

Rupert Austin

Shiyana Eliyas, FJ Trevor Burke, Phil Taylor, James Toner and Peter Briggs

British Society of Prosthodontics Debate on the Implications of the Minamata Convention on Mercury to Dental Amalgam – Should our Patients be Worried?

Abstract: In 2013, the Minamata Convention on Mercury called for a global phase-down of amalgam use, with a view to reduce environmental mercury pollution. This will significantly impact UK dentistry, given the still extensive use of amalgam in UK general dental practice. However, until now there has been little national discussion or debate. In Spring 2015, The British Society of Prosthodontics dedicated a significant part of its Annual Conference to debating the implications of this issue. Clinical case examples were discussed with audience interaction and voting facilitated using innovative Audience Response System Technology. A remarkable range of concerns and opinions were given. The debate elicited specific concerns amongst clinicians regarding the suitability of mercury-free alternatives to amalgam; particularly where cavities are large and extend beneath the gingival anatomy. There are also anecdotal reports of Dental Foundation (DF) dentists not being adequately taught the use of dental amalgam in undergraduate dental schools.

CPD/Clinical Relevance: Many clinicians, especially those treating patients for whom moisture control is challenging, feel that amalgam should remain available for clinicians to choose in certain clinical circumstances for the restoration of posterior teeth, even in the event of a complete phase-down.

Dent Update 2016; 43: 8–18

Rupert Austin (RA), BDS(Hons), MClintDent, PhD, MPros RCS(Ed), MJD FRCS(Eng), FAcadM(Ed), FHEA, Clinical Lecturer and Specialist in Prosthodontics, King's College London Dental Institute, **Shiyana Eliyas**, BDS, MFDS RCS(Eng), MRD RCS(Eng), FDS(RestDent) RCS(Eng), PGCertHE, Consultant in Restorative Dentistry, St George's Hospital NHS Foundation Trust, **FJ Trevor Burke (TB)**, DDS, MSc, MDS, FDS MGDS RCS(Edin) FDS RCS, FADM, Professor of Primary Dental Care, Birmingham School of Dentistry, **Phil Taylor (PT)**, BDS(Ncle), MGDS RCS(Eng), MSc(Lond), MRD RCS(Eng), FDS RCS(Edin), Senior Lecturer and Consultant in Restorative Dentistry, Barts and the London School of Medicine and Dentistry, **James Toner (JT)**, BA(Hons), FHEA, Senior Learning Technologist, King's Learning Institute and Centre for Technology Enhanced Learning, King's College London and **Peter Briggs (PB)**, BDS(Hons), MSc, MRD RCS(Eng), FDS RCS(Eng), Consultant in Restorative Dentistry, Barts and the London School of Medicine and Dentistry, London, UK.

The phase-down of amalgam

The Minamata Convention on Mercury, a United Nations treaty signed on the 10 October 2013 by 128 signatory nations, including the UK, was designed to protect human health and the environment from anthropogenic emissions and releases of mercury and mercury compound.¹ Minamata Bay in Japan was heavily polluted from the 1930s by wastewater, mixed with mercury, dumped into Hyakken Harbour from the Chisso Corporation's factory in Minamata, particularly by methylmercury. The highly toxic compound

bio-accumulated in fish and shellfish in the bay which, when eaten by the people living around the bay, gave rise to Minamata disease (mercury intoxication) affecting more than 10,000 people.² Article 4 on the Convention addresses the question of mercury-added products and includes specific requirements for signatory nations regarding the use of dental amalgam. The requirements are shown in Figure 1.

The aim is to reduce mercury pollution over the next few decades with targeted activities. The Convention prohibited a number of mercury-containing products, including vaccines containing mercury, thermometers, a variety of light bulbs, blood pressure devices and dental fillings using mercury amalgam. By 2020, their production and trade will be prohibited.

