Materials Used to Restore Class II Lesions in Primary Molars: A Survey of California Pediatric Dentists

Rebecca Lee Pair, DDS Richard D. Udin, DDS Thomas Tanbonliong, DDS

Dr. Lee Pair is clinical assistant professor and former resident, Advanced Pediatric Dentistry Program, Dr. Udin is associate professor of clinical dentistry, Division of Health Promotion, Disease Prevention and Epidemiology, and Dr. Tanbonliong is assistant professor of clinical dentistry, Division of Primary Oral Health Care, all at the University of Southern California School of Dentistry, Los Angeles, Calif.
Correspond with Dr. Lee Pair at beckily_99@yahoo.com

Abstract

Purpose: The purpose of this study was to determine which materials were most commonly used by pediatric dentists in California to restore Class II lesions in the primary dentition.
Methods: A questionnaire consisting of 18 multiple-choice questions was mailed to all 440 active members of the California Society of Pediatric Dentistry (CSPD). The questions related to the practitioners' material of choice for restoring Class II lesions in primary molars.
Results: A 66% response rate was received. For 57% of the respondents, amalgam was the material of choice for restoration of Class II lesions in primary molars. Twenty-nine percent selected composite, 5% glass ionomer, 6% compomer, and 1% (1 practitioner) stainless steel crowns. Sixty-eight percent responded that amalgam has historically proven to be a safe, reliable, and affordable material. The main reasons cited for using composite resin were "patient preference" (86%) and "better esthetics" (78%). Most practitioners used either a single-step (fifth-generation) or 2-step (fourth-generation) bonding agent (53% and 35%, respectively). When using a nonamalgam restorative material, 49% of practitioners used a traditional Class II amalgam preparation. The role of dental literature in treatment decision-making was not significantly related to the restorative material used.
Conclusions: While amalgam was the most common material used for Class II restorations, nonamalgam materials were significantly popular among California pediatric dentists. (*Pediatr Dent.* 2004;26:501-507)

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Dental amalgam has been the material of choice for restoring both primary and permanent teeth for over 100 years.[1] Improvements in the physical properties of tooth-colored filling materials, however, have recently given dentists the opportunity to place more esthetic and durable resin-based restorations, requiring less removal of tooth structure. A growing fear among consumers over the potential adverse effects of the mercury contained in dental amalgam has further contributed to the increase in popularity of tooth-colored restorative materials.

In 2001, Forss and Widstrom[2] reported that amalgam was used in only 5% of restorations placed in Finland over a 5-year period, while composite resins and glass ionomers were used in 75% and 9% of the restorations, respectively. Mjor et al[3] reported that over 80% of restorations in primary teeth placed in general practices in Norway were of tooth-colored material, with 46% being glass ionomer-related materials, 38% compomers, and 2% composites.

Christensen reported in a 1995 CRA survey that US dentists used amalgam in 73% of posterior restorations in primary teeth.[4] He later observed in a 2001 paper that compomers and resin-modified glass ionomers had become the most popular restorative materials for posterior primary teeth.[5]

Within the dental literature, there is lack of agreement among clinical and in vitro studies on the relative success of various restorative materials.[6,7] Internationally, the popularity of materials among practitioners and patients and the recommendation of materials by public health services and dental societies also differ widely.[8] Despite the fact that concerns over the safety of dental amalgam are not supported by the major health care organizations (including the US Public Health Service),[6,8-10] a report from the British Society of Paediatric Dentistry acknowledged that parents in Switzerland, Belgium, Denmark, Netherlands, Norway, Germany, and Sweden usually either ask or insist that materials other than amalgam be used.[8] While the

