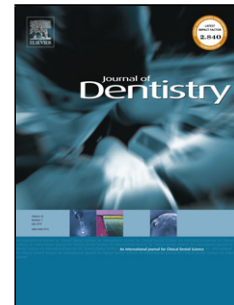


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Teaching of posterior composites in dental schools in Japan – 30 years and beyond

Short title: Teaching of posterior composites in dental schools in Japan

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Title: Teaching of posterior composites in dental schools in Japan - 30 years and beyond

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Abstract:

Objectives: The teaching of posterior composites has been a major part of the curriculum in Japanese dental education for several decades. The aim of this paper was to investigate the current trends in the teaching of posterior composites to undergraduate dental students in Japan by comparing the results of surveys conducted for over 30 years.

Methods: In late 2016-early 2017, a questionnaire seeking information on the teaching of posterior composites was distributed via e-mail to the persons responsible for teaching operative dentistry in 29 dental schools having undergraduate dental degree programs in Japan. The results obtained were compared to those from surveys conducted in 1986, 1997, and 2007.

Results: All 29 schools that were sent the questionnaire completed the responses (response rate = 100%). All 29 schools reported teaching the placement of composite in occlusal and two-surface occluso-proximal cavities in both premolars and molars. Four schools reported not teaching the placement of three-surface occluso-proximal composites in premolars and five schools reported not teaching it for molars. Twenty-seven (93%) schools taught composite first as a part of the preclinical curriculum, whereas 15 (65%) schools did so in the survey of 2007.

Variations were noted between schools in the teaching of, cavity design. In contrast, greater consistency was observed in the teaching of techniques for protecting exposed dentin and light-curing technologies.

Conclusions: It is hoped that measures intended to increase the clinical experience of restoring teeth with direct composite-resin for dental students in Japan will be effective, providing opportunity to bring dental education in Japan more into line with international norms.

Keywords: Posterior composites, Dental education, Operative dentistry, Dentin bonding

Teaching of posterior composites in dental schools in Japan – 30 years and beyond

1. Introduction

A growing body of evidence has demonstrated that the clinical survival of posterior composite-resin restorations (posterior composites) service may be found to be > 90% after five years and >80% after 10 years [1, 2].

While these data, together with the preference of patients for tooth-colored restorations suggest that best performing composite-resin restorations (composites) may be viewed as the clinically successfully material for direct restorations in posterior teeth, they also demonstrate that modern minimal-intervention (MI) approaches to the restoration of posterior teeth are best applied using contemporary composite restorative systems.

Worldwide surveys [3] have demonstrated that the teaching of posterior composite restorations is well-established internationally, and has increased in the last decade, largely at the expense of the teaching of traditional materials, notably dental amalgam.

There remains, however, variations in aspects of the teaching of posterior composites amongst dentals schools, both within and between countries, and across continents, specifically aspects of cavity design and placement technique. The teaching of posterior composites in Japan has been the subject of three previous investigations. (Table 1)[4, 5, 6]

In Japan, the art and science of posterior composites have advanced greatly in last two decades. However, metal inlay restorations (Fig.1) remain popular because the cost of their placement is covered by public health insurance. The number of amalgam fillings placed in Japan fell dramatically following the reporting of ‘Minamata disease’ - a neurological syndrome caused by severe mercury poisoning, was first discovered in Japan, in 1956. The frequency of amalgam fillings is now very low; indeed, the placement of dental amalgam in Japan could be considered to have been extinct [6].

Several studies in Japan have indicated no significant differences between the clinical performance of posterior composites and metal inlay restorations [7, 8].

However, cavity preparation for metal inlays is based on Black’s principles, sometimes resulting in the sacrifice of large amounts of intact tooth structure and unnecessary insult to the pulp-dentine complex. In contrast, posterior composites tend to be placed according to current minimum intervention techniques, maximizing the preservation of tooth tissue, and limiting pulpal insult [9]. As a consequence, the ‘restorative death spiral’ impact of posterior composites is much less than that of metal inlays and metal-based restorations. Despite the strong evidence-base supporting such thinking, the rate of translation of

contemporary minimum intervention operative dentistry into general dental practice worldwide has been slow. In Japan the system for oral healthcare still favors the now outmoded ‘drill and fill’ approach, despite the Japanese Society of Conservative Dentistry (JSCD) having developed evidence-based clinical guidelines for the restoration of carious teeth in adult patients in 2009 [10] and up-dated in 2015 [11].

