

Teaching of implant dentistry in undergraduate dental schools in the UK and Ireland

J. S. Chin,^{*1} C. D. Lynch,² J. Rees,³ M. Locke,⁴ M. B. M. Thomas⁵ and L. D. Addy⁶

Key points

Provides an overview of teaching trends in implant dentistry within undergraduate dental schools in the UK and Ireland.

Highlights the differences in the amount of implant teaching between UK and Irish dental schools compared to other schools worldwide.

Identifies potential areas for improvements in implant teaching and discusses the challenges involved in developing and incorporating implant education into the undergraduate curricula.

Objective The aim of this study was to assess the current status of implant teaching within dental undergraduate schools in the UK and Ireland. **Methods** An online questionnaire relating to current and future possible trends in dental implantology education was developed and distributed to heads of departments of restorative dentistry, in each of the 18 dental schools with undergraduate dental programmes in the UK and Ireland. **Results** Responses were received from 16 schools. All responding schools provided implant training for their students. The majority of schools offered students direct clinical experience in treatment planning (n = 13) however, direct clinical experience in restoring implants (n = 5) and implant placement (n = 1) was low. Barriers to implementing and developing the dental undergraduate implant programme include funding and lack of available time in the curriculum. **Conclusion** There has been a significant improvement in the amount of implant teaching in the UK and Ireland since previous surveys. Further development and improvement of implant teaching in dental undergraduate schools are required, particularly with respect to the amount of direct clinical experience provided. This will ensure that newly qualified dentists will enter practice with a greater level of knowledge in this field and are best prepared for independent clinical practice.

Introduction

This study aims to evaluate the teaching of implant dentistry in undergraduate dental schools in the UK and Ireland to determine whether schools are meeting the required standards set out by the General Dental Council (GDC). Globally, dental implants have become a widely accepted treatment option for the replacement of missing teeth, with reported long-term success and survival rates to be greater than 95%.¹ With a rise in

demand and popularity of dental implants, straightforward implant treatments are now more frequently performed by general dental practitioners.² However, there is the concern of the reported increase in the number and frequency of complaints relating to implants in the UK.³ The publication by the indemnity organisation Dental Protection, *Riskwise* in 2015, revealed that in 2015 implants accounted for 28.8% of UK claims by value, the second highest claim under periodontal cases at 44.7%. Multiple factors contributing to this rise include inadequate consent, treatment planning and record keeping, inadequate post-treatment maintenance and lack of experience in the relevant procedures involved. This situation highlights the importance of implementing structured and comprehensive implant training at an undergraduate and postgraduate level to ensure that patients are receiving safe implant treatment.

Specific to undergraduate dentistry, schools within the UK and Ireland are expected to provide the relevant implant training in order to fulfil the standards set by their relevant regulatory bodies. This article discusses the

standards relating to the UK's dental regulatory body, the GDC. However, the authors recognise that these standards could vary to those set by the Irish dental regulatory body, the Dental Council of Ireland, and this should be borne in mind when reading this article. The GDC's document, published in 2015, *Preparing for practice – Dental team learning outcomes for registration* expects dentists to be competent at maintaining peri-implant health and describing the risks related to dental implant therapy.⁴ Furthermore, dentists are expected to recognise and explain to patients the range of implant treatment options, their impact, outcomes and limitations. Dentists, however, are not expected to perform implant treatment, but should they wish to do so, the GDC has emphasised that UK-qualified general dental practitioners would not be competent to carry out implant dentistry without further training.⁵ The documents *Training standards in implant dentistry*, published by the Faculty of General Dental Practice (UK) in 2016 and *A dentist's guide to implantology* by the Association of Dental Implantology, published in 2012, set out to ensure that dentists have the

¹Specialty Registrar in Restorative Dentistry, Cardiff University School of Dentistry, Heath Park, Cardiff;

