

Trends in Dental Education in the Persian Gulf - An Example From Iran: Contemporary Placement of Posterior Composites.

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Abstract - In recent years, there has been expansion of dental education programmes from established European and North American schools into regions in the Middle East, the Persian Gulf States, and Asia. Accompanying this, there has been migration of dentists from these regions of the world to Europe and North America in the hope of finding employment or to pursue postgraduate education. Little awareness exists, however, in western countries on the amount and level of clinical training provided in dental schools in which these dentists have trained. The aim of this paper is to investigate the teaching to undergraduate students in Iran of an important aspect of clinical dentistry which is showing continual development in western schools, namely the use of resin-based composites in the restoration of posterior teeth. In 2008, a questionnaire seeking information on the teaching of posterior resin-based composites was distributed by email to the person responsible for delivering teaching of operative dentistry in each of the 18 dental schools with undergraduate dental degree programmes in Iran. All 18 schools teach the placement of occlusal and occlusoproximal resin-based composite restorations in premolar and permanent molar teeth. Resin-based composites currently account for 42% of posterior direct restorations placed by undergraduates in Iran. Despite variations between dental schools being noted in the teaching of certain techniques for posterior resin-based composites, the overall extent and content of teaching of posterior resin-based composites in Iran could be described as comparable to that observed in western countries.

KEY WORDS: Posterior composites, resin-base composites, dental education, dental students, restorations, Iran.

INTRODUCTION

In recent years, dental education programmes and initiatives have been developed beyond national borders, and now include international multicentre approaches. Examples include the development and international adoption of education guidelines¹ as well the development of new dental schools in the Middle East, the Gulf Regions, and Asia, which are founded as partnerships or enterprises in association with established dental schools in Europe or North America. At the same time, many European countries have experienced the inward migration of dentists from these regions. Some migrant dentists seek employment, while others wish to pursue postgraduate education and specialist training. The challenges for many potential employers and providers of postgraduate education can include, amongst others, a paucity of information on the levels of knowledge and previous clinical training of migrating dentists from what may be perceived to be regions of the world with relatively poorly developed arrangements for dental education. One such country from which many dentists come to the United Kingdom and other parts of Europe is Iran. Dental education in Iran has undergone considerable expansion. Before 1979, there were only five

undergraduate dental schools in Iran, with a total admission of 200 students each year, and only 2,000 dentists practising in the country. This has increased in recent times to a total of 18 dental schools, with a total annual admission of 750 students, and more than 11,000 dentists practicing in the country². The focus of this paper is to examine the teaching of one important aspect of clinical dentistry in Iran, namely, the teaching of the use of resin-based composites in restoration of posterior teeth and associated aspects of minimal interventional dentistry, and to relate this to current trends in western countries. This teaching is continually evolving in the western world, and is subjected to ongoing modification and evolution given the continuous development of new, increasingly sophisticated materials, coupled with advances in the understanding of contemporary approaches to the management of dental caries^{3,4}.

Recent surveys of dental schools in western countries have demonstrated a significant increase in both the amount and content of teaching programmes in relation to posterior resin-based composites⁵⁻⁸. This has been matched by increased placement of resin-based composites in general dental practice⁹⁻¹¹. Outside of Ireland, the UK, and North America, very little information exists on teaching in respect of resin-based composites. The aim of this study was to examine and report the arrangements for the teaching of posterior resin-based composites and associated minimal interventional dentistry in Iran.

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METHODS

In 2008, a questionnaire was distributed by email to the person responsible for delivering teaching of operative dentistry in each of the 18 dental schools with undergraduate dental degree programmes in Iran. The questionnaire sought information relating to the teaching of posterior resin-based composites in each school. The questionnaire included both 'closed' statements (where respondents were given a number of possible responses to a statement and asked to identify the most appropriate one), and 'open' statements (where respondents were given some space in which to write a textual response to a statement). The questionnaire was re-emailed to non-respondents after one month. Information received was entered onto a Microsoft Excel datasheet (Microsoft® Office Excel 2003, Microsoft Corporation, Reading, UK) to provide descriptive results.

