

# Curriculum Time Compared to Clinical Procedures in Amalgam and Composite Posterior Restorations in U.S. Dental Schools: A Preliminary Study

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**Abstract:** Dental clinicians have an expanding range of biomaterial choices for restoring tooth structure. Scientific developments in cariology, advances in dental biomaterials, and patients' esthetic concerns have led to a reduction in amalgam restorations and an increase in composite restorations. The aim of this study was to compare teaching time with students' clinical procedures in amalgam and composite posterior restorations in dental schools across the United States. Academic deans in 60 schools were invited to complete a survey that asked for the amount of instructional time for amalgam and composite posterior restorations and the number of clinical restorations performed by their Classes of 2009, 2010, and 2011. Of these 60, 12 returned surveys with complete data, for a 20% response rate. Responses from these schools showed little change in lecture and preclinical laboratory instruction from 2009 to 2011. There was a slight increase in two-surface restorations for both amalgam and composites; however, the total number of reported composite and amalgam restorations remained the same. Of 204,864 restorations reported, 53% were composite, and 47% were amalgam. There were twice as many multisurface large or complex amalgam restorations as composites. One-surface composite restorations exceeded amalgams. Among the participating schools, there was little to no change between curriculum time and clinical procedures. Findings from this preliminary study reflect a modest increase in two-surface resin-based restorations placed by dental students from 2009 to 2011 and little change in curricular time devoted to teaching amalgam restorations. The total number of posterior composite restorations placed by students in these schools was slightly higher than amalgams.

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In 1989, Wilson and Setcos reported the results of a worldwide survey on teaching posterior composite restorations in dental schools.<sup>1</sup> At that time, the teaching of posterior composite restorations was limited, yet those authors suggested that schools incorporate such instruction into their curricula. This development was predictable based on the tenets of a minimally invasive approach as summarized by Murdoch-Kinch and McLean.<sup>2</sup> In another article, Wilson concluded that, "subject to meeting a number of prerequisites, the change from amalgam to tooth-colored materials may cause relatively little curriculum disruption, with the added bonus of a consequential shift from reparative to preservative, minimal invasive dentistry."<sup>3</sup> These "prerequisites"

consisted of establishing a set of beliefs about what content was relevant to teaching posterior composites. In 2006, Lynch et al. reported that posterior composite instruction was well established in U.S. dental schools although they found inconsistencies in the content.<sup>4,5</sup>

In 2008, the European Commission on Health and Consumer Protection's Scientific Committee on Emerging and Newly Identified Health Risks concluded that dental health could be adequately maintained by both types of material.<sup>6</sup> The American Dental Association (ADA) review of the empirical literature on dental amalgam agreed that it remains a viable treatment for dental restorations.<sup>7</sup> Both of the materials are considered safe to use, are asso-

ciated with very low rates of adverse effects, and have shown no evidence of association to systemic disease.<sup>6,7</sup> The impact of these studies differs among academic dental institutions. Reduction of the use of amalgam in European dental education is supported by the findings of the European Commission's Scientific Committee: "There is, obviously, a greater level of aesthetic appeal with those alternatives that are tooth-colored compared to the metallic amalgam. Furthermore, these alternatives allow the use of minimally interventional adhesive techniques. These . . . trends [suggest there will be] . . . a sustained reduction in the use of dental amalgams in clinical practice across the European Union."<sup>6</sup>

Many factors influence the contents of dental curricula including scientific research, public opinion, and socioeconomic and political policies. Dental schools worldwide continuously revise their curricula to incorporate innovative teaching techniques and technologies and ensure their students are gaining the appropriate knowledge and skills to practice effectively.<sup>8,9</sup> However, a shift to the teaching of posterior composite restorations requires a knowledge of evidence-based dentistry and calibration of instructors' skills. Ben-Gal and Weiss found that instructors in Israel with fewer than ten years' experience preferred posterior composite resin restorations in 54.8 percent of hypothetical situations, compared to 37.2 percent by instructors with ten or more years of experience.<sup>10</sup> Rosenstiel et al. concluded that many dentists have not replaced posterior metallic restorations with composites.<sup>11</sup> This finding supports the longevity of amalgam restorations as a treatment option, consistent with the philosophy of minimally invasive dentistry<sup>2,7,12</sup> and preservation of the remaining tooth structure. Opdam et al. conducted a retrospective study comparing the longevity of three-, four-, and five-surface amalgam and composite restorations relative to caries risk and concluded that the caries risk of patients played a significant role in restoration survival.<sup>13</sup> In the high-risk group, composite and amalgam restorations performed comparably, with amalgam performing better on smaller restorations. For the combined population and low-risk group, however, composite restorations showed better survival at 12 years.