²Professor/Consultant in Restorative Dentistry, University College Cork, Wilton, Cork, Ireland; ³Professor/Honorary Consultant in Restorative Dentistry, Cardiff University School of Dentistry, Heath Park, Cardiff; ⁴Senior Clinical Lecturer/Honorary Consultant in Restorative Dentistry, Cardiff University School of Dentistry, Heath Park, Cardiff; ⁵Consultant in Restorative Dentistry, Cardiff University School of Dentistry, Heath Park, Cardiff; ⁶Consultant in Restorative Dentistry, Cardiff University School of Dentistry, Heath Park, Cardiff

*Correspondence to: Miss Jann Siew Chin
Email: chinjs@cardiff.ac.uk

Refereed Paper. Accepted 30 August 2018
DOI: 10.1038/sj.bdj.2018.867

necessary competence to perform safe implant dentistry.^{6,7}

Previous studies have evaluated implant education among undergraduate schools. Surveys of UK and Irish dental schools have shown an increasing trend in the amount of implant teaching provided within undergraduate programmes.^{8–11} However, a significant variation in the level of teaching between UK dental schools was observed. These findings are similarly shown in schools worldwide, such as Europe, the US and Canada.^{10,12–14} The most recent survey of UK and Irish dental schools, conducted in 2008, revealed that the majority of schools (87%) offered implant training for their undergraduates.¹⁰ In spite of this, only a limited number of schools provided students with direct clinical experience in treatment planning (46%), restoration (27%) and placement (7%) of dental implants. Concerns were raised that UK dental implant education was failing to keep pace with current developments and other schools worldwide.^{10,15} In Europe, a survey in 2008 found that most dental undergraduate schools offered implant training and 70% provided direct clinical experience in restoring dental implants.¹³ This figure increased in 2014 with 75% providing direct clinical experience in restoring dental implants. In addition, schools were devoting an average of 74 hours in comparison to 36 hours in 2008.^{2,13} Comparable findings can be found in US and Canadian dental schools. In 2006, 86% of predoctoral programmes provided their students with clinical experience in restoring dental implants.¹² A subsequent survey in 2017 revealed an overall increase in both clinical experience and preclinical exercises.¹⁶ It is apparent that further integration and development of implant education into the UK and Irish undergraduate curricula are required, however, this is not without its challenges. Commonly reported barriers in the UK and worldwide include funding, inadequate curriculum time, limited patients and staff training.^{2,10,14} Despite these barriers, there is evidence to show successful incorporation of implant dentistry into undergraduate programmes.^{17–19}

In view of the fast-paced developments in implant dentistry, and the pressures faced by educational providers, the dental profession and various organisations, there is a need to ensure that dentists are sufficiently trained to provide safe implant care that is within their scope of their practice. Previous studies have so far evaluated implant education among undergraduate dental schools, however, to the authors'

Table 1 Teaching formats used in undergraduate implant programme (n = 16)

Teaching format used	Number of schools	Percentage
Phantom head training	14	88%
Lecture programme	13	81%
Symposium	6	38%
Patient treatment	5	31%

Box 1 Recommended textbooks and references for undergraduate implant programmes

1. Hobkirk J, Watson R M, Searson L. *Introducing dental implants*. Churchill Livingstone, 2003.
2. Palmer R. *Clinical Guide Series*. A clinical guide to implants in dentistry. BDJ Books, 2000.
3. Handelsman M. Surgical guidelines for dental implant placement. *Br Dent J* 2006; **201**: 139–152.
4. Palmer R M. Risk management in clinical practice. Part 9. Dental implants. *Br Dent J* 2010; **209**: 499–506.
5. Malet J, Mora F, Bouchard P. *Implant dentistry at a glance*. Wiley-Blackwell, 2012.
6. Various authors. *ITI treatment guide series*. Quintessence Publishing.

knowledge, no recent studies have re-evaluated this topic in relation to the UK and Ireland. The current literature indicates that more information is required on implant education within dental undergraduate schools. Therefore this study set out to evaluate the teaching of implant dentistry in undergraduate dental schools in the UK and Ireland to determine whether schools are meeting the required standards set out by the General Dental Council (GDC).