These guidelines addressed the 16 most-frequent clinical questions about the management of dental caries such as enamel incipient caries, dentin caries including deep caries adjacent to pulp, and root caries. One of the clinical questions is ‘the usefulness of direct resin composite restorations for the restoration of posterior teeth’. In the guidelines, direct resin composite restorations are recommended for occlusal and proximal surfaces of posterior teeth. It is uncertain whether the guidelines have been effective in terms of changes having been made to the operative dentistry curriculum in Japanese dental schools.

The aim of the present study was to investigate the current teaching of posterior composites to undergraduate dental students in Japan.

2. Methods

In late 2016-early 2017, a questionnaire was distributed by e-mail to the individuals responsible for the teaching of operative dentistry in each of the 29 dental schools with undergraduate dental degree programs in Japan. The questionnaire sought information regarding the teaching of posterior composites. The questionnaire, based on the questionnaire used in previous studies for the purpose of comparing data, included both ‘open’ and ‘closed’ questions. The questionnaire was re-emailed to non-respondents after one month. The results were compared to those of previous surveys conducted in 1986 [4], 1997 [5], and 2007 [6] to identify changes and trends in teaching over the last 30 years.

3. Results

3.1. Response rate

Completed questionnaires were received from all 29 dental schools -a 100% response (Table 1). It was understood that the questionnaires had been completed by a senior member of the clinical academic staff responsible for the teaching of operative dentistry in each school.

3.2. Composite restorations taught

All 29 respondent schools reported teaching the placement of composite in occlusal and two-surface occluso-proximal cavities in both premolars and molars. Eighty six percent (25/29) and 83% (24/29) of the schools reported teaching the placement of composite in three-surface occluso-proximal cavities in premolars and molars, respectively (Table 2).

3.3. Pre-clinical and clinical teaching

3.3.1. Material

Twenty-seven (93%) of the schools reported teaching composite as the preferred (first) choice of material for the placement of direct restorations in posterior teeth. Two (7%) schools reported teaching metal inlays as the preferred approach. No school chose to teach amalgam.

All schools (n=29) indicated that the teaching of preferred material will remain unchanged in the foreseeable future.

3.3.2. Applications

The theoretical lectures -, clinical skills (simulation using models) - and clinical teaching of posterior composites in the restoration of occlusal - and two-and three-surface cavities in premolar and permanent molar teeth is detailed in Table 2.

The limited clinical teaching of posterior composites was not considered to be surprising, given that it is still common practice in Japan for undergraduate dental students to largely observe rather than provide clinical care; clinical experience being gained in postgraduate programs, entered immediately following completion of the primary dental degree program. When compared with the findings of the previous surveys, the use of composite in the restoration of posterior teeth has progressively expanded, notably in the restoration of two-and three-surface cavities in molars (Table 3).

3.3.3. Cavity design

Teaching of cavity designs for composite restorations varied among the schools. The differences in design from traditional amalgam restorations included 'no extension for prevention' (n=22, 76% of schools), box only preparations (n=11, 38% of schools), rounded internal line angles (n=22, 76% of schools), bevelled occlusal margins (n=15, 52% of schools) and bevelled box margins (n=13, 45% of schools). The teaching of cavity design was not found to have changed to any great extent since the time of the previous survey in 2007 [6] (Table 4).

3.3.4. Contraindications

The contraindications for the placement of posterior composites taught in the respondent dental schools are reported in Table 5. The most common contraindications for the placement of posterior composites were: 1) a history of an adverse reaction to composite resin (93% schools), 2) poor patient cooperation (38% schools), 3) sub-gingival margins (34% schools), and 4) poor oral hygiene (21% schools).

In comparison with the data on contraindications obtained in 2007 [6], 'inability to place rubber dam' when restoring occlusal and occluso-proximal cavities in premolars and molars would appear to have become cause for more concern in the intervening 10 years. In contrast, the buccolingual width of the occlusal portion of occluso-proximal cavities would appear to be a matter of lesser concern (Table 5).

3.3.5. Management of operatively exposed dentine

The data obtained regarding teaching the management of operatively exposed dentin prior to placing a posterior composite restoration is shown in Table 6. The trend shows the reduced use of liners and bases, even in deep (inner third of dentin) cavities.