As required by the Commission on Dental Accreditation (CODA), dental students should be educated to make evidence-based decisions. Evidence-based instruction is defined by CODA as the "judicious integration of systematic assessments of clinically relevant scientific evidence, relating to

the patient's oral and medical condition and history, supported by the dentist's clinical expertise and the patient's treatment needs and preferences."<sup>14</sup> Using their clinical expertise, dentists also need to educate their patients about treatment options, so that informed consent is an educated decision. Remuneration from private and public insurance may also influence restorative material selection. While Medicaid currently pays for either amalgam or composite restorations, cost differences in some practices may affect patient choice of material.

In 2007, the University of Florida College of Dentistry undertook a self-assessment to compare preclinical teaching in amalgam and composite restorations with clinical procedures in our student dental clinics. The conclusion of the study was "There is a move from amalgam towards composite restorations in posterior teeth and that the data suggest that dental curricula may not keep pace with the clinical shift."<sup>15</sup> Wilson<sup>3</sup> and Lynch et al.<sup>5</sup> documented similar results internationally. These studies raised questions about how much predoctoral curriculum time should be invested in teaching amalgam and whether the clinical services provided should be aligned with the curriculum. The aim of our study was to compare teaching time (effort) with student clinical procedures in amalgam and composite posterior restorations across U.S. dental schools.

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## Materials and Methods

The University of Florida Institutional Review Board classified this study as exempt (IRB #2010-U-348). A 12-question survey was emailed to 60 of the 61 academic deans at U.S. dental schools in June 2011 via SurveyMonkey. A new school that did not yet have students in clinical patient care was not included. Contact information was acquired through the American Dental Education Association (ADEA) Academic Deans ListServ. The academic deans were asked to complete as much curricular information as they could and to consult with their schools' clinical deans as needed regarding the clinical data. Two reminders were emailed in July; the survey closed in August 2011.

The survey asked the academic deans to report the amount of instructional time and clinical data regarding amalgam and composite posterior restorations for their schools' graduating Classes of 2009, 2010, and 2011. The respondents were asked to indicate how their posterior restoration curriculum

was sequenced: if amalgam was taught first followed by composite, if composite was taught first followed by amalgam, or if the two materials were taught concurrently. Other questions asked them to specify the amount of lecture and laboratory time for the two materials. Finally, the participants were asked to provide the costs at their predoctoral student dental clinic of composite and amalgams for one-surface, two-surface, three-surface, and four-surface restorations and to report the number of clinical procedures completed for each surface across a three-year period.

## Results

Of the 60 potential respondents, 33 replied; however, five of the returned surveys were found to be duplicates and were removed from the analysis, and four had incomplete data. Of the remaining 24 surveys that provided complete curriculum information, 12 provided complete clinical data. These 12 responses, representing a 20% response rate, were the focus of the analysis. Six of the 12 responding schools were located in the Eastern region, five in the Central region, and one in the Western region.

Six of these schools reported providing more than ten hours of evidence-based instruction in teaching posterior restorations; two reported 6-10 hours; three reported 1-5 hours; and one reported no evidence-based hours of instruction in this subject. Seven of the schools reported teaching amalgam prior to composite posterior restorations. Four schools reported teaching composites before amalgams, and one indicated that the two were taught simultaneously.

Reported curricular hours assigned to lecture and laboratory in the preclinical instruction of amal-

gam and composite posterior preparation and restoration are shown in Table 1. Regarding the amount of lecture time devoted to education in amalgam restorations, eight schools reported fewer than 20 hours, one reported 20-25 hours, two reported 26-40 hours, and one reported more than 40 hours for all classes. Regarding the amount of time for laboratory instruction in amalgam, six schools reported between one and 59 hours; three reported 60-69 hours; two reported 70-79 hours for the Class of 2009; one reported 70-79 hours for the Classes of 2010 and 2011; one reported 80 or more hours for the Class of 2009; and two reported 80 or more hours for the Classes of 2010 and 2011.