Materials and methods

An online questionnaire consisting of 30 questions was developed to assess the level of teaching in implant dentistry at an undergraduate level from the dental schools of the UK and Ireland. The online questionnaire was constructed using software developed by Bristol University (Bristol Online Surveys, Bristol, UK). Both 'open' and 'closed' style questions were included. The questionnaire was adapted from a previous study by Addy *et al.*¹⁰ and pre-piloted within the Cardiff Dental School. This was subsequently amended, reviewed and approved by the Cardiff Dental School Research Ethics Committee (Reference No: 1703a)

In March 2017, an email was sent to restorative heads of departments in the 18 UK and Irish dental schools, providing them with the HTML link for the questionnaire, together with a participant information sheet. Topics included:

- Current level of teaching of dental implants at their institution
- Planned changes in this teaching during the subsequent 12-month period

- The respondent's perception of what dental implant training/education for undergraduates would be like at their institution in five years' time.

Reminder emails were sent at two and four weeks from the initial email. After a six-month reply period, the data was collated and examined. The Bristol Online Surveys software (Bristol University) programme permitted collection and analysis of the data. Descriptive statistics are reported.

Results

Completed questionnaires were received from 16 out of 18 dental schools (88%). It is understood that the responses were completed by the restorative dentistry heads of department or by a senior academic with teaching responsibilities relating to implant dentistry.

Current teaching

All responding dental schools reported that they provided training in implant dentistry for their undergraduates. In addition, all said that there were requirements within their curriculum for undergraduates to receive implant training. Twelve schools stated that implant training occurred during the fourth and fifth years, however, six schools also included this teaching in their third year programme.

Ten schools (62.5%) reported that teaching was provided solely by the restorative dentistry staff. For the remaining six schools (37.5%), both the restorative dentistry and oral and maxillofacial surgery departments provided teaching.

Table 2 Available resources for providing an undergraduate implant programme (n = 16)

Resource	Number of respondents	Percentage
Selected papers	11	69%
Blackboard available seminars	8	50%
Video/DVD	5	31%
Other	3	19%
Internet-based programmes	2	13%
CAL programmes	1	6%
None	2	13%

Table 3 Clinical experience provided by dental schools in the undergraduate implant programme (n = 16)

Type of clinical experience	Number of respondents	Percentage
Observation		
Live surgery	12	75%
Restorative implant procedures	10	63%
Direct clinical experience		
Treatment planning	13	81%
Restorative implant procedures	5	31%
Surgical implant placement	1	6%

Table 4 The types of cases treated by students in the undergraduate implant programme

Type of case	Number of respondents	Percentage
Restorative implant procedures		
Removable edentulous	4	50%
Single unit	3	37.5%
Short span bridgework	1	12.5%
Surgical implant placement		
Single unit	1	100%

Table 1 describes the mode of delivery of dental implant teaching to dental undergraduates. Fourteen schools (88%) had a phantom head component to their course with 13 (81%) and six (38%) schools utilising a lecture programme and symposium respectively. Five schools (31%) incorporated patient treatment into their teaching programme.

The majority of schools (n = 9, 56%) devoted four to six sessions to the implant programme, five schools (31%) assigned one to three sessions and two schools provided greater than six sessions (13%).

Six schools had recommended textbooks and references on implants as part of their undergraduate reading lists. These are listed in Box 1. The educational resources available

to undergraduate students relating to dental implants are listed in Table 2. In relation to internet-based programmes, one school utilised the ITI online programme. ‘Other’ resources included implant guide stents for clinic, use of locator changing devices and torque drivers as well as use of models and kits in the clinical skills learning environment.

In 12 of the 16 schools (75%), students observed live surgery. In ten of the 16 schools (63%), students observed restorative implant procedures. Five schools stated that not all students were guaranteed to observe such procedures.

The type of clinical experience provided by dental schools and the cases treated by students in the undergraduate implant programme are summarised in Tables 3 and 4.

Schools providing implant restoration experience expected their students to provide treatment for one or two cases. In two schools (40%), cases were completed by students in pairs, while in the remaining schools (60%), cases were completed individually. Four of the five schools (80%) had measures of competency for restoring dental implants within their undergraduate programmes.