However, dental amalgam is the only mercury-added product that is subject to a phase-down, whereas all products will be banned or phased out. Countries such as Norway had previously undertaken significant national debate in the 1980s and 1990s and began phasing out dental amalgam in 1991, mainly due to environmental concerns. From 2008 onwards, a ban on the import, export and use of most mercury-based products came into place in Norway. However, dental

offices in Norway may apply for exemptions to use amalgam on a case-by-case basis. Therefore, dental professionals living in countries that have ratified the Convention (of which UK is one) will need to amend their practice accordingly, which is likely to affect the global dental profession and public. This has resulted in a spectrum of clinical opinion on the use of dental amalgam, with views being expressed in the dental literature regarding the use of mercury-free direct restorative materials, which are perhaps not fully representative of the wider dental community, especially that of the general dental practitioner.^{3,4}

Dental amalgam and its current alternatives

Amalgam is a cost-effective and clinical proven restorative material, the use of which has been widespread in the UK for over a century. Amalgam contains silver (40–70%), tin (12–30%), copper (12–30%), zinc (1%) and 44–48% mercury by weight.⁵ The process of mixing amalgam has changed significantly over the years, as has the handling and disposal within a dental surgery. It is advocated that amalgam is placed under rubber dam with high volume suction, within a room with good ventilation. The removal of amalgam should

also be carried out under rubber dam with high-speed suction, water spray and sectioning and scooping of the fragments of the restoration.

The principal alternatives to dental amalgam for restoration of posterior teeth today are resin composite and glass ionomer. The latter, in a review of the literature, has been shown to perform suboptimally under certain conditions,⁶ although results of a recent clinical evaluation in Turkey indicate 100% survival of reinforced glass ionomer restorations at four years.⁷ Recent work on the thermocuring of glass ionomer restorations indicates that this substantially improves the early physical properties of these materials⁸ and appears to hold promise for the future development of these materials in load-bearing situations. The use of resin composite restorations in posterior teeth has been the subject of a number of extensive clinical evaluations,^{9,10,11} with positive findings, and two recently published systematic reviews, also publishing positive findings, by Opdam and colleagues,¹² and by Astvaldsdottir *et al*,¹³ who concluded 'that the overall survival proportions of posterior resin composite restorations is high', reporting that the overall failure incidence rate for all reasons of failure was 1.55 restorations per 100

Measures to be taken by a Party to phase down the use of dental amalgam shall take into account the Party's domestic circumstances and relevant international guidance and shall include two or more of the measures from the following list:

- Setting national objectives aiming at dental caries prevention and health promotion, thereby minimizing the need for dental restoration;
- Setting national objectives aiming at minimizing its use;
- Promoting the use of cost-effective and clinically effective mercury-free alternatives for dental restoration;
- Promoting research and development of quality mercury-free materials for dental restoration;
- Encouraging representative professional organizations and dental schools to educate and train dental professionals and students on the use of mercury-free dental restoration alternatives and on promoting best management practices;
- Discouraging insurance policies and programmes that favour dental amalgam use over mercury-free dental restoration;
- Encouraging insurance policies and programmes that favour the use of quality alternatives to dental amalgam for dental restoration;
- Restricting the use of dental amalgam to its encapsulated form;
- Promoting the use of best environmental practices in dental facilities to reduce releases of mercury and mercury compounds to water and land.

Figure 1. MINAMATA Convention on Mercury 2013 – ANNEX A Part II: Products subject to Article 4, paragraph 3.

restoration years. Major reasons for failure were secondary caries and restoration fracture.

However, there are continuing concerns amongst dental professionals regarding the management of large cavities in posterior teeth with direct restorations, which suggests that there is a need for wider debate amongst the UK dental profession as to whether an effective ban of the use of amalgam may result in poorer clinical outcomes for patients. This may be especially concerning for some patients (namely those patients with special needs) for whom long clinical appointments and increasingly complex alternative treatments, such as posterior composite resin restorations or indirect restorations, are not possible.

Against this background, members of the British Society of Prosthodontics expressed concern regarding the phase-down of dental amalgam, as it is still a clinically useful material without an ideal successor in the event that it is no longer available. Therefore, the programme of the 2015 British Society of Prosthodontics (BSSPD) Annual Conference, which was held in London, included a live interactive debate regarding the 'Implications of the Minamata Convention on Mercury to Use of Dental Amalgam' entitled 'Should our patients be worried?'. The goal of the debate was two-fold. First, to gauge the views of two eminent speakers on the subject and, secondly, to ask the large group of dentists (that consisted of specialists, generalists and foundation trainees) who had listened to this debate, to input their views on the management of several clinical examples.