3.3.6. Moisture control

In the 2017 survey, all schools taught the placement of rubber dam prior to posterior composite placement. While seven (24%) schools taught the use of rubber dam as mandatory (to be used in 100% of cases), 11 (38%) schools taught that it should be used in 'most' cases (>75%). Of the remaining schools six (21%) taught that it should be used 'often' (about 50% of cases), and five schools (17%) taught that it should be used 'sometimes' (about 25% of cases). Alternative forms of moisture control taught included cotton rolls (27 (93%) schools), gauze/throat pack (seven schools, 24%), and dry guard (two schools, 7%).

3.3.7. Matrix and wedging techniques

In the 2017 survey, all schools taught the placement of circumferential metal matrix bands when placing occluso-proximal composite restorations. In addition, sectional matrix systems were taught in 86% (25/29) of the schools. The use of wooden wedges was taught in 90% (26/29) of the schools, with plastic and light-transmitting wedges being taught in 72% (21/29) and 41% (12/29) of the schools respectively. The use of sectional matrix systems was found to have increased by 69 % since the time of the 2007 survey, where 17% (4/23) of the schools taught the systems [6].

3.3.8. Light-curing technologies

In the 2017 survey, all 29 schools taught the use of light-emitting diode (LED) light-curing units, with five schools (17%) also teaching the use of 'traditional' quartz-tungsten-halogen (QTH) light-curing units. In the 2007 survey [6], all 23 schools which responded taught the use of QTH units, with 61% (14/23) of schools having taught the use of LED units.

3.3.9. Finishing techniques

In the 2017 survey, twenty-six (90%) schools taught 'delayed finishing' (i.e., at least 24 hours after placement) of posterior composites. In 2007 [6], only 11 (48%) had such teaching. Eighteen (62%) schools taught the use of water-cooling while finishing -down 12% since 2007 [6]. Popular finishing instruments included finishing points such as fluted carbide burs and fine diamond points in 28 (97%) schools, finishing strips for occluso-proximal restorations in 28 (97%) schools, and finishing diamonds in 24 (83%) schools.

3.4. Dental amalgam

In the 2017 survey, no schools were found to teach the use of dental amalgam in clinical skills or in the care of patients.

3.5. Fees

The average fees of posterior composite restorations were as follows:

- For an occlusal composite in a premolar or molar: 2,400 Yen (approx. €18/US\$22)
- For an occluso-proximal composite in a premolar or molar: 3,200 Yen (approx. €24/US\$28).

Patients mostly pay 20–30% of these fees, the rest being covered by employers or government under the National Health Insurance scheme.

4. Discussion

Undergraduate dental education in Japan is delivered at 29 dental schools. The Programs generally last for 6 years, with clinical instruction tending to be limited to the final year, following clinical skills (simulation) training in typically the fourth and fifth years of instruction. The core curriculum is set by the government; however, each school is responsible for implementing and delivering its own teaching program. Students graduating from a Japanese dental school must pass the government's, computer-based, national final qualifying examination before receiving their license to practice.

The results of this survey indicate that the teaching of posterior composites in Japan is a well-established component of dental school curricula. In the 1986 survey, the teaching of posterior composites was found to be relatively limited, with 9 of 14 schools reporting inclusion in their curriculum [4]. Thereafter, teaching of the subject expanded beyond that observed in equivalent surveys in Europe and North America, according to data collected in 1997 [12, 13] and 2007 [14]. With the use of metal inlays (Fig.1) declining

in Japan, and despite growing interest in alternative, indirect, tooth-colored systems, it is anticipated that the teaching of posterior composites will continue to expand.

From the 2017 survey, it was found that all Japanese dental schools teach posterior composite in occlusal and two-surface cavities in premolars and permanent molars theoretically, in clinical skills (simulation) and through clinical observation. However, according to the survey, the undergraduate students in 69% of dental Schools in Japan graduate with no actual clinical experience of placing posterior composite in two-surface cavities. This is because Japanese dental schools, in particular those in urban areas, have difficulties in recruiting patients for students' clinics, as patients tend to have a preference for dental treatment by an experienced clinician and can choose from the local dental school or a number of dental practices. To help overcome these difficulties students are required to complete clinical skills 'gateway assessments' before participating in the clinical program.

In addition, the government is in the process of establishing a system for external validation of gateway assessments to ensure quality and encourage patient utilization of care in undergraduate student clinics. The system is expected to be launched within the next three years.