One school detailed the format of implant training within the institution. The school stated that all students are assigned a case for implant maintenance during their clinical training. Some students may shadow a private implant practice, some undertake restoration of implant mandibular overdentures and some participate as assistants on the postgraduate diploma programme.

Fifteen schools (94%) indicated that they received support from implant companies for the provision of implant training. Tables 5 and 6 detail the level of support and companies involved. Only 25% (n = 4) of dental schools had arrangements for patients to contribute to the cost of treatment.

Future plans for dental implant undergraduate training – next 12 months

Dental schools that did not provide undergraduate experience for restoring and placing implants were asked whether there were plans to introduce this teaching in the next 12 months. None of the schools stated that they planned to introduce such experiences in the next 12 months.

Current challenges to the provision of implant training at an undergraduate level

Table 7 details the current challenges to the provision of implant training at an undergraduate level. One school stated that they did not have any current challenges.

Schools were asked to identify what components of fixed or removable prosthodontics teaching programmes they felt would increase or decrease to accommodate the introduction and development of a teaching programme in implant dentistry. The responses are summarised in Table 8.

Future predictions for implant undergraduate training – five years’ time

Thirteen out of 16 dental schools (81%) believed that there will be clinical requirements relating to implant placement and restoration for

undergraduate students in five years' time. Fifteen out of 16 dental schools (94%) reported that they did not think undergraduates would/should be surgically placing implants in five years' time. Only one school thought that undergraduates would/should be placing implants for single unit or removable edentulous cases. Table 9 summarises the dental schools' opinions on which type of implant restorations they believe that students would/should be involved in restoring in five years' time.

Discussion

This survey sought to determine the current status of implant education in undergraduate schools across the UK and Ireland. In this survey the response rate of 88% was much higher in comparison to other dental questionnaires and deemed favourable.²⁰ The overall results show a notable improvement in the amount of implant education across undergraduate dental schools since previous surveys.^{9,10} It is encouraging to see that all responding dental schools provided implant training for their undergraduate students and acknowledged that there were curriculum requirements to provide such training. This is a significant development from 2008 whereby only 87% of schools provided implant training and 53% stated that there were curriculum requirements.¹⁰ Introduction of the GDC's publication *Preparing for dental practice – Dental learning outcomes for registration*, updated in 2015, may have facilitated this change.⁴ This document sets out more specific learning outcomes for the implant component in dental undergraduate programmes compared to the previous documents, *First five years* and *Developing the dental team*.^{21,22} The improvements in implant education will further help newly graduated dentists to meet the requirements of this document.

Greater exposure to implant training at an undergraduate level leads to an increased likelihood of students taking on postgraduate implant training after qualification.^{23,24} Dentists that choose to provide implant restoration or placement must, however, be competent at performing these procedures. To ensure this is the case, postgraduate training requirements published in 2016 by the Faculty of General Dental Practice (UK) and the Association of Dental Implantology provide the standards expected of dentists to perform safe implant treatment.^{6,7} Although the GDC does not expect dentists to place and restore implants, it is a requirement that they are

Table 5 Type of support received by implant companies for the provision of implant training for undergraduate implant teaching (n = 15)

Type of support	Number of respondents	Percentage
Provision of simulated models for surgery and implant restoration	14	93%
Provision of implants	7	47%
Provision of restorative components	7	47%
Laboratory funding support	2	13%

Table 6 Implant companies principally involved in supporting undergraduate programmes

Implant company	Number of respondents
Straumann	8
Nobel Biocare	7
Dentsply	4
3i Biomet	3

Table 7 Current challenges to the provision of implant training at an undergraduate level

Issues	Number of respondents
Funding	12
Lack of available time within existing teaching curricula	9
Limited numbers of suitably trained teaching staff	4
Limited patients	1
Lack of clinical space	1
Lack of consensus as to what level of implant training undergraduates should receive	1

Table 8 Views of respondents on possible changes within existing prosthodontics teaching programmes in response to the development of teaching programmes in implant dentistry

Area of prosthodontics	Decrease as a result of implant programme	Stay the same	Increase as a result of implant programme
Removable prosthodontics	13%	81%	6%
Fixed conventional bridgework	38%	56%	6%
Resin retained bridgework	6%	94%	0%
Occlusion	0%	94%	6%