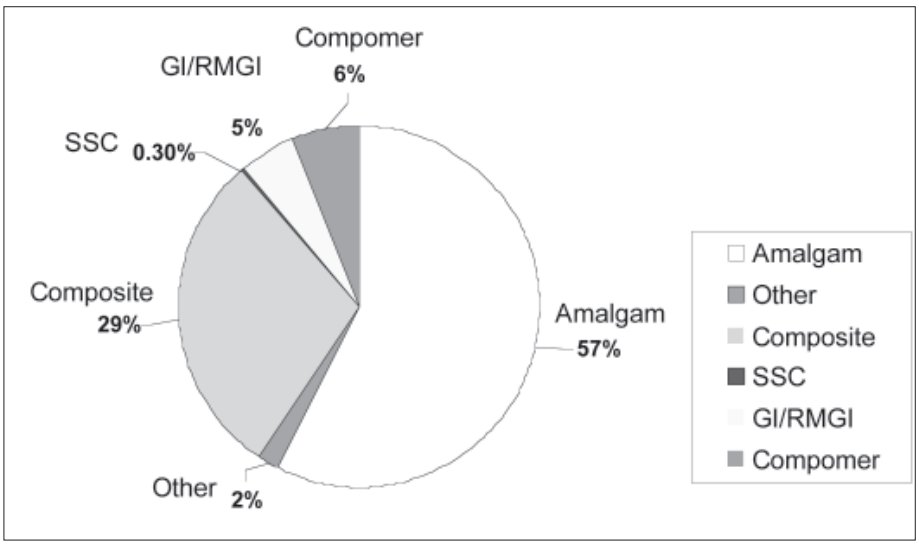

Figure 1. Primary restorative materials used in Class II lesions in primary molars.

debate over the current material of choice for restoring Class II restorations remains unresolved, pediatric dentists must choose between amalgam, composite resin, glass ionomer, resin-modified glass ionomer, compomer, and stainless steel crowns for restoring primary teeth.

The purpose of this study was to determine which materials are most commonly used among California pediatric dentists to restore Class II lesions in the primary dentition and the rationale behind their use.

Methods

This study was approved by the Committee on Clinical Investigations, Human Subjects Protection Program, Childrens Hospital Los Angeles. A survey was mailed to all 440 active, nonstudent, in-state members of the California Society of Pediatric Dentists (CSPD) (including faculty members). The material included an invitation to participate, a cover letter explaining the study's purpose, the questionnaire, and a prestamped envelope for the reply. The questionnaire consisted of 18 questions in a multiple-choice format. The questions assessed:

1. dentist's material of choice for restoring Class II carious lesions in primary molars;
2. indications and contraindications affecting his/her use of the materials;
3. techniques used in placing the restorations (eg, use of rubber dam, use of dentin bonding adhesives for composites and amalgams, cavity design, and steps in placing glass ionomer restorations);
4. role of dental literature in the dentist's selection of restorative materials;
5. demographic profile of the provider, including age, number of years in practice, insurances accepted, and number of patients seen daily.

Approximately 2 months after the invitation's initial mailing, a reminder letter was sent. Response to the questionnaire was anonymous. Chi-square testing was used for association between predictive factors and outcomes. Factors with insufficient sample size were analyzed with Fisher's exact test. Mantel-Haenzel chi-square analysis was used to test for linear trends.

Results

A 66% response rate was received (290/440). The survey was sent only to active, in-state CSPD members. Because of the respondents' anonymity, no returned survey could be considered ineligible due to the respondent's retirement, relocation, etc. A majority of the clinicians answered most of the questions, although some responded with more than one answer to questions where only one response was requested. These were, therefore, not counted. Response rates for each question were calculated based on the number of respondents. One respondent did not answer any of the questions, stating that his practice was currently limited to orthodontics.

Population demographics

Thirty-seven percent of the respondents had been practicing for less than 10 years, 7% for 10 to 15 years, and 56% for greater than 15 years. No significant trend could be seen between the primary restorative material used for Class II restorations in primary teeth and the number of years practicing pediatric dentistry (P=.93; Mantel-Haenzel chi-square test). The clinicians were asked for the average number of patients they treated per day. Chi-square analysis revealed that the average number of patients seen per day was not significantly related (P=.97) to the material of choice for restoring Class II lesions in primary teeth.

The types of insurance/third party payment plans accepted by the respondents are listed in Table 1. Some practitioners listed Delta Dental under "other" types of insurance accepted, while others included it under the HMO and/or PPO groupings. Chi-square analysis revealed amalgam users accepted HMOs (P=.009), Denti-Cal (P=.0006), and Healthy Families (P=.002) plans significantly more often than clinicians who primarily used esthetic restorative materials. Amalgam users also accepted private insurance more often than did nonamalgam users (P=.04; Fisher's exact test). PPO insurance plans were accepted by amalgam users and nonamalgam users to a similar extent (P=.06; chi-square analysis).

