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Author/s:

Cheung, MC;Hopcraft, MS;Darby, IB

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Implant education patterns and clinical practice of general dentists in Australia

Short title: GDPs' implant training and clinical practice

Monique Charlene Cheung, Matthew S Hopcraft, Ivan B Darby

Melbourne Dental School, The University of Melbourne, Victoria, Australia

Corresponding author:

Professor Ivan Darby

Head of Periodontics

Melbourne Dental School, The University of Melbourne

720 Swanston Street, Carlton, 3053 VIC Australia

T: +61 3 9341 1471 E: idarby@unimelb.edu.au

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DR. MONIQUE CHARLENE CHEUNG (Orcid ID : 0000-0001-5326-3048)

PROF. IVAN DARBY (Orcid ID : 0000-0002-6457-5327)

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Implant education patterns and clinical practice of general dentists in Australia

Abstract

Background: This study aimed to understand trends in dentists' implant training attendance and correlation to treatment provision. Implant-specific oral hygiene instruction coverage in training programs was investigated.

Methods: A cross-sectional web-survey of dentists registered in Australia was conducted. Respondents were asked about their background, implant training history and treatment provision. Results were analysed by implant provision characteristics and graduation decade.

Results: Three hundred and three responses from general dentists (GDPs) were received and analysed. The highest implant training levels attained post-graduation were postgraduate non-specialist qualification (7.9% of respondents), continuing professional development (CPD) (73.6%) versus none (18.5%), with differences between implant providers and non-providers ($p < 0.001$), different graduation decades ($p < 0.001$) and those restoring implants or performing surgery as well ($p < 0.001$). University-based CPD was attended less than

dental association/society or implant-company CPD. Non-providers were significantly less likely to recall implant oral hygiene instruction sources ($p<0.001$). Most GDPs (74.9%) provided implant services, with younger GDPs beginning earlier after graduation. About 16% of respondents did not provide implants once established career-wise.

Conclusions: Dentists may be providing implant treatments increasingly earlier in their careers. Respondents with more training were significantly more likely to perform more complex procedures, while implant training attendance trends varied by graduation decade.

Keywords: Continuing education, dental implants, dentists' practice patterns, oral hygiene, survey.

Introduction

The development of the field of implantology in Australia since the 1980s has been accompanied by the evolution of implant education. A baseline curriculum for implantology within the undergraduate/graduate dental degrees in Australia was established by consensus in 2010¹ and includes treatment planning, diagnostic procedures, limited restorative services and maintenance. Dentists who graduated prior to 2010 or who want to provide more complex services may seek training of their own volition. Postgraduate courses leading to formal qualifications have been available since the 2000s. There are many non-degree continuing professional development (CPD) programs available, for which there are no regulations or standards required for academic content or assessment.² Evaluation of CPD training programs in Europe found them to be highly variable in structure and content.³ Furthermore, there is no such thing as a generic implant and the role of implant companies in implant education must be considered. While some surveys in the literature have included dentists' brand preferences,⁴⁻⁶ the relationship to usage in training, as well as the popularity of implant-company training courses among the CPD-level options available to dentists have rarely been investigated.

Previously published surveys of general dentists have investigated the characteristics of implant providers, their interest in further training, implant case types treated, referral patterns, patient enquiries and their main sources of training.⁴⁻⁷ A survey of general dentists in Victoria in 2008 surveyed the different types of implant training programs attended and found training and higher levels thereof to be correlated to greater

provision of more complex cases as well as more complex implant maintenance services.⁷ Overall, the implantology training paths taken by different generations of dentists, and possible correlations to their subsequent and/or current clinical practice remain unclear.

As research continues into peri-implant diseases (with patient-level weighted mean prevalences of peri-implant mucositis of about 45% and peri-implantitis of about 20% reported^{8,9}), their prevention and management, the role of oral hygiene as a risk factor for disease¹⁰⁻¹² and in long-term implant maintenance^{13,14} is becoming clearer. However, the literature on implant-specific oral hygiene techniques performed by patients for disease prevention and as part of peri-implant management is lacking.^{15,16} It is unknown therefore whether dentists are receiving any information from their training programs about implant-specific oral hygiene instructions (OHI) to give to their patients, and whether this varies according to the type of program.

This study aimed to investigate dentists' historical attendance at implant training programs after graduation, their current provision, complexity and volume of implant treatment, and any association with time since graduation. The coverage of implant oral hygiene information within training programs and the impact of implant companies on training and clinical usage of their products was also explored.

Methods

The research protocol for this study was approved by the Health Sciences Human Ethics Sub-Committee of the University of Melbourne (Ethics ID 1443625). Dentists and dental specialists who were registered in Australia were anonymously surveyed using a web-based questionnaire via the SurveyMonkey™ website (San Mateo, CA, USA). To maximise the number of responses, the Australian Dental Association's seven state branches, the Australian Society of Periodontology and the Royal Australasian College of Dental Surgeons assisted by distributing the survey electronically to their memberships, and a prize draw was advertised as part of these communications. Data were collected between March and September 2016.

Respondents provided information about their gender, dental qualifications, graduation year and university, registration type, practice location and practice sector. They were asked about their history of attendance at implant training programs (both restorative and surgical), their recollection of implant oral hygiene education, provision of implant treatment services, estimated annual case volume and implant brands used in their training and in clinical practice.

Data were described and analysed according to decade of graduation, implant treatment provision status, highest level of implant training and provision of restorative and/or surgical services among those with implant experience, to investigate trends in implant training attendance as the field of implantology has developed in Australia as well as subsequent service provision patterns. Graduation decade analysis pooled together all graduates from 1985 and before, accounting for the more widespread development of the field in the mid-1980s. Highest level of implant training for each respondent was determined by their reported completion of implant-related university qualifications, university-run CPD days, professional association/society programs, implant-company programs and/or work-based mentorship. If respondents had completed any formal non-specialist postgraduate university-based qualifications, their highest level of training was considered to be at the formal postgraduate level. Respondents who had completed any CPD programs but no formal postgraduate qualifications were considered to have CPD as their highest level of implant training. The remainder who did not report any completion of formal postgraduate or CPD programs were placed in the “neither” or no-training category.