RESULTS

Completed responses were received from all 18 schools (response rate= 100%). It is understood that the questionnaires were completed by a senior member of the clinical academic staff with responsibility for the teaching of operative dentistry in each school.

Types of resin-based composites taught

All 18 respondent schools reported that they teach placement of resin-based composites in occlusal and occlusoproximal cavities in premolar and molar teeth.

Preclinical and clinical teaching of posterior resin-based composites and amalgam

All 18 schools reported that they teach preparation of posterior cavities for dental amalgam prior to teaching preparations for posterior resin-based composites. In five years, four schools anticipate that they will teach preparation of cavities for posterior resin-based composites before teaching those for amalgam.

Respondents indicated that within dental schools, the average current teaching time for posterior restorations in preclinical courses was split 3:1 in favour of amalgam to resin-based composite. It is anticipated that the amount of time spent teaching amalgam will decrease over the next five years to a ratio of 3:2 (amalgam: resin-based composite). The mean proportions of posterior restorations currently placed clinically using amalgam and resin-based composite were 58% and 42%, respectively (range: amalgam= 20% - 80%; resin-based composite= 5% - 60%). In five years time it is anticipated that the percentage of amalgam restorations placed clinically will decrease from 58% to 49%, while the percentage of resin-based composite restorations placed clinically will increase from 42% to 51% (anticipated ranges: amalgam= 20% - 75%; resin-based composite= 20% - 80%).

Differences in cavity preparation

In contrast to cavity preparations for amalgam restorations, design features for posterior resin-based composite taught include:

- 16 schools (89%) taught minimal cavity preparations, with no "extension for prevention";
- 14 schools (78%) taught rounded internal line angles;
- 11 schools (62%) taught bevelled box margins;
- 10 schools (56%) taught "slot type" cavities (i.e, no occlusal component).

No school taught bevelling of the occlusal margins as part of the cavity preparation.

Contraindications to the placement of posterior resin-based composites

The contraindications to the placement of posterior resin-based composites taught in dental schools in Iran are set out in Table 1. The most common contraindications to the placement of posterior resin-based composites were a history of allergy to resin-based composite resin (16 schools), poor patient cooperation (15 schools for occlusoproximal restorations), poor oral hygiene (15 schools for occlusoproximal restorations), and subgingival margins (13 schools for occlusoproximal restorations).

Moisture control during posterior resin-based composite placement

While all 18 schools reported that they recommend the application of a rubber dam when placing posterior resin-based composites, no schools taught the application of rubber dam as mandatory for this purpose. Alternative forms of moisture control taught include cotton wool rolls (17 schools), gauze (7 schools), and a dry guard (2 schools).

The protection of operatively exposed dentine

The reported teaching on the use of liners and bases to protect operatively exposed dentine under posterior resin-based composites is shown in Table 2. While respondents preferred a 'total-etch' approach for superficial cavities involving the outer one-third of dentine, schools preferred to teach the use of a base, with or without a liner, when managing cavities involving the middle and inner one-thirds of dentine (Table 2).

Matrix and wedging techniques

All 18 schools taught the use of circumferential metal matrix bands and wooden wedges when placing occlusoproximal resin-based composites. Additionally, six schools taught the use of a sectional metal matrix band and wooden wedges, and two schools taught the use of transparent matrix bands and light-transmitting wedges for this purpose.

Commercial brands of resin-based composite and bonding systems taught

All 18 schools taught the use of hybrid or microhybrid resin-based composites for the restoration of posterior cavities. The most commonly used commercial brands of resin-based composite taught were 'Z250' (3M ESPE, St Paul, MN, USA) (11 schools), 'Z100' (3M ESPE, St Paul, MN, USA) (7 schools), and 'Spectrum TPH' (Dentsply DeTrey GmbH, Konstanz, Germany) (5 schools). The most com-

Table 1. Contraindications taught to the placement of posterior resin-based composites.