Primary restorative material for Class II lesions in primary molars (Figure 1)

Amalgam was selected most often (57%) as the material of choice for restoring Class II lesions in primary molars. Twenty-nine percent of the practitioners primarily used

Table 1. Percentage Acceptance of Insurance Plans

Type of isurance accepted	% of amalgam users	% of esthetic, nonamalgam users
*Private	99	94
†HMO	19	8
PPO	52	40
‡Denti-Cal	44	23
§Healthy Families	36	18
Other	8	6
¶None	0	4

*P=.04.
†P=.009.
‡P=.0006.
§P=.002.
¶P=.01.

composite resins, while 5% and 6% of the practitioners primarily used glass ionomer/resin-reinforced glass ionomer and compomer, respectively. One respondent used stainless steel crowns most often when restoring Class II lesions in primary molars.

Amalgam

Most practitioners (41%) used amalgam 75% to 99% of the time when restoring Class II lesions in primary teeth. For 5% of the practitioners, amalgam was the only material used for restoring Class II lesions, while 21% never used amalgam in these situations (Figure 2). Of the 67 clinicians who described their amalgam usage as "not routine," reasons for which they would consider using amalgam included: (1) lack of insurance coverage for nonamalgam restorations (69%); (2) poor isolation (57%); (3) poor patient cooperation (46%); (4) poor oral hygiene (33%); (5) subgingival preparation margins (28%); (6) preparation margins in cementum (24%); and (7) excessively large preparations (24%). In general, 78% of the practitioners who used amalgam responded that amalgam has historically proven to be a safe, reliable, and affordable material.

Reasons clinicians gave for using amalgam are listed in Table 2. Between 57% to 67% felt that amalgam possessed greater longevity and superior mechanical properties, required less time to place and less patient cooperation, and was more affordable for the patient than nonamalgam alternatives. Of the clinicians who used amalgam for Class II restorations in primary teeth, 15% always placed a bonding agent when placing the amalgam, while 57% never did. Twenty-eight percent of the amalgam users responded that they used a bonding agent when placing Class II amalgam restorations in primary teeth "not often and only when" the restoration required increased retention (53%) or pulpal protection due to the depth of the preparation (45%), or when the clinician had a concern over marginal leakage (19%). The use of a bonding agent when placing an amalgam was not significantly related to the role the practitioners felt dental literature played in their selection of material when restoring a Class II lesion in a primary tooth (P=30; Fisher's exact test).

Composite

Thirty-seven percent of the practitioners primarily placed composite resins more than 50% of the time for their Class II restorations in primary teeth (Figure 2). Of the clinicians who used composite resins for restoring Class II lesions in primary teeth, the main reasons for which they used the material were patient preference (86%) and better esthetics (78%; Table 2).

Approximately a quarter of the clinicians who used composites felt that the material possessed greater longevity and superior mechanical properties and that its usage is evidence-based and supported by research. Fourteen percent felt that, in their "clinical experience, composite resin has proven to be a more superior restorative material for Class II lesions in primary teeth," and 14% were more comfortable with its placement technique. Twenty-three clinicians, or 9% of the respondents who used composite resins, included concern about the toxicity of amalgam restorations as one reason for their use of composite. In terms of types of bonding agents used when placing composite restorations:

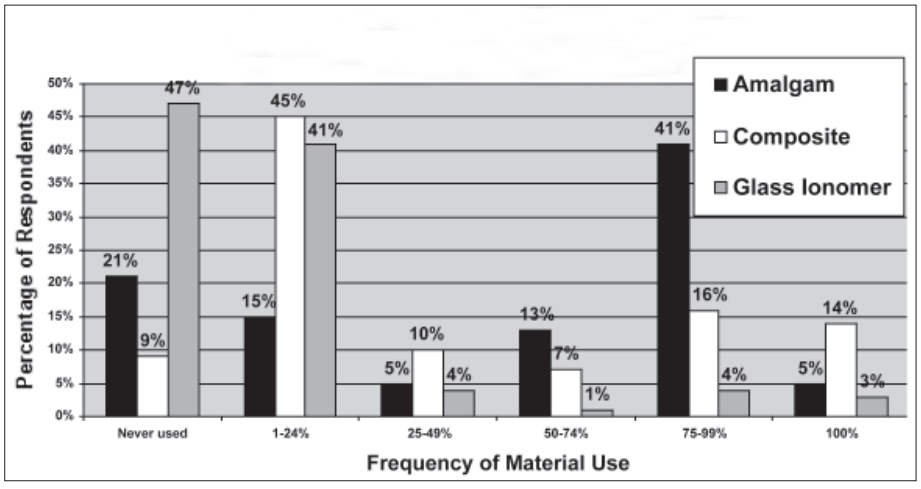

Figure 2. Percentage of time a material is used to restore Class II lesions in primary molars

Table 2. Reasons Given for Using Particular Materials in Class II Restorations in Primary Teeth

Reasons for using a particular material in Class II restorations in primary teeth	% of amalgam users (N=227)	% of composite users (N=260)	% of glass ionomer/resin-modified glass ionomer users (N=151)
Historically safe, reliable, and affordable	78		
More affordable for the patient	67		
Requires less time and/or fewer steps to place	65		
Requires less patient cooperation	64		
Superior/equivalent longevity and mechanical properties	57	25	8
In my clinical experience, the material is superior	52	14	11
Use of the material is supported by research and is evidence-based	51	27	22
Esthetics is of less concern for posterior teeth	45		
Provide for more esthetic restorations		78	23
My patients prefer or insist on nonamalgam restorations		86	28
Offers the benefit of fluoride release			69
More comfortable with the technique of placing	24	13	9
Was primarily taught the material in school	22	3	0
There are no nonamalgam alternatives I find acceptable or superior	19	4	4
Other	9	10	
I am concerned about toxicity of alternate available materials	3	9	1

1. 53% of the practitioners used a single-step, light curable agent (fifth generation);
2. 35% used a 2-step, light curable agent (fourth generation);
3. 9% used an all-in-one system (such as the Prompt L-Pop);
4. 1% used a self-cure adhesive.

Glass ionomer/resin-reinforced glass ionomer (RMGI)

Eighty-eight percent of the respondents used glass ionomer/RMGI less than 25% of the time in restoring Class II lesions in primary teeth, while 8% of the practitioners used the materials in over 50% of their Class II restorations (Figure 2). The main reason practitioners gave for using glass ionomers/RMGI's was the benefit of fluoride release (69%). Other reasons for the material's use are included in Table 2. Thirty-eight percent of the respondents felt that there were no indications for the use of glass ionomer/RMGI in Class II lesions in primary teeth. Practitioners were divided on what steps should be taken prior to material placement, with:

1. 32% of the practitioners placing the material directly in the cavity preparation;
2. 27% acid etching and bonding before placing the material;
3. 25% using only a conditioner prior to placement of the glass ionomer/RMGI;
4. 14% only acid etching and then placing the material in the cavity preparation.

Restorative technique

In nonamalgam Class II restorations, most practitioners (49%) used a classic Class II preparation similar to that of an amalgam preparation. Thirty-seven percent of the practitioners used a conservative preparation with no occlusal extension (slot-type), with 39% of these practitioners placing retention grooves in the proximal box. Fifty-three percent of the clinicians felt that a rubber dam was mandatory when restoring Class II carious lesions in primary teeth, while 30% tried to always use a rubber dam but felt there were situations where they may not be able to place one. Eighteen percent only occasionally or never used a rubber dam. Chi-square analysis revealed that rubber dam usage was not significantly related to the choice of primary restorative material for Class II restorations in primary teeth (P=.13).

Role of dental literature

Most clinicians (76%) felt the dental literature played a major but not necessarily a primary role in their selection of restorative materials. The relative importance of the dental literature was not significantly different between those respondents who preferred amalgam restorations and those who preferred esthetic, nonamalgam restorations (P=.75, chi-square test).

