Compomers as class II restorations in primary molars

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Abstract

A variety of alternatives to amalgam are now available for use in class II restorations in primary teeth, including glass ionomer, composites, and intermediate materials such as componer and resin modified glass ionomers (RMGI). The purpose of the present study was to evaluate the clinical performance of two componers, Hytac and Dyract, and to compare these results to those reported for other intracoronal restorative materials. Evaluation after 24 months shows Hytac and Dyract to have performed well and comparably as class II restorations in primary teeth. The low failure rate, even in a population with a high caries increment, suggests that componers are a suitable alternative to amalgam or other, tooth-colored materials when used as class II restorations in primary teeth. (Pediatr Dent 23:24-27, 2001)

Increasing demand for more esthetic restorations and public concern over the harmful effects of mercury on health and the environment have fueled a search for acceptable alternatives to amalgam. A variety of tooth-colored restorative materials are now available. At either end of the spectrum are traditional glass ionomers and resin composites, and in between are a range of newer products with intermediate properties.[1,2] Traditional glass ionomers offer the advantage of fluoride release, minimal shrinkage, and resistance to microleakage. However, they are less esthetic than composites and show poor abrasion and fracture resistance. Composite resins, on the other hand, are highly esthetic and fracture and wear resistant, but do not release fluoride and shrink on setting. Resin modified glass ionomers (RMGI) and polyacrylic acid modified composite resins (compomers) are two materials with intermediate properties. RMGIs consist of the same components as conventional GICs with resin added for improved strength and esthetics as compared to GIC. The strength and esthetic characteristics do not equal those of compomers or composite resins. Examples of RMGI include Fuji II LC (GC America), Vitremer (3M Dental Products), and Photac-Fil Quick (ESPE). Compomers are more closely related to composite resin, consisting of the same components as composite resin with the addition of glass ionomer. They release some fluoride, offer good esthetics, and show intermediate wear characteristics and shrinkage. Examples of compomers are Dyract (Dentsply), Compoglass (Vivadent), and Hytac (ESPE).

For restoration of permanent teeth, composites offer advantages over compomers and glass ionomers in wear resistance and esthetic stability. However, requirements may differ for primary teeth. Primary teeth have a limited lifespan, and the enamel of primary teeth is less wear resistant than permanent teeth. In addition, caries rates are likely to be high in children with proximal lesions so that fluoride release may be helpful. Manufacturers have packaged compomer with the recommen-

Table 1. Mean (±SD) Restoration Ratings at 2 Years

	Rating scale	Dyract	Hytac
Margin adaption	1. barely detectable 2. readily detectable one margin 3. readily detectable two margins 4. penetrated by explorer one margin 5. penetrated by explorer two margins	1.1±0.3	1.07±0.3
Margin dicoloration	1. not evident on either margin 2. evident on one margin 3. evident on two margins 4. penetrating one margin 5. penetrating two margins	1.07±0.3	1.13±0.4
Fracture	1. no fracture lines 2. small discontinuous fracture lines 3. major fracture line 4. crack	1.11±0.4	1.1±0.5
Color	1. matches shade guide 2. mismatch with shade guide	1.04±0.19	1.0±0.0
Failure rate		4%	7%

Received March 3, 2000 Revision Accepted August 11, 2000

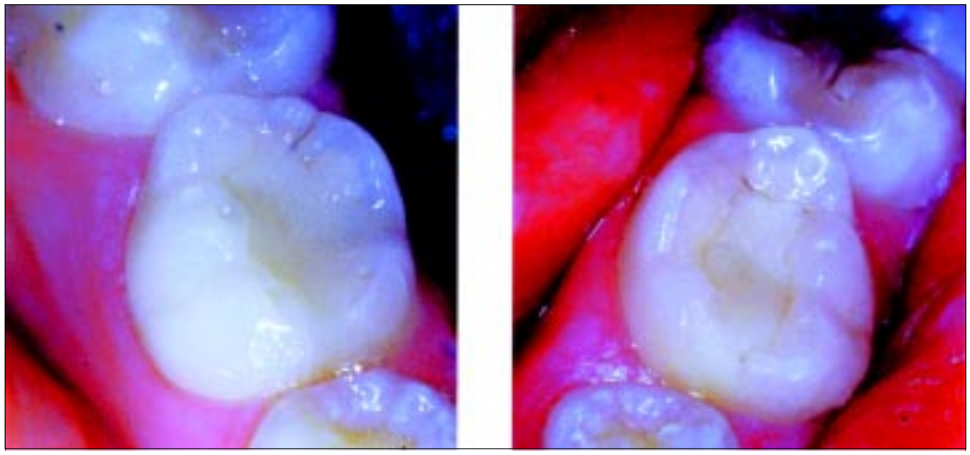

Fig 1. The two panels show bilateral mesial-occusal componer restorations on the primary second molars of a single subject 24 months after placement. The left panel shows a Dyract restoration, and the right, Hytac. The first primary molars have been exfoliated since the placement of the restorations, and first bicuspids are erupting.