Table 9 The type of implant restorations dental schools thought undergraduates will be/should be involved in restoring in five years' time

Type of restoration	Number of respondents	Percentage
Implant overdenture with ball or stud attachments	12	75%
Single tooth anterior	4	25%
Single tooth posterior	3	19%
Implant overdenture with bar attachment	3	19%
Simple implant retained bridges	1	6%

able to communicate to patients the range of implant treatment options, their risks, impacts, outcomes and limitations.⁴

Most schools provided implant training for their undergraduates during the fourth and fifth years, with some schools starting in third year, which would be expected. There would be opportunity in this respect for students to first develop the necessary core knowledge and skills in dentistry before approaching a subject that is more complex like implant dentistry. Interestingly, a reduction in multi-disciplinary teaching was observed, with schools reporting that restorative dentistry staff predominantly provided the implant teaching (63%), compared to previous findings where most teaching was jointly provided by restorative dentistry and oral surgery specialties (61%). Without further information, it is difficult to speculate on the reasons for this change, however, investigating this would be worthwhile given that a multi-disciplinary approach in teaching can potentially bring benefit to students' understanding of successful dental implant therapy.

Theory and practical study are both important aspects in the acquisition of skills and knowledge necessary for students to fulfil the learning outcomes of implant dentistry. Previous findings revealed that limited implant teaching was available for undergraduate students and this was delivered mainly in didactic or lecture-based settings with some phantom head hands-on training only.¹⁰ The current results show a significant improvement in this area with the majority of schools now providing teaching in the form of phantom head training (88%) and lectures (81%). Although these teaching modalities offer an excellent means for students to develop their clinical knowledge and skills, it cannot substitute the broader depth of clinical learning that students can achieve by direct clinical exposure to patients and dental implants in a clinical setting. The results of the survey showed that most dental schools offered students the opportunity to observe live implant surgery (75% vs 33% in 2008) and restorative implant procedures (63% vs 46% in 2008), which is very encouraging given that the majority did not provide this experience in the past.¹⁰ Another encouraging observation is the significant increase in the number of schools that offered students direct clinical experience in treatment planning (81% vs 46% in 2008). In a climate where UK litigation is rising, especially in implant dentistry, such experience is

invaluable for students to appreciate first hand, not just the importance of treatment planning but also aspects such as obtaining informed consent and patient communication. These factors if performed poorly, have been shown to result in patient claims and complaints.³

Despite the improvement in the overall amount of implant teaching, the level of direct clinical experience that dental schools provide students in restoring and placing dental implants remains low and similar to previous findings.¹⁰ Contrary to the argument that such direct clinical experience would be best reserved for qualified dentists that wish to provide implant treatment, studies have shown that dentists are more likely to incorporate implant dentistry into their clinical practice if they received clinical experience during their undergraduate training compared to dentists that did not.^{23,24} It is therefore the authors' view that dental schools should strive to provide students with clinical experience in implant procedures as this can only serve to improve and enhance students' training experience and result in producing dental graduates that are more proficient and willing to manage implant cases in their clinical practice.

When asked about future trends, the majority of dental schools anticipated that there would be clinical requirements relating to implant placement and restoration for undergraduates in five years' time. This is an indication that dental schools foresee such changes occurring so as to keep up with other dental schools worldwide. In contrast to UK and Irish dental schools, the majority of dental schools in Europe, the US and Canada already offer their students clinical experience of restoring dental implants and surgical implant placement. While 31% of responding schools in the UK and Ireland stated undergraduates gained clinical experience of restoring dental implants, surveys found that students in 75% and 98% of responding schools in Europe and North America respectively received experience of restoring implants.^{2,10,16} Only one school in the current survey offered clinical experience of surgically placing implants while in Europe and North America, 64% and 89% of responding schools respectively provided clinical experience in surgical placement of implants. These findings raise similar concerns to previous studies that dental implant education in the UK and Ireland is failing to keep up with other dental schools worldwide and there is a particular need to improve the amount of clinical exposure that

students receive for dental implant procedures.^{10,11} Certainly, incorporation of this type and level of training is challenging, however, it is essential that dental school curricula keep pace with current developments and remain evidence based.