Discussion

The finding that amalgam was primarily used by 57% of the responding California pediatric dentists in restoring Class II lesions in primary teeth is in disagreement with 2

recently published surveys conducted in Florida and "Australasia." Among the members of the Australasian Academy of Paediatric Dentistry and the Australian and New Zealand Society of Paediatric Dentistry, 84% of the practitioners chose to use tooth-colored restorative materials when placing Class II restorations in primary molars, with glass ionomer cement being the material most often selected.[11] In Florida, only 28% of the pediatric dentists chose amalgam as their preferred material for restoring Class II carious lesions in primary molars, whereas 46% chose resin-based materials.[12]

The present study's results are more in agreement, however, with the materials currently being taught in dental schools. In 2001, Guelmann et al[13] found that, while hybrid composites and compomers were gaining in popularity among pediatric departments in North American dental schools, most (63%) continued to teach the use of amalgam as the material of choice for Class I and II restorations. Similar surveys conducted in Brazil, North America, Europe, and Japan revealed that a majority of dental schools devoted only 5% to 20% of their curriculum time towards teaching posterior resin-based composite restorations.[14] Notably, only 22% of the amalgam users in the present study reported that one reason they used amalgam for Class II restorations in primary teeth was because use of amalgam was primarily taught during dental school and/or their residency program.

With only 5% of this study's respondents primarily using glass ionomer/RMGI in Class II restorations in primary molars, the material's popularity among California pediatric dentists differs markedly from dentists in Australia and New Zealand,[11] but resembles more closely the material's popularity in Florida (<10%).[12] A recent Norway survey demonstrated that the popularity of glass ionomer has been decreasing, with only 46% of the restorations placed in primary teeth being of glass ionomer-related materials in 2001, compared to 80% seen 5 years previously.[3] This popularity decrease may be due to the variability in findings when glass ionomer-type materials have been compared to composites in in vitro studies[15] and/or to the significantly inferior short term clinical performance of glass ionomer over amalgam in multiple longevity studies.[2,3,8,16,17]

The routine use of a bonding agent when placing Class II amalgam restorations in primary teeth by 15% of the amalgam users in this survey agrees with the finding from Guelmann et al[13] that 15% of North American pediatric dentistry departments currently recommend the use of total etch and bonding agents as a standard procedure in placing Class II amalgam restorations. A 1995 survey by Christensen,[4] however, reported that a much larger percentage of dentists (64%) apply bonding agent prior to amalgam placement.

In the present study, 49% of the clinicians used classic Class II preparations for their nonamalgam restorations, while 37% used rounded, conservative "slot-type" preparations without occlusal extensions. This differs significantly from the results of a similar survey conducted in Florida, where 65% of the respondents used slot-type preparations for their resin-based Class II restorations.[12]

Concern over the potential adverse effects of mercury from dental amalgam has fueled an international debate over the placement of amalgam restorations in children. While the use of amalgam restorations is currently not banned in any European Union country,[6] general recommendations against the use of amalgam in children and pregnant females are found in Canada, Austria, Germany, Sweden, Norway, Denmark, France, and Finland.[6,8,18] Ninety-one percent of the respondents who used composite for restoration of Class II lesions in primary teeth did not feel amalgam toxicity was a reason to use a nonamalgam material. This finding is consistent with most official reviews, including those by the American Dental Association (ADA), the United States Public Health Service, and the British Society of Paediatric Dentistry, which have concluded that no restrictions in the use of dental amalgams should be made, as there exists "no sound scientific evidence supporting a link between amalgam fillings and systemic diseases or chronic illness."[19]

Beyond esthetics, cost, wear, microleakage, and retention, there are factors specific to the primary dentition that must be considered when selecting a restorative material. The increased technique sensitivity and time required for placing most tooth-colored restorations can be considered contraindications for placing esthetic restorations in younger patients where patient cooperation can be limited.[20] Bond strengths in relationship to the degree of microleakage have also been of concern in placing resin-based restorations in the primary dentition. The decreased mineralization or higher organic content,[21] increased thickness of the hybrid layer (and thus decreased adhesive resin penetration),[22] and morphological differences[20] of primary teeth have all been cited as explanations for the lower bond strengths found in primary teeth compared to permanent teeth in previous dentin bonding studies.[23,24] On the other hand, recent literature reports neither microleakage[25] nor dentin bond strengths[23,26] to be significantly different in primary vs permanent teeth.