dation that a separate phosphoric acid etching step is not required because the acidity of the bonding agents results in some dentin etching and produces acceptable bond strengths as measured in vitro. Since children may be uncooperative for lengthy etching and bonding procedures, compomer may provide a better alternative than composite resin.

Laboratory data and speculation based on properties of materials can be helpful, but clinical trials are needed to determine the success of a material for a particular application. The clinical performance of compomer as a class II restorative in primary molars has been evaluated in several studies,[3-7] but these studies tested the performance of only one compomer, Dyract. The purpose of the present study was to evaluate the clinical performance of two compomers, Hytac and Dyract, as class II restorations in primary molars.

Methods

Forty-nine healthy subjects between 5 and 8 years of age were identified by clinical and radiographic examination as having two primary molars indicated for class II restorations. Teeth were selected based on the following criteria: radiographic evidence of caries into the inner half of enamel but not the inner half of dentin; proximal contact with adjacent healthy or restored teeth; occlusal contact with opposing healthy or restored teeth, no indication for pulp therapy or other restorative treatment; and a predicted survival until exfoliation of at least two years. After informed consent was obtained, a random number chart was used to assign one tooth for restoration with Dyract and one for Hytac. Two operators, who demonstrated ability to prepare teeth according to guidelines,[8] prepared and restored 92 teeth. Local anesthesia and rubber dam isolation were used. In 6 subjects only one tooth received a compomer restoration due to a carious pulp exposure during preparation, indicating placement of a stainless steel crown. Teeth were prepared with a high speed 330 bur, rinsed and dried, and two coats of the bonding agent supplied by the manufacturer were applied, dried and cured. Restorations were placed in maximum increments of 2 mm and cured.

Upon recall, teeth were evaluated for 4 different parameters by two examiners, as detailed in Table 1. In the case of a discrepancy in ratings, the examiners reevaluated the restoration and discussed the ratings until agreement was reached. Overall failure rates were calculated as the percentage of restorations requiring replacement over the number of restorations evaluated at 2 years.

Results

At 2 years, 58 restorations (63%) were evaluated , and 8 (12%) were lost to natural exfoliation. The rest were lost to follow up. Figure 1 shows a typical example of both Dyract and Hytac restorations after 2 years. Mean ratings and failure rates are shown in Table 1. Differences between the two compomers were not significant by Kruskal-Wallis Test for any of the ratings. The overall failure rate was 10.3%. Although the number of failures was lower for Dyract, the difference was not significant by chi-square analysis (P= 0.43). One restoration failed within the first six months of the study due to insufficient fill at the gingival margin in the proximal box. One failure resulted from bulk fracture at the isthmus after 24 months, and the remaining 4 failures were detected at 24 months and were due to recurrent caries at the gingival margin. One or more new carious lesions in teeth other than those restored for the study were noted in 67% of subjects evaluated after 2 years. Figure 2 shows an example of radiographs from a typical subject with new carious lesions.

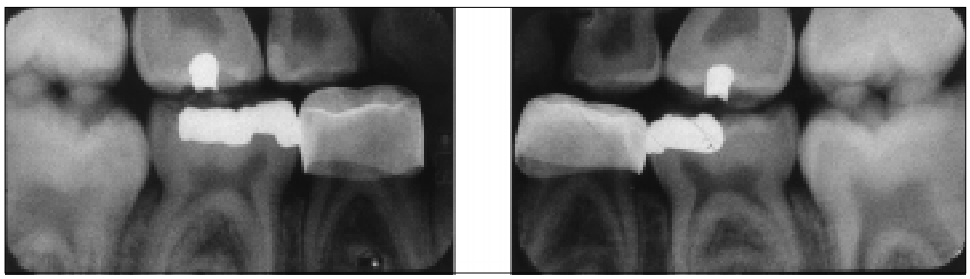

Fig 2. The two panels show radiographs of a typical subject 12 months after placement of the study restorations. Hytac was placed as an MO in tooth A, and Dyract as a DO in tooth B, as seen in the left panel. New carious lesions can be noted in the right panel on the distal surface of I and the mesial surface of J. Stainless steel crowns and amalgam restorations are present in the lower primary molars.