The audience response system (ARS)

This debate used novel audience response system technology in order to survey the audience regarding their opinions and feelings on the potential ramifications for clinical practice, education and policy of phasing-down dental amalgam in the UK. There has been increasing awareness of the use of technology-enhanced ARSs in order to enhance the quality and quantity of audience participation during higher education lectures and debates.¹⁴ Initially,

this technology operated using clicker-based devices requiring dedicated battery-powered handsets distributed to the audience and collected at the end of the session. However, this could only accommodate simple yes/no, true/false or multiple-choice questions and therefore limited the uptake of this technology. Recently, the technology has become sufficiently advanced allowing the use of smartphones, tablets and laptops to respond to text or image-based responses, as well as closed or open-ended questions in real time via PowerPoint.¹⁵ This widens the potential for interaction and discussion with a potentially unlimited worldwide audience via a web URL, as well as providing beneficial qualitative information regarding the audience's responses in order to increase the interaction between speakers and their audience, whether they share the same physical location or not.

To our knowledge, this is the first time that a smartphone-based audience response system has been used during a live debate within a dental educational context. This article describes the debate and the resulting views of the audience; captured using this novel information technology enhanced learning technique.

Method: the debate

A personal device-based ARS (Polleverywhere, San Francisco, CA) was used to live poll the audience at The British Society of Prosthodontics national debate on the global phase-down in the use of dental amalgam as a direct restorative material in March 2015. The ARS was operated via PowerPoint (Microsoft Office 2010) using a free add-in (available from www.polleverywhere.com/app) and the audience was asked to use their personal device internet browsers to navigate to the website (www.pollev.com/bsspd), in order to display and interact with the question which was being simultaneously displayed via the projected PowerPoint slide. A series of image-based, closed- and open-ended questions were displayed and the audience was invited to respond via their personal devices.

Two of the authors (PB and RA) developed the questions regarding amalgam for this debate. Using the PollEv and PowerPoint integration, the questions

were then entered into the slides of the two main presenters representing the two sides of the debate (PT spoke in favour of the continued use of amalgam and TB spoke in favour of the complete phase-down of amalgam). The two speakers had a two-week window prior to the event to provide their responses to the questions. Therefore, once the audience had been live-pollled, the speakers' positions could be revealed and the chairman (PB) could challenge the speakers to defend their statements in light of the audience responses.

Before the debate commenced the audience was asked to access, via their browsers, a unique PollEv URL, which displayed a waiting screen until the first poll was displayed. During the live debate, following the opening statements by the two main speakers, the chairman ran the PowerPoint with the PollEv Add-In installed and the pre-selected polls embedded within to enable a seamless experience. As a result, the PowerPoint ran as normal and the polls were automatically opened and instantly 'pushed' to the audience's personal devices whilst also simultaneously displaying the polls using the lecture theatre projector in the normal way. The respondents' answers were then displayed in real-time on the projected PowerPoint screen. Participants were allowed to send in their answers as long as the chairman kept the poll open. The responses were tallied and displayed as a horizontal bar chart, with a total count for the multiple-choice questions and as a word cloud for the free text responses. For the free text responses, two of the authors present (RA and JT) acted as moderators to remove any inappropriate responses prior to display of the results of each poll.