In the previous survey from 2007 [6], it was noted by one school in free comments that '...we still teach metal inlay restorations first in the curriculum given the demand of the practitioners who may employ the graduates. While the need to train graduates to be fit for immediate purpose and employment is acknowledged, it is considered more important to train graduates to be fit for future purpose when, in all probability, metal inlays will have become obsolete through the adoption of more minimal intervention approaches as recommended in the JSCD guidelines [10, 11]. These guidelines, together with publications such as the present report will hopefully prove to be a powerful tool in improving dental education, clinical outcomes in clinical practice and governmental healthcare insurance policy provisions.

The findings of the present study indicate trends toward common approaches in the management of operatively exposed dentin prior to the placement of posterior composites (Table 6) which conform with best available evidence [10, 15]. However, there would appear to be continuing differences of opinion on, in particular, aspects of cavity design (Table 4). Indeed, it could be considered that some elements of the teaching have not moved forward since the time of the last survey in 2007 [6], if not reverted to traditional dogma; for example, 'extension for prevention' (Table 4). International thinking would favor preparation form sufficient to manage caries, but no 'extension for prevention', especially if it involves the unnecessary sacrifice of sound tooth tissue [9]. Such thinking extends to proximal box preparations only, with no occlusal fissure extension, unless carious.

Rounded internal angles should be the norm, given the cusp-weakening effect of angular line- and point angles, and composites adaptation tending to be much better in cavities with rounded rather than sharply defined internal architecture [9]. Given that enamel prisms tend to be crosscut, creating so-called intra-enamel bevelling in occlusal and proximal preparations in premolars and molars intended for restoration with composite, there is no indication for additional bevelling of suitably finished cavosurface margins, occlusally, proximally or gingivally (Fig.2). Confusion over additional bevelling of cavosurface margins of posterior composite preparations may be due to preparation design for composite restorations in anterior teeth. Long, low, additional bevelling of the cavosurface margins of posterior composite cavities is contraindicated [9].

The use of sectional matrix systems with wooden wedges was found to have increased since the time of the 2007 survey [6]. There is no contemporary evidence base to support the use light-transmitting wedges. The use of traditional wooden wedges, which swell and adapt when they become moist, or flexible plastic wedges which adapt to the shape of the gingival margin following placement is to be encouraged.

5. Conclusions

The teaching of posterior composites in Japan is well-established and presented increased uniformity. Except for two schools which teach metal inlays first and aspects of cavity design, this teaching is tending to move toward a relatively common approach.

It is to be hoped that measures intended to increase the clinical experience of dental students in Japan will be effective, providing opportunity to bring dental education in Japan more into line with international norms.

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Figures

Fig 1



Fig 2

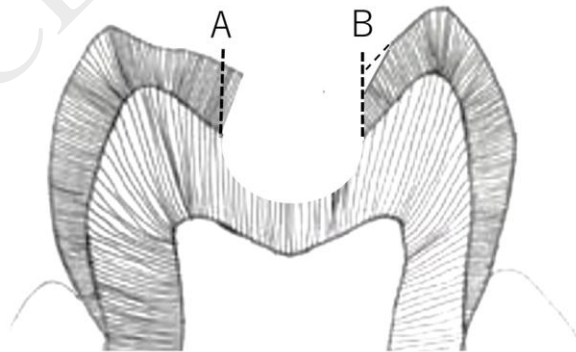


Table 1 - Details of surveys on the teaching of posterior composites in Japan.

Year	Title	Authors	Journal	Citation	Number of schools contacted	Number of respondent schools	Response rate (%)
2017	Teaching of posterior composites in dental schools in Japan.	Hayashi M, Yamada T, Lynch CD, Wilson NH	Present research		29	29	100
2007	Teaching of posterior composites in dental schools in Japan.	Hayashi M, Seow LL, Lynch CD, Wilson NH	J Oral Rehabil	2009; 36: 292-8	27	23	79
1997	Teaching of posterior composite restorations in Japanese dental schools.	Fukushima M, Iwaku M, Setcos JC, Wilson NH, Mjor IA	Int Dent J	2000; 50: 407-11	29	27	93
1986	The teaching of posterior composites: a worldwide survey.	Wilson NH, Setcos JC	J Dent	1989; 17 Supple.1: S29-33	29	14	49

Table 2 –Nature of the teaching of posterior composites.