Regarding the amount of lecture time devoted to education in composite restorations, for the Class of 2009, ten schools reported 1-19 hours; one reported 20-25 hours; and one reported 26-40 hours. For the Class of 2010, nine schools reported 1-19 hours of lecture in composite restorations; two reported 20-25 hours; and one reported 26-40 hours. For the Class of 2011, nine schools reported 1-19 hours of lecture in composite restorations; one reported 20-25 hours; and two reported 26-40 hours. No programs reported more than 40 hours of lecture instruction in composite. Regarding laboratory instruction in composite restorations, 11 schools reported 1-59 hours and one reported 70-79 hours for the Class of 2009. For the Class of 2010, nine schools reported 1-59 hours, one reported 60-69 hours, and one reported 70-79 hours. For the Class of 2011, ten schools reported 1-59 hours, one reported 60-69 hours, and one reported 70-79 hours. No schools reported 80 or more hours of laboratory instruction in composite. Overall, there was little change over this three-year period for time spent in preclinical lecture and laboratory instruction in posterior restorations in the responding schools.

**Table 1. Comparison of lecture and laboratory time for Classes of 2009, 2010, and 2011 by dental school (N=12)**

Class	Amalgam Lecture Hours				Amalgam Laboratory Hours			
	1-19	20-25	26-40	≥41	1-59	60-69	70-79	≥80
2009	8	1	2	1	6	3	2	1
2010	8	1	2	1	6	3	1	2
2011	8	1	2	1	6	3	1	2
Class	Composite Lecture Hours				Composite Laboratory Hours			
	1-19	20-25	26-40	≥41	1-59	60-69	70-79	≥80
2009	10	1	1	0	11	0	1	0
2010	9	2	1	0	9	1	1	0
2011	9	1	2	0	10	1	1	0

Note: One program did not report 2010 composite laboratory hours.

The data showed only a slight increase in composite lecture hours and a slight increase in amalgam laboratory hours in 2010 and 2011.

Five schools reported intending to increase instructional time for CAD-CAM and other indirect resin and porcelain restorations. Three schools planned on reducing curriculum time in amalgam instruction. Two schools did not anticipate curricular changes, while one reported having made significant changes. Ten schools reported expecting changes in their curriculum hours or course content in the upcoming three years. These changes included additional hours on CAD-CAM (two schools), decrease in amalgam and increase in composite and ceramic (two schools), more concentration on amalgam preparations and composite restorations (one school), including more partial coverage indirect restorations (one school), including larger Class II restorations (one school), and incorporating more evidence-based dentistry (one schools). Two responses did not provide details about expected changes.

The responses regarding clinical production by restoration surface for each class are shown in Figure 1. There was a slight increase in total procedures over the three-year period from the Classes of 2009 (65,051) to 2010 (69,003) to 2011 (70,810). These schools reported many more one- and two-surface

restorations (85,190 and 74,209, respectively) than large restorations characterized by three and four surfaces (35,432 and 10,033, respectively). Twice as many one-surface composite restorations (59,412) were reported being performed than one-surface amalgam restorations (25,778), while the number of two-surface composites (36,277) was comparable to two-surface amalgams (37,932). There were twice as many three-surface amalgam restorations (23,937) as three-surface composite restorations (11,495) and four times as many four-surface amalgam restorations (8,009) as four-surface composite restorations (2,024.) For these 12 schools, the cost of composite restorations was generally higher than the cost of amalgam restorations (Table 2). One program reported the same fees for the two types.

## Discussion

Previous studies have found increases in the teaching of posterior composites in dental schools in the United States, Canada, Ireland, and United Kingdom over the last 15 years.<sup>3-5</sup> This increase was more evident in the interval between the 1997 and the 2004-05 surveys than between the 1989 and 1997 surveys. Our study found a slight increase in