Most schools cited funding, lack of available time within existing teaching curricula and staff training as the main challenges to improving/increasing teaching of implant dentistry, and this is commonly reported by other dental schools worldwide.¹⁴ Support from implant companies can help reduce the funding pressures associated with incorporating implant training into the existing curricula. Ninety-four percent of schools indicated that they received support from implant companies, which is a significant improvement from previous data (60%).¹⁰ Most schools (93%) received simulated models for surgery and restoration, however, less than half of responding schools received implant or restorative components and only 13% received laboratory-funding support. It is apparent that dental schools have established stronger ties with implant companies to increase their level of funding since the last survey. In order for additional improvements in future training to be achieved, with consideration that funding is a common barrier, it may be necessary for dental schools to seek further funding support from implant companies. Obtaining sponsored implant or restorative components may alleviate financial pressures related to provision of clinical implant training, for example. Curriculum congestion can present a barrier to introducing implant training and often the reduction of other clinical components in the curriculum is required. This survey revealed that 44% of schools anticipated a decrease in the teaching of fixed conventional bridgework to accommodate increased implant dentistry teaching over the next five years. It is clear that integrating a high quality implant programme into the undergraduate curricula is not a simple task. Dental schools may therefore benefit from reviewing existing teaching models from schools that have successfully integrated implant dentistry into their curriculum.

The use of dental implants is rising and it is inevitable that dentists, even those that do not place or restore implants, will play a greater role in discussing implant treatment options and providing care for implant patients. Educational providers therefore have an ever-increasing responsibility to ensure that new dental graduates are sufficiently trained to perform these procedures. Although it is

evident that all responding dental schools are meeting the GDC's undergraduate curriculum requirements for implant dentistry, the level of coverage of this subject is varied, with some schools providing the minimum amount of teaching while others provide significantly more clinical experience in implant procedures. Perhaps there is a need for more rigidity in these requirements in order to standardise implant teaching across dental undergraduate schools. It is promising that there is a large body of evidence looking at trends in implant education within undergraduate schools worldwide. The ability to compare UK and Irish undergraduate implant teaching against worldwide trends enables educational providers and those involved to push for developments and changes in order to keep pace with other teaching units worldwide. It is hoped that the findings of this survey will help inform educational providers of the current teaching trends so as to promote standardisation, improvement and development of the undergraduate implant curricula across dental schools in the UK and Ireland.

In order to monitor the development of implant teaching within UK and Irish dental undergraduate schools and to ensure that the standards set by the GDC are being met, a repeat of this survey on a five-yearly basis is recommended. For future studies, it would also be beneficial to evaluate the teaching of peri-implant maintenance. The issue of peri-implant diseases has become an increasing concern and it is important to ensure that newly qualified dentists are competent in clinically assessing peri-implant health and preventing and managing peri-implant diseases.

Conclusions

All responding dental undergraduate schools in the UK and Ireland provide implant training for their students. There was significant improvement in the amount of implant education across dental undergraduate schools since previous surveys, however, direct clinical experience remained low in restoring (31%) and placing (6%) dental implants. Barriers to implementing and developing the dental undergraduate implant programme include funding and lack of available time in the curriculum. Further development and improvement of implant teaching in dental undergraduate schools are required, particularly with respect to the amount of direct clinical experience provided.