The debate

The chairman 'flipped' a coin and TB chose to speak first in support of the phasing-down of amalgam. He began by summarizing the history of amalgam and citing the evidence suggesting that amalgam restorations release small amounts of mercury, below the threshold levels considered dangerous for occupational exposure for patients. The use of amalgam has steadily decreased in the United States and the United Kingdom, from 86% in 2002 to 59% in 2008.¹⁶ The

alternatives to amalgam were presented. Myths associated with composite restorations were challenged. It was stated that polymerization shrinkage of the restoration would be reduced to 1% by the use of, for example, *Filtek Silorane* (3M ESPE, Seefeld, Germany). Recently introduced bulk fill composites were recommended to reduce the technique sensitivity and the time required to place and polish the restorations, with most recent materials not requiring a conventional composite top layer. *Supermat* (Kerr-Hawe) matrix bands and sectional matrices were advocated to achieve a good contact point, a problem noted when using resin composites in Class II cavities prior to the introduction of dedicated composite matrices. Proximal box elevation using resin modified glass ionomer cements were endorsed for deep proximal boxes with limited or no enamel for bonding, with the caveat that the patient must be warned that this is a compromised situation. It was suggested that new graduates in some schools have received more training and experience in the placement of composite restorations than in placing amalgam restorations. At five years the annual failure rate of posterior composite restorations has been cited at 1.8% and that at 10 years as 2.4%.¹¹ Other studies have suggested the overall failure of posterior composite restorations to be 2% per annum.^{10,12}

The second speaker (PT) spoke against the phasing-down of amalgam, citing evidence that there was no significant risk to neuropsychological function from amalgam restorations in children. Numerous governments (United States, Canada, Australia and a number of countries in Europe) had issued statements to the effect of maintaining amalgam as a dental restorative material as the current evidence suggests that it is a safe and effective material. The Norwegian Board of Health stressed that its decision to phase out amalgam was not related to safety of dental amalgam but due to long-term goals in reducing the release of mercury into the environment. Both Norway and Sweden have stated that they will issue exemptions to the ban on amalgam on a case-by-case basis. Potential health risks associated with composite monomers were discussed.¹⁷ Composite restorations were said to have a significantly higher risk of failure than



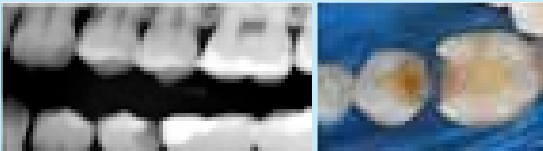

<p>Case 1:</p> 	<p>How would you manage the pulp in this case? You have chosen to restore with composite – which would be your preferred cavity modification prior to applying the dentine-bonding agent? Which type of dentine-bonding agent would you use? What type of composite would you use?</p>
<p>Case 2:</p> 	<p>Which matrix band system would you use to restore the proximal cavity?</p>
<p>Case 3:</p> 	<p>What would be your preferred material choice for restoring these teeth?</p>
<p>Case 4:</p> 	<p>What would be your preferred material choice for restoring this tooth? What would be your tooth-coloured restoration of choice for this tooth? If using amalgam restoration, what design would you choose?</p>

Table 1. Clinical case photographs and questions posed to the audience regarding the clinical management of the tooth.

tooth. Fifty six percent of respondents would use a total etch technique using 37% orthophosphoric acid prior to the bonding agent, as would both speakers. Seventy percent of respondents preferred a two-bottle or two-stage 'total etch' or 'total rinse' system. TB stated that he would use a new Universal Bonding System and PT stated that he would use a three-step system every time. The majority (30%) of respondents stated that they would use a microhybrid composite and 20% would restore this cavity with amalgam. The main reason given for restoring with amalgam was longevity (Figure 2).

Case 2

Forty nine percent of respondents would use a sectional matrix with ring retainer for restoring the proximal cavity, as would TB. PT stated that he would use a *Siqveland* (Dentsply, Addlestone, UK) or *Automatrix* (Dentsply, Addlestone, UK), which were the second and third choices of respondents.

Case 3

The majority of respondents would restore these teeth with direct composite (61%), as would TB. Twenty one percent, and PT, stated that they would restore using amalgam.

