracture of amalgam restorations
    b. bulk fracture of amalgam restorations
    c. reducing stress caused by expansion of amalgam restorations
    d. a and c
14. Poor _________ with amalgam is the main reason why patients increasingly prefer direct posterior composites over amalgams.
    a. function
    b. longevity
    c. esthetics
    d. all of the above
15. Reasons for composite restoration failure include _________.
    a. marginal degradation
    b. discoloration and loss of anatomic shape
    c. bulk fracture
    d. all of the above
16. _________ is the single most common reason for the replacement of both amalgam and posterior composite restorations.
    a. Fracture of the restoration
    b. Secondary caries
    c. Discoloration of the restoration
    d. all of the above
17. Polymerization shrinkage of composites results in stresses that can lead to _________.
    a. enamel cracks
    b. postoperative sensitivity
    c. marginal degradation
    d. all of the above
18. Polymerization shrinkage occurs due to chemical bonds that _________ the material's bulk.
    a. increase
    b. maintain
    c. decrease
    d. none of the above
19. Polymerization shrinkage is influenced by the _________.
    a. intensity and duration of light curing
    b. material's shade
    c. material's chemistry and curing dynamics
    d. a and c
20. A recent study by _________ found that cuspal deflection (tooth deformation) was statistically similar for conventional hybrid composites and flowable composites.
    a. Bourguignon et al.
    b. Bouillaguet et al.
    c. Black et al.
    d. Bellman et al.
21. Composite restorations generally offer _________ properties compared to amalgam.
    a. superior antibacterial
    b. inferior antibacterial
    c. superior functional
    d. superior antiviral
22. Fluoride-releasing composites appear to offer _________ benefits over nonfluoride composites.
    a. substantial
    b. moderate
    c. no
    d. none of the above
23. Currently-available composites offer _________ compared to the earliest composites.
    a. improved color stability and esthetics
    b. improved physical properties
    c. improved handling
    d. all of the above
24. Biofilm-formation reduction on composites has been tried by _________.
    a. modifying composites
    b. modifying dentin bonders
    c. including glutaraldehyde in the dentin bonder
    d. all of the above
25. Silsesquioxane-based nanocomposites and oligomeric thiolene-based materials have been investigated for _________.
    a. increases in bond strength
    b. reductions in polymerization shrinkage
    c. improved esthetics
    d. all of the above
26. _________ posterior composite material has been found to reduce polymerization shrinkage to <1%.
    a. Pilorane-based
    b. Silorane-based
    c. Silicone-based
    d. none of the above
27. Shrinkage using silorane-based composite material is decreased due to _________.
    a. the silorane ring simultaneously opening up and compensating for material shrinkage during curing
    b. the oxygen content compensating for material shrinkage during curing
    c. a condensation of the material during bonding
    d. none of the above
28. Silorane-based composite materials can be used with _________ bonding agent.
    a. any
    b. several
    c. only the compatible
    d. none of the above
29. A long working time under operatory light aids _________ prior to curing of composite materials.
    a. detailed shaping
    b. flash removal
    c. placement
    d. a and b
30. Composites are being placed in preference to amalgams in large part due to _________.
    a. patient demands for esthetics
    b. easier placement than with amalgams
    c. an increased ability to do minimal preparations and provide bonded restorations
    d. a and c

ANSWER SHEET

The Properties and Selection of Posterior Direct Restorations

Name: ______________________ Title: __________ Specialty: __________

Address: ______________________ E-mail: ______________________

City: ______________________ State: __________ ZIP: __________

Telephone: Home (   ) ______________ Office (   ) ______________

Requirements for successful completion of the course and to obtain dental continuing education credits: 1) Read the entire course. 2) Complete all information above. 3) Complete answer sheets in either pen or pencil. 4) Mark only one answer for each question. 5) A score of 70% on this test will earn you 2 CE credits. 6) Complete the Course Evaluation below. 7) Make check payable to PennWell Corp.

Educational Objectives

1. Describe the modes of failure, advantages and disadvantages of amalgam restorations
2. Describe the modes of failure, advantages and disadvantages of composite restorations
3. Describe the properties of an ideal restorative material
4 Describe the types of composite materials and recent new materials and their application

Course Evaluation

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

1. Were the individual course objectives met? Objective #1: Yes No Objective #3: Yes No
Objective #2: Yes No Objective #4: Yes No

2. To what extent were the course objectives accomplished overall?	5	4	3	2	1	0
3. Please rate your personal mastery of the course objectives.	5	4	3	2	1	0
4. How would you rate the objectives and educational methods?	5	4	3	2	1	0
5. How do you rate the author's grasp of the topic?	5	4	3	2	1	0
6. Please rate the instructor's effectiveness.	5	4	3	2	1	0
7. Was the overall administration of the course effective?	5	4	3	2	1	0
8. Do you feel that the references were adequate?		Yes		No		
9. Would you participate in a similar program on a different topic?		Yes		No		

10. If any of the continuing education questions were unclear or ambiguous, please list them.

____

11. Was there any subject matter you found confusing? Please describe.

____

____

12. What additional continuing dental education topics would you like to see?

____

____

Mail completed answer sheet to

Academy of Dental Therapeutics and Stomatology,
A Division of PennWell Corp.
P.O. Box 116, Chesterland, OH 44026
or fax to: (440) 845-3447

For IMMEDIATE results, go to www.ineedce.com and click on the button "Take Tests Online." Answer sheets can be faxed with credit card payment to (440) 845-3447, (216) 398-7922, or (216) 255-6619.

☐ Payment of $49.00 is enclosed.
(Checks and credit cards are accepted.)

If paying by credit card, please complete the following: ☐ MC ☐ Visa ☐ AmEx ☐ Discover

Acct. Number: ______________________________

Exp. Date: ____________________

Charges on your statement will show up as PennWell

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2.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	17.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
3.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	18.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	19.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
5.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	20.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	21.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
15.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	30.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

AGD Code 253

PLEASE PHOTOCOPY ANSWER SHEET FOR ADDITIONAL PARTICIPANTS.

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Dr. Margeas has been a speaker on behalf of 3M ESPE as well as other composite manufacturers.

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