Discussion

Failure rates for intracoronal filling materials for class II restorations of primary teeth have been evaluated in several studies, and are summarized in Figure 3. Studies have varied in the length of follow up, sample size, number of operators, and the stringency of the conditions for preparation and placement. For all materials, lower failure rates were found in controlled prospective studies while higher rates were found in multicenter or retrospective field studies. Glass ionomer failure rates have been reported between 16 and 60%, [11,13,15,16] amalgam failure rates between 8 and 32%,[6,11-13] RMGI failure rates between 2 and 27%,[9,10,14] and composite resin failure rates between 2 and 16%.[5,11,12,17,18] Failure rates for compomers range from 2 to 20 %.[3-7] The large variability in study conditions makes comparison difficult, but examination of median failure rates among studies eliminates outliers and provides a good comparison of different materials. The median failure rate for glass ionomer is between 23% (after 2.5 years) and 37% (after 3 years), for RMGI 20% (after 3 years), for amalgam 12 to 18% (after 3 years), for compomer 10% (after 2 years), and for composite 7% (after 4 years). For amalgams and glass ionomers, the leading reported cause of failure was bulk fracture. For compomer and composite it was recurrent caries at the gingival margin. For RMGI no single type of failure predominated.

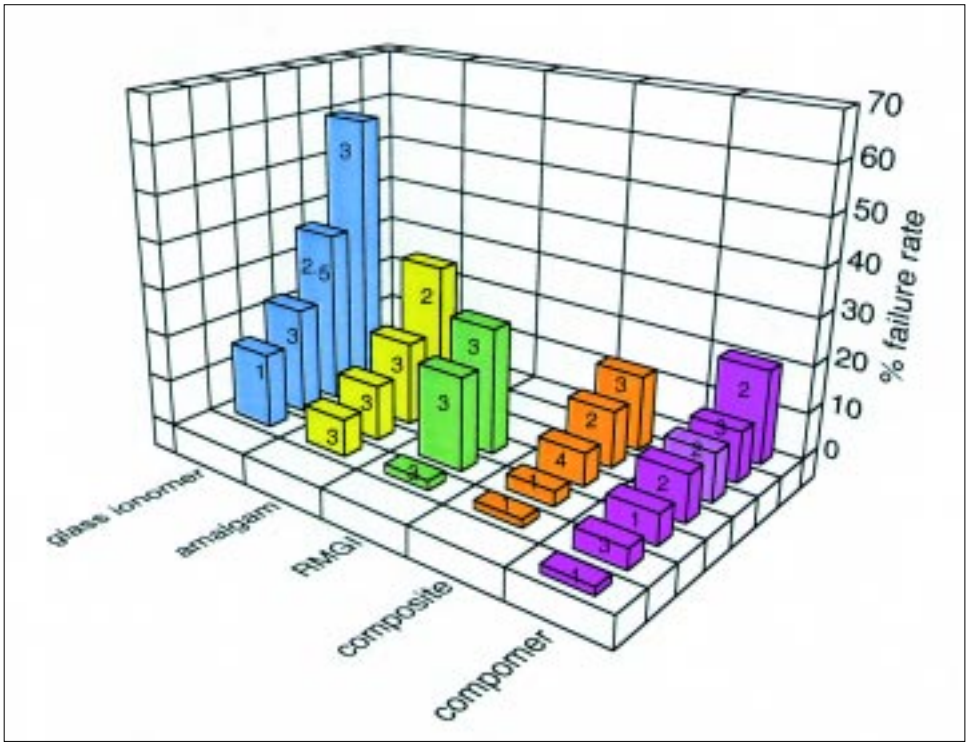

Fig 3. Failure of class II intracoronal filling materials in primary molars as previously reported.[3-7, 9-18] Each bar shows data from a single study, and the numbers on the bars indicate the length of the study in years. The light magenta bar in the componer column shows data from the current study.