Contraindication	Occlusal cavities premolars	Occlusal cavities molars	Occlusoprox. cavities premolars	Occlusoprox. cavities molars
inability to place rubber dam	1	1	5	6
parafunctional activity	6	7	6	8
pathological wear	7	9	9	10
poor oral hygiene	8	10	15	15
replacement of a large amalgam restoration	6	5	6	9
history of allergy to resin-based composite materials	16	16	16	16
atypical diet	1	1	1	1
large pulp	0	0	1	1
proximity to the pulp	1	1	2	2
denture abutment	2	3	8	9
subgingival margins	0	0	13	13
temporomandibular dysfunction	1	1	2	2
no valid aesthetic requirement	2	2	2	2
endodontically treated tooth	0	0	0	0
opposing resin-based composite restoration	1	1	1	1
susceptibility to caries	4	4	7	7
poor patient cooperation	12	12	15	15
history of postoperative pain with posterior resin-based composite restorations	2	2	3	3
poor enamel quality	6	6	8	8
buccolingual width of occlusal portion is <1/3 of the intercuspal width	1	1	1	1
buccolingual width of occlusal portion is 1/2 of the intercuspal width	1	1	1	1
buccolingual width of occlusal portion is >2/3 of the intercuspal width	3	3	3	3
buccolingual width of proximal box >1/2 intercuspal width	1	1	1	1

Table 2. Teaching of the management of operatively exposed dentine prior to the placement of posterior resin-based composites.

Cavity depth	None ('total-etch')	Calcium hydroxide & glass-ionomer cement	Glass-ionomer cement only
Shallow cavities (outer third of dentine)	18	0	0
Moderate cavities (middle third of dentine)	4	0	14
Deep cavities (inner third of dentine)	2	17	5

*some schools selected more than one option

mon brands of bonding system used were 'Excite' (Ivoclar Vivadent AG, Schaan, Liechtenstein) (12 schools), 'Single Bond' (3M ESPE, St Paul, MN, USA) (11 schools), and 'SE Bond' (Kuraray Dental, New York, USA) (4 schools).

Light curing technologies

All 18 schools taught the use of 'traditional' quartz tungsten halogen light curing units. In addition to this, four schools taught the use of light emitting diode light curing units. No school taught the use of plasma arc based light curing units.

Finishing techniques

All eighteen respondent schools taught 'immediate' finishing of posterior resin-based composite restorations (in distinction to 'delayed' finishing after 24 hours). Twelve schools taught the use of water-cooling whilst finishing. Popular finishing instruments include finishing diamonds (15 schools), finishing points (14 schools), and finishing discs and strips (13 schools each).

Fees

All schools reported that they charge fees for resin-based composite and amalgam restorations placed by undergraduate students. The average fee for a posterior amalgam was 36,000 Iranian Rials (approx €2.50/US\$3.90), while the average fee for a posterior resin-based composite was 38,000 Iranian Rials (approx € 2.66/US\$4.10).

Indirect posterior resin-based composites

Five schools reported that they taught the placement of indirect posterior resin-based composites; however, in each of these schools, this teaching is solely didactic with no clinical teaching.

DISCUSSION

The Islamic Republic of Iran, with an area of over 1.6 million km² (about 2.5 times the size of France), is a vast region in the Persian Gulf. It has a population of ap-

proximately 61 million people. While information on caries rates within Iran are sparse, a recent study has indicated a DMFT rate of 2.8 in adolescents¹². The Constitution of the Islamic Republic of Iran states that "... the government is duty bound to prepare free education facilities for all people on graduation from high school. Higher education should be available to all aspirants as the self-sufficiency of the country prescribes..."². Access to the university programmes is similar to the model in western countries, where students complete high school education, followed by a secondary education diploma or a pre-university certificate for higher education, as well as a passing grade on the National University Entrance Examination². For a brief period from 1982-1990 there was an alternative route to dental school education for those already trained as oral hygienists. These dental care professionals trained for three years, during which time they learned skills such as simple fillings, scaling and extraction (somewhat akin to dental therapists in the UK). After six years service in local rural communities, and after passing the National University Entrance Examination at the end of their service, they were allowed to continue their education to obtain a dental degree².