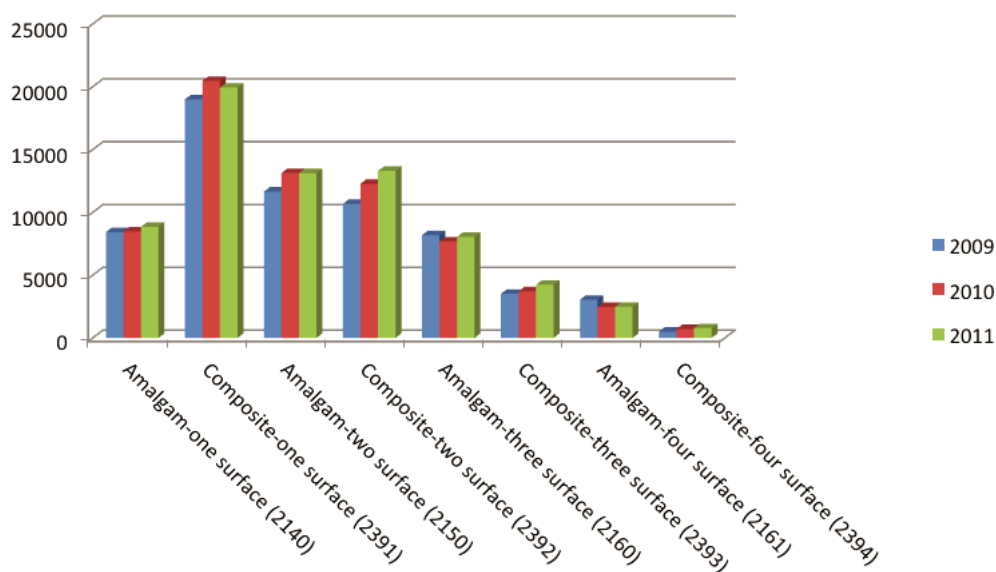


Figure 1. Total number of amalgam and composite clinical procedures reported for Classes of 2009, 2010, and 2011 by participating schools (N=12)

**Table 2. Comparative cost for composite and amalgam by number of surface restorations reported by participating schools (N=12)**

	Composite Cost Less Than or Equal to Amalgam	Amalgam Cost Less Than Composite	No Response	Range of Cost Differential
1-surface restoration	1	9	2	\$0-\$33
2-surface restoration	1	8	3	\$1-\$63
3-surface restoration	0	11	1	\$5-\$74
4-surface restoration	0	11	1	\$0-\$67

composite lecture and laboratory hours from 2009 to 2010, while the time devoted to amalgam lecture and laboratory hours remained unchanged. This relative lack of change in amalgam curriculum time across the three-year period differs from the findings of Lynch et al., who predicted that the net gain in curriculum time associated with adding posterior composites would be offset by a reduction in curriculum time assigned to teaching amalgam restorations.<sup>4,5</sup> A longer period of time may be needed to better evaluate this prediction. Of the 204,864 restorations reported in our study, 47% were amalgam, and 53% were posterior composite, inferring that the “limited clinical experience” previously noted by Wilson and Setcos<sup>1</sup> is no longer a concern. Our data from 12 U.S. dental schools showed that, for these institutions, dental students were placing more than twice as many one-surface posterior composites and at least as many two-surface posterior composite restorations as their amalgam counterparts (Figure 1). This corroborates the prevalence of posterior composite restorations in student dental clinics<sup>16</sup> and the “marked change in instruction in placement of posterior composites in U.S. dental schools” reported by Lynch et al.<sup>4,5</sup> in 2006. Our data indicating more three- and four-surface amalgam restorations compared to their composite counterparts reflect differences in treatment planning and coding rather than differences in technique noted in Lynch’s studies.<sup>4,5</sup> Our findings are also comparable to those reported by Rosenstiel et al.<sup>11</sup>

The findings in our study show composite restoration fees were higher than amalgam fees. Overton and Sullivan found that posterior composite restorations placed by dental students were replaced ten times more frequently than amalgam restorations.<sup>17</sup> While composite science has advanced, amalgam continues to have certain advantages over composite in terms of marginal integrity in situations in which moisture control is difficult to contain and wear resistance is likely to be problematic in posterior occlusal function.<sup>3,16,17</sup> Increasing Clean Water Acts

may result in environmental fees associated with the use of amalgam restorations. Current minimally invasive dentistry offers options for repair rather than replacement.<sup>18</sup> Based on the ADA’s position paper on dental amalgams,<sup>7</sup> it may not yet be prudent for U.S. dental schools to eliminate amalgam restorations from their curricula.

One limitation of our study was related to survey distribution. The survey was sent via email with two bi-monthly reminders, rather than using pre-notification and weekly reminders. Another limitation may have been respondents’ access to clinical information. This is based on receiving nearly twice as many responses regarding curriculum time as clinical procedures. Clinic production is not always available by student class, and clinical management programs may or may not be able to report the information we requested. We also recognize that reporting large multisurface restorations may not be consistently defined in the same way across schools; therefore, the information reported may not be generalizable across all dental schools. Finally, the low response rate limits our ability to generalize these results regarding U.S. dental schools.

The results of this study are exploratory. The findings are in no way meant to imply that when the number of procedures increases in the clinic, there should be more time spent in teaching these techniques preclinically. This decision should be based on the best use of curriculum time and resources combined with patient preferences and treatment outcomes.