Compomer and composite appear to equal or surpass the success of glass ionomer, RMGI, and amalgam for class II restorations in primary molars over the time interval studied, and offer an excellent and esthetic alternative. Since the desired longevity of a restoration in a primary tooth may often exceed 2 to 4 years, longer followup studies are needed. The failure rate observed in our study of Hytac and Dyract is very consistent with that observed in previous reports for compomers, and no significant difference was observed between the two materials. The success rate was high even though the subjects exhibited a high caries increment over the study period. The majority of failures were due to recurrent caries at the gingival margin, suggesting that adequate filling of the box by the operator is critical, and that the wear and fracture-resistance of both materials is adequate for primary teeth.

Although composite resins and compomers have not been compared directly, based on reported failure rates from multiple studies they appear to perform comparably. Compomer does provide an advantage over composite resin in convenience, since a separate phosphoric acid etching step is not necessary (and was not included in any clinical studies in primary teeth,[3-7] including the present study). It is interesting to note, however, that laboratory studies have shown phosphoric acid etching to both reduce microleakage[19] and improve the bond strength of compomers.[20] This suggests that the survival rates of compomers might be improved by etching, but clinical data to confirm this are not available.

Conclusion

Evaluation after 24 months shows Hytac and Dyract to have performed well and comparably as class II restorations in primary teeth. The low failure rate, even in a population with a high caries increment, suggests that compomers are a suitable alternative to amalgam or other, tooth-colored materials when used as class II restorations in primary molars.

This study was supported by a grant from ESPE America. The authors gratefully acknowledge operators Drs. Celeste Lamell and Gianfranco Fraone, raters Drs. James Preisch, Stephen Wilson, and Amr Moursi, and dental assistants Carol Roseberry and Becky Sweeney.

References

1. Berg, J. H. The continuum of restorative materials in pediatric dentistry—a review for the clinician. Pediatr Dent 20, 93-100, 1998.
2. Hse, K. M., Leung, S. K. & Wei, S. H. Resin-ionomer restorative materials for children: a review [see comments]. Aust Dent J 44, 1-11, 1999.
3. Roeters, J. J., Frankenmolen, F., Burgersdijk, R. C. & Peters, T. C. Clinical evaluation of Dyract in primary molars: 3-year results. Am J Dent 11, 143-8, 1998.
4. Papagiannoulis, L., Kakaboura, A., Pantaleon, F. & Kavvadia, K. Clinical evaluation of a polyacid-modified resin compos-

ite (compomer) in Class II restorations of primary teeth: a two-year follow-up study. Pediatr Dent 21, 231-4, 1999.
5. Hse, K. M. & Wei, S. H. Clinical evaluation of compomer in primary teeth: 1-year results. J Am Dent Assoc 128, 1088-96, 1997.
6. Marks, L. A., Weerheijm, K. L., van Amerongen, W. E., Groen, H. J. & Martens, L. C. Dyract versus Tytin Class II restorations in primary molars: 36 months evaluation. Caries Res 33, 387-92, 1999.
7. Andersson-Wenckert, I. E., Folkesson, U. H. & van Dijken, J. W. Durability of a polyacid-modified composite resin (compomer) in primary molars. A multicenter study. Acta Odontol Scand 55, 255-60, 1997.
8. Project TAPP, D. o. H. E. a. W. *Cavity preparation for primary teeth* (Quercus, Castro Valley, California, 1978).
9. Donly, K. J., Segura, A., Kanellis, M. & Erickson, R. L. Clinical performance and caries inhibition of resin-modified glass ionomer cement and amalgam restorations. J Am Dent Assoc 130, 1459-66, 1999.
10. Espelid, I., Tveit, A. B., Tornes, K. H. & Alvheim, H. Clinical behaviour of glass ionomer restorations in primary teeth. J Dent 27, 437-42, 1999.
11. Qvist, V., Laurberg, L., Poulsen, A. & Teglers, P. T. Longevity and cariostatic effects of everyday conventional glass-ionomer and amalgam restorations in primary teeth: three-year results. J Dent Res 76, 1387-96, 1997.
12. Barr-Agholme, M., Oden, A., Dahllof, G. & Modeer, T. A two-year clinical study of light-cured composite and amalgam restorations in primary molars. Dent Mater 7, 230-3, 1991.
13. Ostlund, J., Moller, K. & Koch, G. Amalgam, composite resin and glass ionomer cement in Class II restorations in primary molars—a three year clinical evaluation. Swed Dent J 16, 81-6, 1992.
14. Folkesson, U. H., Andersson-Wenckert, I. E. & van Dijken, J. W. Resin-modified glass ionomer cement restorations in primary molars. Swed Dent J 23, 1-9, 1999.
15. Forsten, L. & Karjalainen, S. Glass ionomers in proximal cavities of primary molars. Scand J Dent Res 98, 70-3, 1990.
16. Kilpatrick, N. M., Murray, J. J. & McCabe, J. F. The use of a reinforced glass-ionomer cermet for the restoration of primary molars: a clinical trial [see comments]. Br Dent J 179, 175-9, 1995.
17. Attin, T., Opatowski, A., Meyer, C., Zingg-Meyer, B. & Hellwig, E. Clinical evaluation of a hybrid composite and a polyacid-modified composite resin in Class-II restorations in deciduous molars. Clin Oral Investig 2, 115-9, 1998.
18. Letzel, H. Survival rates and reasons for failure of posterior composite restorations in multicentre clinical trial. J Dent 17, S10-7; discussion S26-8, 1989.
19. Kugel, G., Perry, R. D., Hoang, E., Hoang, T. & Ferrari, M. Dyract compomer: comparison of total etch vs. no etch technique. Gen Dent 46, 604-6, 1998.
20. Tate, W. H., You, C. & Powers, J. M. Bond strength of compomers to dentin using acidic primers. Am J Dent 12, 235-42, 1999.