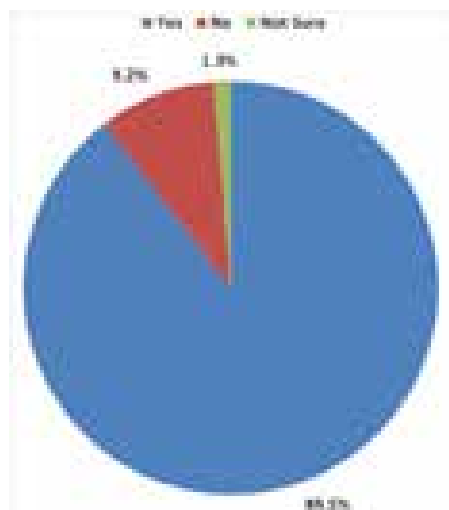


Figure 3. Audience response results to the question 'Assuming that there will be a phase-down of dental amalgam use, should we be fighting for continued use of dental amalgam in selected clinical situations?' (n = 153).

Case 4

Forty percent of respondents would restore this tooth with an indirect metal restoration, 18% stated that they would restore with amalgam, 15% would restore with indirect composite. Twelve percent would restore the tooth with ceramic and 12% with direct composite. TB stated that he would use direct resin composite and PT stated that he would use amalgam. If using a tooth-coloured restoration, 27% percent (the majority) of respondents stated that they would restore this tooth with an indirect resin composite onlay. TB stated that he would use direct composite and PT an amalgam core and a milled partial coverage crown. If using amalgam, 50% would place an amalgam

core restoration with a view to placing a cuspal coverage indirect restoration.

Having listened to the debate, 66.7% of the participating audience stated that amalgam and composite were not equal in their clinical performance as approximal posterior restorations and that amalgam performs better than composite.

When asked if we should be fighting for the continued use of dental amalgams in selected clinical situations, 89.5% of the participating audience stated that we should (Figure 3). The free text responses stated moisture control as the main reason for not using composite and for using amalgam in posterior teeth (Figure 4 and Figure 5). The two questions, which effectively asked the same open-ended



Figure 4. Audience response results to the question 'State clinical situations for which you consider composite resin contra-indicated for posterior teeth?' (n = 63).

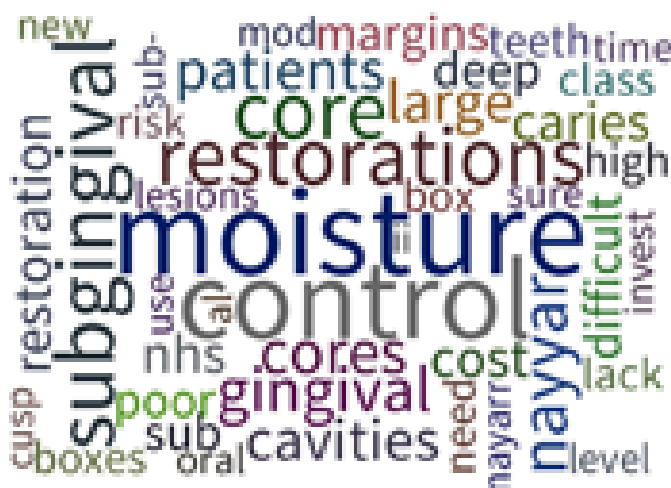


Figure 5. Audience response results to the question 'State clinical situations for which amalgam should continue to be used?' (n = 106).

can be an inexpensive and environmentally friendly alternative to clicker-based ARS and has the added advantage that the communication medium is familiar to nearly all audience members, thus allowing live surveying of a potentially unlimited audience size. Although those without an internet-enabled device or with difficulty using their device are not able to participate, in this present study only one audience member reported that they felt excluded by the process as they did not have a smartphone. As the market presence of smartphones, tablets and laptops widens to almost universal adoption, such issues will become ever rarer due to increasing familiarity with their features and usages.

The results of this survey appear to indicate that there is still not an actual replacement/substitute for amalgam. Indeed, it may be surmised that, if the ideal amalgam replacement had been developed, it would have taken over the market and amalgam would no longer be used. This ideal material might have the following properties:

- Be non-toxic;
- Be self adhesive, providing an ideal seal as well as obviating the need for producing or removing undercuts;
- Set fully in its entirety over a clinically acceptable time span;
- Have good physical properties once set such as being dimensionally stable and wear resistant;
- Be quick and easy to place and usable in all shapes and sizes of cavities;
- Be aesthetically acceptable;
- Perform well even when placed during suboptimal conditions.