	Lecture		Clinical skills (simulation)		Clinical program (observation)		Clinical program	
	Premolars	Molars	Premolar	Molars	Premolar	Molars	Premolar	Molars
Occlusal cavities	100%(29)	100%(29)	83%(24)	83%(24)	100%(29)	100%(29)	86%(25)	72%(21)
2-surface	100%(29)	100%(29)	83%(24)	52%(15)	100%(29)	93%(27)	31%(9)	31%(9)

3-surface	86%(25)	83%(24)	14%(4)	10%(3)	86%(25)	62%(18)	17%(5)	17%(5)
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Clinical program (observation) means that students observe and support clinical treatments by their tutors, but they do not treat patients by themselves, while clinical program means that students treat patients under the supervision by their tutors.

Table 3- Information on the teaching of applications of posterior composites 1986-2017.

Year	Number of respondent schools	Percentage of schools including teaching of posterior resin composites (%)	Schools teaching various types of posterior composite restoration					
			(% , n)					
			Occlusal premolar	Occlusal molar	2-Surface occluso-proximal premolar	2-Surface occluso-proximal molar	3-Surface occluso-proximal premolar	3-Surface occluso-proximal molar
2017	29	100%(29)	100% (29)	100% (29)	100% (29)	100% (29)	86% (25)	83% (24)
2007	23	100%(23)	100% (23)	100% (23)	96% (22)	74% (17)	39% (9)	35% (8)
1997	27	93%(25)	93% (25)	93% (25)	67% (18)	67% (18)	23% (6)	23% (6)
1986	14	64%(9)	No information collected on this question.					

Table 4 – Principles of cavity design taught; differences with ‘traditional’ amalgam cavities.

Year	Number of respondent schools	Principles of cavity design taught; differences with ‘traditional’ amalgam cavities.				
		(% , n)				
		No ‘extension for prevention’	‘Slot type’ cavity (i.e. no occlusal component)	Rounded internal line angles	Beveled occlusal margins	Beveled box margins
2017	29	76% (22)	38% (11)	76% (22)	52% (15)	45% (13)
2007	23	100% (23)	43% (10)	96% (22)	48% (11)	17% (4)

Table 5 – The contraindications taught to the placement of posterior resin composites in dental schools surveyed.

	Occlusal				Occ-prox cavity			
	Premolar		Molar		Premolar		Molar	
	2007	2017	2007	2017	2007	2017	2007	2017
History of adverse reaction to composite resin	96%(22)	90%(26)	96%(22)	90%(26)	96%(22)	93%(27)	96%(22)	93%(27)
Poor patient cooperation	30% (7)	28% (8)	30% (7)	31% (9)	35% (8)	38% (11)	39%(9)	38% (11)
Subgingival margins	N/A				26% (6)	34% (10)	26% (6)	34% (10)
Inability to place rubber dam	9% (2)	17% (5)	9% (2)	24% (7)	9% (2)	17% (5)	17% (4)	24% (7)
Buccolingual width of proximal box >1/2 intercuspal width	N/A				26% (6)	21% (6)	26% (6)	24% (7)

Buccolicangual width of occlusal portion is >2/3 of the intercuspical width	35% (8)	17% (5)	43% (10)	24% (7)	48% (11)	17% (5)	61% (14)	24% (7)
Poor oral hygiene	22% (5)	17% (5)	22% (5)	17% (5)	26% (6)	21% (6)	35% (8)	21% (6)
Replacement of a large amalgam restoration	9% (2)	7% (2)	13% (3)	7% (2)	35% (8)	14% (4)	39% (9)	14% (4)

Table 6 –Teaching of management of operatively exposed dentine (moderate/middle –third and deep/inner-third cavities; Ca(OH)₂ =calcium hydroxide; GIC=glass ionomer cement).

Year	Number of respondent schools	Techniques taught for management of operatively exposed dentine% (n)					
		Moderately deep			Deep		
		(middle third of dentine)			(inner third of dentine)		
		No liner/base	Ca(OH) ₂ & GIC	GIC only	No liner/base	Ca(OH) ₂ & GIC	GIC only
2017	29	93% (27) *	3% (1)	3% (1)	62% (18)	24% (7)	14% (4)
2007	23	91% (21)	0% (0)	13% (3)	35% (8)	48% (11)	48% (11)
1997	27	63% (17)	11% (3)	22% (6)	26% (7)	44% (12)	67% (18)

* 2 schools indicated to use flowable CR directly.