The dental degree programme in Iran is of six years duration. Unlike dental curricula in most UK and European countries, there is little vertical integration of subject areas in the programme, with the first two years focussing on basic sciences, years three and four involving courses in human diseases and preclinical sciences, and years five and six comprising clinical courses. Students submit a thesis as part of the requirements to obtain their degree. Dental degrees offered in Iran are either DMD (Doctor of Dental Medicine) or DDS (Doctor of Dental Surgery). Before newly qualified dentists can practice independently, they are required to fulfil certain commitments such as two years of military service, or service in deprived areas of the country².

From the responses to the survey, it is apparent that the teaching of posterior resin-based composites is an established feature of dental curricula in Iran, which is likely to develop further in years to come. The nature and extent of the preclinical teaching of posterior restorations is not unlike that in most dental schools in the USA, Ireland, and the UK, where there is still continued, albeit diminishing emphasis on the teaching of amalgam restorations⁵⁻⁸. Currently, Iranian dental undergraduates gain experience in the clinical placement of posterior resin-based composites that is comparable to the experience gained by dental students in the USA, the UK and Ireland (Iranian schools: 42% of restorations placed, US schools: 30% of restorations placed, UK & Irish schools: 30% of restorations placed)⁵⁻⁸. Respondents anticipated that the amount of clinical experience in placing posterior resin-based composites in Iranian dental schools will increase in coming years. These figures are to be welcomed, indicating that Iranian dental students gain internationally favourable, and increasing levels of exposure to adhesive resin-based composite dentistry.

Despite many advances in preventive dentistry, the management of dental caries remains a substantial element of contemporary dental practice. One important change in the contemporary management of dental caries has been a shift from traditional surgical approaches to biologically-driven management strategies. In contrast to traditional

surgical approaches, involving caries and adjacent sound tissue being excised and the resultant cavity obturated with a restorative material, the biological approach involves the excision of irreversibly damaged and infected carious tooth tissue, together with employing various techniques to limit the risk of subsequent progression of residual caries. Part of this latter approach is to recognise that a principal aim of cavity preparations is to preserve as much healthy tooth tissue as possible. The use of resin-based composite resin, in contrast to amalgam, facilitates such a minimally interventive approach when managing caries in posterior teeth^{4,13,14}. As this paradigm represents the future direction of operative dentistry, the challenge for dental educators is how best to prepare their graduating dental students to practice the modern, minimally invasive management of caries⁸. Dental students who graduate in the next few years may continue to practice dentistry well into the 2050s. It is important that new generations of dentists are familiar with, amongst many other matters, new and changing concepts in the restoration of teeth and the maintenance of restored tooth units.

Despite the established teaching of posterior resin-based composites in Iran, there was evidence of variation in teaching between dental schools. This is not unlike the situation observed in UK, Irish, and North American schools⁵⁻⁸. In this study, the following variations and areas for further consideration were observed:

- Eleven schools taught bevelling of the cavosurface margins of the proximal box. This is usually not advised as it may result in the unnecessary loss of enamel that could be used to optimise adhesion, and create difficulties in ensuring ideal marginal adaptation in the critical areas apical to the maximum convexity of the tooth. Removal of enamel in forming cavosurface margin bevels in the proximal box, in particular along the gingival floor, can necessitate bonding to dentine or cementum which is less desirable than bonding to enamel. Proximal bevelling can also make the identification of the cavosurface margins difficult during finishing, possibly resulting in unnecessary iatrogenic damage to adjacent tooth substance¹⁴;
- There was a lack of consensus in respect of contraindications for posterior resin-based composites between the respondent schools (Table 1). Most schools agreed that a history of allergic reaction to resin composites was a contraindication to the placement of posterior resin-based composites, given the evidence in the literature, albeit limited, of true allergy to resin-based composites¹⁵. This was also found to be the case in the surveys of US, Canadian, Irish and UK schools⁵⁻⁸. The other most commonly agreed contraindications were poor patient cooperation and poor oral hygiene, which are recognised as being problematic in the placement of tooth-coloured restorations;
- In keeping with the patterns observed in Irish, UK, US and Canadian schools, there was a lack of consistency among the schools in respect of the teaching in pertaining to the management of operatively exposed dentine⁵⁻⁸. While a majority of the schools taught a 'total-etch' approach when restoring cavities involving the outer third of dentine, a similar majority preferred to use a glass-ionomer cement base, with or without

a liner, to protect dentine prior to the placement of a resin-based composite restoration in cavities involving the middle or inner third of dentine. The use of a 'total-etch' dentine-bonded approach, in contrast to the use of a cement base, offers several advantages, such as increased surface area for bonding, and an increased thickness, and therefore strength of the restoration;

- Some interesting choices of composite material and bonding systems were noted. The main choices of composite materials taught were either 3M or Dentsply products, which may reflect the commercial availability of composite materials in Iran. Interestingly there was a 'mis-match' in the use of composite materials and bonding agents – while the most popular composite materials used were products of 3M (11 schools) and Dentsply (5 schools), the main choices of adhesive systems taught were products of Ivoclar Vivadent (12 schools) or Kuraray Dental (4 schools), as well as 3M (11 schools).
- When placing occlusoproximal restorations, two schools taught the use of transparent matrix bands and light transmitting wedges, albeit as well as teaching the use of metal matrix bands and wooden wedges. The use of transparent matrix bands and light-transmitting wedges has been discredited given their stiff, thick nature. The use of these systems often results in inappropriate contour, and an increased risk of overhang formation¹⁶.

It is clear that the teaching of posterior resin-based composites in Iranian dental schools is well established, and will continue to develop in the future. Variation between the dental schools in respect of the teaching of various aspects of placement techniques may lead to confusion amongst students and new graduates and ultimately hamper the delivery of a quality educational programme, let alone compromise the quality of patient care^{17,18}. Consensus guidelines on the teaching of posterior resin-based composites have recently been published, and are regarded as helpful¹⁹. Teachers of Operative/ Restorative Dentistry in Iran should, together with colleagues in other parts of the world, consider reviewing their teaching programmes to develop instruction in accordance with best clinical evidence. Such measures help prepare new graduates for everyday clinical practice.

Given the findings of the present study, it is suggested that graduates of dental schools in Iran may be expected to have knowledge, skill and understanding of the use of posterior resin-based composites similar to that of graduates of dental schools in Europe and North America. Implicit in this finding is an indication that graduates of dental schools in Iran may, in a similar manner to their peers from dental schools in Europe and North America, lack clarity in respect of certain aspects of the use of posterior resin-based composites. This, in turn, highlights the international need for postgraduate continuing education in respect of the application of posterior resin-based composites.

CONCLUSIONS

This study has demonstrated that:

- the teaching of posterior resin-based composites is an established feature of undergraduate dental education in Iran.
- variation exists between Iranian dental schools in the teaching of certain aspects of placement techniques for posterior resin-based composites, but no more than that observed in previous, related surveys in western countries.

Dental school educators in Iran, in common with their colleagues in Europe and North America, need to ensure that their graduating students are best prepared for contemporary independent clinical practice, particularly in relation to the use of posterior resin-based composites and relevant minimally interventive dentistry.

ADDRESS FOR CORRESPONDENCE

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