While resin composite fulfils some of these properties, with some of its variants being self-adhesive (for example, self-adhesive resin luting materials), some having 5 mm depth of cure (bulk fill resin composites), some having low shrinkage stress (for example, *Filtek Silorane*²⁵ and *Filtek Bulk Fill Restorative* [Palin WM, unpublished data]) and all having suitable physical properties, there remains concern in respect of the increased time required for placement as compared with amalgam and technique sensitivity. If and when these concerns are addressed and an ideal material becomes available (as listed above), the phase-down of amalgam will not be an issue. The authors, and

indeed all the respondents of this BSSPD survey, keenly await the development of this material. Moreover, given industry awareness of the vast global demand for a mercury-free alternative to dental amalgam, all major dental materials manufacturers are investing significant resources and revenue to develop exactly such a solution.

Currently, however, over 90% of respondents stated that they believed the use of dental amalgam should continue to be taught in UK dental schools, with only 62% of the younger dentists in the audience saying that they felt adequately trained to use amalgam at undergraduate dental school. On the other hand, it may be salutary to note that, when the phase-down of amalgam takes effect, many senior practitioners may not necessarily have the skills to provide posterior composite restorations to an optimal standard. In the present study, the responding dentists cited time as the most important limiting factor for use of composite in general dental practice (Figure 7) and, moreover, subgingival margins were mentioned as the most important factor favouring use of amalgam for all posterior restorations (Figure 5).

Altogether, the results of this survey suggest significant workforce impacts to the phase-down, for example, when practitioners undergo a new learning curve there can be variability in the speed at which new techniques are adopted. The responsibility for training the workforce appropriately will fall to Health Education England, National Societies and the individual practitioner, with a financial impact to the NHS. This present paper therefore clearly highlights the need for strong leadership amongst the dental profession, in terms of raising awareness of the potential issues of the phase-down of amalgam. The results from this study suggest that only a third of respondents considered that the general dental practitioner's (GDP's) voice was being heard in this debate and there was a concerning lack of consensus as to how the voice of the GDP can best be heard as the debate continues (Figure 6). Therefore, there remains a clear and present need to engage and involve as broad a spectrum of the dental profession as possible. Professional societies and representative bodies should bear this in mind as the global picture

increasingly trends towards the complete phase-down of dental amalgam use.

Conclusions

This debate has confirmed that dental amalgam is still considered a useful and important material for the restoration of posterior teeth. Over 90% of those that voted wished to see the choice of dental amalgam continue into the future within the UK for certain indications. The majority of conference attendees participating in the amalgam debate also felt that more posterior teeth will be extracted if amalgam is no longer available.

References

1. Bailey M, ed. *Minamata Convention on Mercury*. United States Environmental Protection Agency, 2013.
2. Walker BL. *Toxic Archipelago: A History of Industrial Disease in Japan*. Seattle; London: University of Washington Press, 2010.
3. Wilson NHF, Gelbier S. *The History and Impact of Development in Dental Biomaterials over the Last 60 Years*. The John Mclean Archive: A Living History of Dentistry. Witness Seminar 4: British Dental Association, 2014.
4. Lynch CD, Wilson NHF. Managing the phase-down of amalgam: part I. Educational and training issues. *Br Dent J* 2013; **215**: 109–113.
5. Combe EC, Burke FJT, Douglas WH. *Clinical Dental Materials*. Chicago: Kluwer Academic Publishers, 1999.
6. Burke FJT. Dental materials – what goes where? The current status of glass ionomer as a material for loadbearing situations in posterior teeth. *Dent Update* 2013; **40**: 840–844.
7. Gurgan S, Kutuk ZB, Ergin E, Oztas SS, Cakir FY. Four year randomised controlled clinical trial to evaluate the clinical performance of a glass ionomer restorative system. *Oper Dent* 2015; **40**: 134–143.
8. Gavic L, Gorseta K, Glavina D, Czarnecka B, Nicholson JW. Heat transfer properties and thermal cure of glass-ionomer dental cements. *J Mater Sci Mater Med* 2015; **26**: 249.
9. Opdam NJM, Bronkhorst EM, Loomans BAC, Huysmans MC. 12 year survival of composite vs amalgam restorations.