Abstract of the Scientific Literature

Adverse Sedation Events in Pediatrics

The purpose of this was paper was to perform a systematic investigation of medications associated with adverse sedation events in pediatric patients using critical incident analysis of case reports. One hundred eighteen case reports from the adverse drug reporting system of the Food and Drug Administration, the US Pharmacopoeia, and the results of a survey of pediatric specialists were used. Outcome measures were death, permanent neurologic injury, prolonged hospitalization without injury, and no harm. This relationships between outcome and medications: individual and classes of drugs, routes of administration, drug combinations and interactions, medication errors and overdoses, patterns of drug use, practitioners, and venues of sedation were analyzed. Sixty out of 95 incidents resulted in death or permanent neurologic injury. No significant relationship between outcome and drug class (e.g. opioids; benzodiazepines; barbiturates; sedatives; antihistamines; and local, intravenous, or inhalation anesthetics) or route of administration (oral, rectal, nasal, intramuscular, intravenous, local infiltration, and inhalation) was found. Death and permanent neurologic injury were often associated with: 1) drug overdose, 2) drug combinations and interactions 3) with drugs administered by nonmedically trained personnel and 4) drugs administered at home. Some injuries occurred on the way to a facility after administration of sedatives at home: some took place in automobiles or at home after discharge from medical supervision. The use of 3 or more sedating medications compared with 1 or 2 medications was strongly associated with adverse outcomes (nine times more). Nitrous oxide in combination with any other class of sedating medication was frequently associated with adverse outcomes. Dental specialists had the greatest frequency of negative outcomes associated with the use of 3 or more sedating medications. Adverse events occurred despite drugs being administered within acceptable dosing limits.

Comments: Every pediatric dentist who treats children under conscious sedation should read this important paper in its entirety. In the body of this study the authors state that they “do not know the reason why dental specialists (bold emphasis is my addition) were disproportionately represented”. Of the 60 incidents that resulted in death or permanent neurologic injury 29 were sedated for dental procedures. The authors conclude that the AAPD guidelines should be changed to equal those of the AAP and ASA . However, close analysis of the data may show that this conclusion may be incorrect and misleading. Of the 29 incidents resulting in death or permanent neurologic damage only 3 involved pediatric dentists (specialists) and 17 were dentists with unknown training! Practitioners may need to reconsider the use of combination of multiple drugs due to the increased risk shown in this paper. Note that in most of the cases adverse reactions were associated with drug overdoses, drug combinations (particularly 3 or more drugs) and when medications were administered without proper medical supervision. Strict adherence to AAPD guidelines and limiting the sedation of children for dental treatment to qualified dental specialists with adequate and appropriate training should assist in preventing such tragic incidents. Placing the blame on the AAPD guidelines is a simple but baseless conclusion. AK

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Charles J. Coté, Helen W. Karl, Daniel A. Notterman, Joseph A. Weinberg, and Carolyn McCloskey: Adverse Sedation Events in Pediatrics: Analysis of Medications Used for Sedation. PEDIATRICS Vol. 106 No. 4 October 2000, pp. 633-644

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