- Jung R E, Zembic A, Pjetursson B E, Zwahlen M, Thoma D S. Systematic review of the survival rate and the incidence of biological, technical, and aesthetic complications of single crowns on implants reported in longitudinal studies with a mean follow-up of 5 years. *Clin Oral Implants Res* 2012; **23**: 2–21.
- Koole S, Vandeweghe S, Mattheos N, De Bruyn H. Implant dentistry education in Europe: 5 years after the Association for Dental Education in Europe consensus report. *Eur J Dent Educ* 2014; **18**: 43–51.
- Dental Protection. Riskwise. 2015. Available at <https://www.dentalprotection.org/docs/librariesprovider4/default-document-library/riskwise-uk.pdf?sfvrsn=0> (accessed September 2018).
- General Dental Council. Preparing for practice – Dental team learning outcomes for registration. 2015. Available at <https://www.gdc-uk.org/professionals/students-and-trainees/learning-outcomes> (accessed June 2018).
- British Dental Journal. GDC warns general dental practitioners on implantology. *Br Dent J* England; 2008; **205**: 425.
- Association of Dental Implantology. A Dentist's Guide to Implantology. 2012. Available at www.adi.org.uk/resources/guidelines_and_papers/dentist_guide (accessed June 2018).
- Faculty of General Dental Practice UK. Training standards in implant dentistry. 2016. Available at <https://www.fgdp.org.uk/sites/fgdp.org.uk/files/docs/in-practice/fgdp%20implant%20training%20standards%202016.pdf> (accessed June 2018).
- Watson R M. The teaching of osseointegrated implant dentistry in the schools of the UK and Eire. *Br Dent J* 1993; **175**: 201–203.
- Young M P, Carter D H, Sloan P, Quayle A A. A survey of oral implantology teaching in the university dental hospitals and schools of the United Kingdom and Eire. *Br Dent J* 1999; **187**: 671–675.
- Addy L D, Lynch C D, Locke M, Watts A, Gilmour A S. The teaching of implant dentistry in undergraduate dental schools in the United Kingdom and Ireland. *Br Dent J* 2008; **205**: 609–614.
- Blum I R, O'Sullivan D J, Jagger D C. A survey of undergraduate education in dental implantology in UK dental schools. *Eur J Dent Educ* 2006; **12**: 204–207.
- Petropoulos V C, Arbreu N S, Tarnow D *et al*. Teaching implant dentistry in the predoctoral curriculum: a report from the ADEA Implant Workshop's survey of deans. *J Dent Educ* 2006; **70**: 580–588.
- De Bruyn H, Koole S, Mattheos N, Lang N P A. A survey on undergraduate implant dentistry education in Europe. *Eur J Dent Educ* 2009; **13**: 3–9.
- Atashrazm P, Vallae N, Rahnema R, Ansari H, Shahab M P. Worldwide predoctoral dental implant curriculum survey. *J Dent (Tehran)* 2011; **8**: 12–18.
- McAndrew R, Ellis J, Lynch C D, Thomason M. Embedding implants in undergraduate dental education. *Br Dent J* 2010; **208**: 9–10.
- Kihara H, Sun J, Sakai M, Nagai S, Da Silva J. A Survey of Dental Implant Instruction in Predoctoral Dental Curricula in North America. *J Dent Educ* 2017; **81**: 1085–1090.
- Jahangiri L, Choi M. A model for an integrated predoctoral implant curriculum: implementation and outcomes. *J Dent Educ* 2008; **72**: 1304–1317.
- Wilcox C W, Sheets J L, Nilsson D E. Predoctoral implant education: the Creighton experience at 20 years. *J Prosthodont* 2010; **19**: 144–149.
- Kroeplin B S, Strub J R. Implant dentistry curriculum in undergraduate education: part 2-programme at the Albert-Ludwigs University, Freiburg, Germany. *Int J Prosthodont* 2011; **24**: 544–556.
- Tan R, Burke F. Response rates to questionnaires mailed to dentists. A review of 77 publications. *Int Dent J* 1997; **47**: 349–354.
- General Dental Council. The first five years. 2008. Available at <https://www.gdc-uk.org/api/files/TFFYthirdeditionfinal.pdf> (accessed September 2018).
- General Dental Council. Developing the dental team. 2009. Available at <https://www.gdc-uk.org/professionals/education> (accessed September 2018).
- Huebner G R. Evaluation of a predoctoral implant curriculum: does such a programme influence graduates' practice patterns? *Int J Oral Maxillofac Implants* 2002; **17**: 543–549.
- Maalhigh-Fard A, Nimmo A, Lepczyk J W, Pink F E. Implant dentistry in predoctoral education: the elective approach. *J Prosthodont* 2002; **11**: 202–207.