- J Dent Res* 2010; **89**: 1063–1067.
10. Rodolpho PADR, Donassollo TA, Cenci MS, Loguercio AD, Moraes RR, Bronkhorst EM, Opdam NJ, Demarco FF. 22-Year clinical evaluation of the performance of two posterior composites with different filler characteristics. *Dent Mater* 2011; **27**: 955–963.
 11. Pallesen U, van Dijken JW, Halcken J, Hallonsten A-L, Höigaard R. Longevity of posterior resin composite restorations in permanent teeth in Public Dental Health Service: a prospective 8 years follow up. *J Dent* 2013; **41**: 297–306.
 12. Opdam N, van de Sande F, Bronkhorst E, Cenci M, Bottenberg P, Pallesen U. Longevity of posterior composite restorations: a systematic review and meta-analysis. *J Dent Res* 2014; **93**: 943–949.
 13. Astvaldsdottir A, Daerhamn J, van Dijken JWV, Naimi-Akbar A, Sandborgh-Englund G, Tranieus S, Nilsson M. Longevity of posterior resin composite restorations in adults – a systematic review. *J Dent* 2015; **43**: 934–954.
 14. Banks DA, ed. Audience response systems in higher education: applications and cases. Hershey Pa: Information Science Publishing, 2006.
 15. Shon H, Smith L. A review of Poll Everywhere audience response system. *J Technol Hum Serv* 2011; **29**: 236–245.
 16. Brunton PA, Burke FJT, Sharif MO, Creanor S, Hosey MT, Mannocci F, Wilson NHF. Contemporary dental practice in the UK in 2008: aspects of direct restorations, endodontics and bleaching. *Br Dent J* 2012; **212**: 63–67.
 17. Soderholm KJ, Mariotti A. BIS-GMA – based resins in dentistry: are they safe? *J Am Dent Assoc* 1999; **130**: 201–209.
 18. Rasines Alcaraz MG, Veitz-Keenan A, Sahrman P, Schmidlin PR, Davis D, Iheozor-Ejiofor Z. Direct composite resin fillings versus amalgam fillings for permanent or adult posterior teeth. *Cochrane Database Syst Rev* 2014 Mar 31; 3:CD005620. doi: 10.1002/14651858.CD005620.pub2.
 19. Kwang S, Aminoshariae A, Harding J, Montagnese TA, Mickel A. The critical time-lapse between various restoration placements and subsequent endodontic intervention. *J Endod* 2014; **40**: 1922–1926.
 20. Hunter A, Treasure E, Hunter A. Increases in cavity volume associated with the removal of class 2 amalgam and composite restorations. *Oper Dent* 1994; **20**: 2–6.
 21. Purk JH, Dusevich V, Glaros A, Spencer P, Eick JD. *In vivo* versus *in vitro* microtensile bond strength of axial versus gingival cavity preparation walls in Class II resin-based composite restorations. *J Am Dent Assoc* 2004; **135**: 185–193.
 22. Hashimoto M. A review – micromorphological evidence of degradation in resin-dentin bonds and potential preventative solutions. *J Biomed Mater Res* 2010; **92**: 268–280.
 23. Beazoglou T, Eklund S, Heffley D, Meiers J, Brown LJ, Bailit H. Economic impact of regulating the use of amalgam restorations. *Public Hlth Reps* 2007; **122**: 657.
 24. Lynch CD, Wilson NHF. Managing the phase-down of amalgam: part II. Implications for practising arrangements and lessons from Norway. *Br Dent J* 2013; **215**: 159–162.
 25. Fleming GJP, Hall DP, Shortall ACC, Burke FJT. Cuspal movement and microleakage in premolar teeth restored with posterior filling materials of different reported volumetric shrinkage values. *J Dent* 2005; **33**: 139–146.

CPD ANSWERS NOVEMBER 2015

- | | |
|------|-------|
| 1. C | 6. D |
| 2. D | 7. D |
| 3. D | 8. D |
| 4. C | 9. D |
| 5. C | 10. C |