## Conclusion

The purpose of this study was to compare preclinical teaching efforts to clinical production of dental students. The findings showed a slight increase in composite lecture hours and amalgam laboratory hours across a three-year period in the 12 schools in the study. Lecture and laboratory hours for composite

instruction remained less than for amalgam. A slight increase in two-surface restorations for both amalgam and composites was reported. Dental schools should routinely evaluate their curricula to incorporate advances in dental sciences to best prepare new dentists to improve their patients' oral health outcomes. The findings in this study point out that even though more dental schools retain a traditional sequence of instruction and more hours in amalgam preclinical instruction, the number of posterior composites exceeded amalgams. The results regarding comparative cost of the two show that composite restorations are somewhat higher than amalgam restorations. While cost advantage to the patient may be one factor, other factors to be considered in material selection include bite force, caries risk, moisture control, bonding efficacy, and age and experience of the supervising instructor. Curriculum alignment and the use of evidence-based dentistry may best address the growing body of knowledge that dental schools must teach future dental professionals.

## REFERENCES

1. Wilson NH, Setcos JC. The teaching of posterior composite: a worldwide survey. *J Dent* 1989;17:S29-33.
2. Murdoch-Kinch C, McLean M. Minimally invasive dentistry. *J Am Dent Assoc* 2003;134:87-95.
3. Wilson NHF. Curricular issues changing from amalgam to tooth-colored materials. *J Dent* 2004;32:367-9.
4. Lynch CD, Robert J, McConnell RJ, Wilson NH. Teaching the placement of posterior resin-based composite restorations in U.S. dental schools. *J Am Dent Assoc* 2006;129:1415-21.
5. Lynch CD, McConnell RJ, Wilson NH. Teaching the placement of posterior composite resin-based restorations in U.S. dental schools. *J Am Dent Assoc* 2006;137:619-35.
6. European Commission on Health and Consumer Protection, Scientific Committee on Emerging and Newly Identified Health Risks. Scientific opinion on the safety of dental amalgam and alternative dental restoration materials for patients and users. 6 May 2008. At: [http://ec.europa.eu/health/scientific\\_committees/opinions\\_layman/en/dental-amalgam/1-3/1-tooth-fillings.htm](http://ec.europa.eu/health/scientific_committees/opinions_layman/en/dental-amalgam/1-3/1-tooth-fillings.htm). Accessed 29 May 2014.
7. American Dental Association, Council on Scientific Affairs. State of dental amalgam, 2009. At: [www.ada.org/1741.aspx](http://www.ada.org/1741.aspx). Accessed 6 Feb. 2012.
8. Lynch CD, Frazier KB, McConnell RJ, et al. Minimally invasive management of dental caries: contemporary teaching of posterior resin-based composite placement in U.S. and Canadian dental schools. *J Am Dent Assoc* 2011;142(6):612-20.
9. Liew Z, Nguyen E, Stella R, et al. Survey on the teaching and use in dental schools of resin-based materials for restoring posterior teeth. *Int Dent J* 2011;61:12-8.
10. Ben-Gal G, Weiss EI. Trends in material choice for posterior restoration in an Israeli dental school: composite resin versus amalgam. *J Dent Educ* 2011;75(12):1590-5.
11. Rosenstiel SF, Land MF, Rashid RG. Dentists' molar restoration choices and longevity: a web-based survey. *J Prosthet Dent* 2004;91:363-7.
12. Mjör IA, Gordan VV. Failure, repair, refurbishing, and longevity of restorations. *Oper Dent* 2002;27:528-34.
13. Opdam N, Bronkhost E, Loomans B, Huysmans M. Twelve-year survival of composite vs. amalgam restoration. *J Dent Res* 2010;89(10):1063-7.
14. Commission on Dental Accreditation. Accreditation standards for dental education programs, 2013. At: [www.ada.org/sections/educationAndCareers/pdfs/predoc\\_2013.pdf](http://www.ada.org/sections/educationAndCareers/pdfs/predoc_2013.pdf). Accessed 29 May 2014.
15. Ottenga M, Mjor I. Amalgam and composite posterior restorations: curriculum versus practice in operative dentistry at a U.S. dental school. *Oper Dent* 2007;30:524-8.
16. Mjor AM, Wilson NH. Teaching Class I and Class II direct composite restoration: results of a survey of dental schools. *J Am Dent Assoc* 1998;129:1415-21.
17. Overton JD, Sullivan DJ. Early failure of Class II resin composite versus Class II amalgam restorations placed by dental students. *J Dent Educ* 2012;76(3):338-40.
18. Gordan V, Riley JL, Blaser, et al. Alternative treatments to replacement of defective amalgam restoration: results of a seven-year clinical study. *J Am Dent Assoc* 2011;142(7):842-9.