In the present study, of the 67 clinicians who responded that they did not routinely use amalgam, less than 50% reported that poor patient cooperation, poor oral hygiene, or excessively large cavity preparations were conditions under which they would consider using amalgam. With esthetics and patient preference being the overwhelming reason for use of composite resins among the practitioners in the present study, pediatric dentists may base their decision to use tooth-colored restorations on the limited lifespan of primary teeth and the need to please the public. Proponents of nonamalgam alternatives have argued that the expected longevity of a restoration in a primary tooth may be justifiably shorter than that in a permanent tooth.[5,20] Fuks et al[7] found that composite Class II restorations performed similar to amalgam and

resin-reinforced glass ionomer restorations up to 18 months but performed significantly worse between 19 to 24 months. The authors concluded that composite Class II restorations are indicated if the teeth are expected to exfoliate within 2 years. Further, the ADA standard set for minimum longevity of a restorative material is 3 years in the primary dentition.[27]

Amalgam restorations have been shown to require replacement sooner in primary teeth than in permanent teeth.[3] While this observation may be explained either by the decreased lifespan of primary teeth or by the general increased difficulty of placing restorations in the pediatric population, the median age of failure of glass ionomer-type restorations, interestingly, was found to conform more with that of the permanent dentition.[3] Christensen[5] argued that the advantage of fluoride release in compomers, hybrid ionomers (or resin-modified glass ionomers), and enhanced-strength glass ionomers have made these materials the "most promising" or "best" restorative materials for primary teeth, challenging the continued use of amalgam in children.

The fact that 40% of this study's respondents reported primarily using a nonamalgam, esthetic restorative material for restoring Class II lesions in primary teeth agrees with the movement away from amalgam restorations seen in Europe,[2,3,8] "Australasia,"[11] and areas within the United States.[8,12] Recent studies, however, continue to demonstrate that amalgam restorations outlast those of tooth-colored materials.[6,7,16,17,28-31] In light of the comparatively shorter functional lives of tooth-colored restorations, one must consider the potential negative effect their increasing use can have on the cost of restorative therapy.[3] This becomes a significant issue when reimbursement (or lack of reimbursement) for posterior tooth-colored restorations by insurance plans, Medicaid and other government-financed programs is considered. Interestingly, among the various factors considered in this study (rubber dam usage, role of literature, number of years in practice, or number of patients seen daily, etc.), the only factor found to be significantly related to the choice of restorative material was the types of insurance plans accepted by the respondents.

The discrepancy between the longevity studies comparing amalgam to tooth-colored restorations and the materials being used in practice is reflected in this study's results, where 88% of clinicians felt that dental literature played a primary or major role in their selection of restorative materials, but no significant relationship was found between the role of dental literature and the materials chosen by the practitioners.

While this lack of significance may be related to the lack of unanimous agreement in the dental literature supporting one material or technique over another, it may also be due to a bias introduced in the questionnaire's broad definition of "major role." Under this definition, selecting "major role" could have appealed to clinicians as a less disputable, intermediate choice between the more extreme choices of "primary" and "minor" roles.

Nonetheless, a recent literature review of posterior resin-based composites by Burgess et al[32] emphasizes the importance of dental literature by stating that the proper use of resin-based composites in posterior teeth "requires knowledge of adhesives, composites, polymerization kinetics, and the ability to apply those principles to the patients being treated."

Because this survey included only members of CSPD, some caution must be taken when generalizing the survey's results to all California pediatric dentists. The exact percentage of Californian pediatric dentists who are (or are not) members of CSPD is not currently known, nor is it known whether nonrespondents or nonmembers of CSPD are similar in characteristics to this survey's respondents. While approximately 10% of the active Californian members of the American Academy of Pediatric Dentistry are not also CSPD members, CSPD has been estimated to represent an excess of 80% of the active California pediatric dentists.

Conclusions

While amalgam was the most common material used for Class II restorations, nonamalgam materials were significantly popular among pediatric dentists in California.

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