The statistical analysis (Pearson’s Chi-squared tests and independent sample t-tests) was performed using SPSS software version 23.0 (SPSS, Chicago IL, USA) and significance set at $p < 0.05$.

Results

Demographics

From the 405 responses received, most were registered as general dentists (74.8%, $n=303$). As there can be differences between different specialty types’ involvement in implantology in clinical practice, only the findings for the general dental practitioner (GDP) group are presented forthwith.

Over half of the respondents were male (54.1%, $n=164$) and most of the respondents did not own a practice, worked only in private practice or only in metropolitan areas (not all respondents provided their metropolitan or rural/regional location), and graduated from an Australian university (Table 1). Almost three-quarters of GDPs offered implant services to their patients ($n=227$, 74.9%) and these implant providers were significantly more likely to be male, practice owners or working only in the private sector (all $p < 0.001$).

Grouped by decade of graduation, the largest cohort of respondents graduated between 2006-15 (43.9%), followed by 1996-2005 (22.1%), with the smallest numbers graduating before 1976 (4.9%) (Fig. 1). The mean year of graduation was 1998 and the median year 2002. GDPs who provide implant treatment had a significantly earlier average year of graduation (1997) than non-providers (2003) ($p < 0.001$, 95% CI: 3.3-9.6 years earlier).

Implant training after graduation

The types of implant training that GDPs had attended after graduation from their initial degree are shown in Table 2. Formal university postgraduate diploma/degree training was the highest level of implant training completed by 7.9% of GDPs, compared to CPD as the highest level for 73.3%, and 18.5% had attended neither (Table 3). Implant providers attended significantly more implant training at all levels and types than the GDPs not providing implants (non-providers), but 2.6% of implant providers had neither formal postgraduate nor CPD training (Table 3). Overall comparisons of GDPs by decade of graduation showed a significant difference overall for the highest level of training attended ($p < 0.001$). Graduates from 2006-15 were most likely to have had no formal postgraduate or CPD implant training (28.6%). Graduates from 1986-2005 had the highest rates of formal postgraduate training (approximately 15%) and graduates from ≤ 1985 had the most CPD attendance as their highest level of training at 87.9% (Table 3). However, different graduation decade had no significant impact on the highest level of implant training among implant providers.

When comparing attendance at CPD provided by different organisations, programs run by implant companies (62.0%) and dental associations/societies (60.7%) were more frequently attended than those from universities (38.0%) (Table 4). Restoration-focused programs followed a very similar pattern to the overall, while surgical-focused programs were more evenly attended although university-based courses still had the lowest attendance (Table 2).

Dentists who had more experience with providing services and complex treatments reported higher rates of attendance at the various CPD types, but the longer time that older graduates had had to accumulate CPD must be considered and statistical analysis between groups was not performed. However, university CPD was the least attended within all decade groups, and the most recent graduates (2006-2015) reported a historical attendance of only 21.2%, less than half of their attendance at the other CPD program types, a greater difference than in the older graduate groups (Table 4). There were no significant differences between restorative only and surgical/restorative providers in terms of CPD program types attended.

Implant treatment provision

About three-quarters of GDPs (74.9%) offered implant services to their patients, including 213 (70.3%) who had begun and continue to do so (considered to have implant experience). GDPs were found to gradually begin performing implant treatment in the decade periods after they graduate (Table 5), with approximately 16% across the different graduation groups who never begin to do so. The most recent graduates appeared to be starting to perform implant treatments earlier with 54.1% doing so within the same decade period as their graduation.

Out of the entire GDP cohort (n=303), 78.5% treatment planned implants, 74.6% provided restorative treatment, 24.4% provided surgical treatment and 50.5% provided only restorative treatment. Of the 227 implant providers, 67.4% only restored implants, 0.4% only placed implants, and 32.2% performed both. Among GDPs with implant experience (n=213), those with formal postgraduate training (83.3%) were much more likely than those with CPD-level training (37.4%) to perform both surgical and restorative treatments ($p<0.001$).

Estimated annual case volume

Most of the GDPs with previous implant experience (n=213) estimated their annual implant case volume to be ≤ 20 cases (70.0%) while 8.4% estimated >50 cases (Table 6). Those with higher levels of implant training treated significantly more cases annually ($p<0.001$), and thus those who do both surgery and restoration also had a significantly greater caseload than those who restore only ($p<0.001$). GDPs in graduation decade groups before 2006 had similar case volumes, with about 40% treating over 20 cases per year, while the most recent graduates (2006-15) were more likely (86.1%) to treat ≤ 20 cases per year ($p=0.016$).

Implant brands – training and usage

The most common implant brands used during training were also those preferred most commonly for patient treatment, with Astra Tech® (which merged with Dentsply Sirona® shortly after this survey was conducted), Straumann® and Nobel Biocare® predominating (Table 7). Among GDPs with implant experience (n=213), Straumann® was the most highly preferred brand (42.7%) although reported training history was highest from Nobel Biocare® among all GDPs as well as among implant providers only.

There were no significant differences in overall brand preferences between GDPs of different graduation decades. Straumann® was the most popular brand for all decade groups, but Nobel Biocare® was the second

most popular for the ≤ 1985 graduates while Astra Tech® was the second most popular for all subsequent graduation cohorts.

Reported sources of implant oral hygiene instruction information

There were significant differences in the sources of information that GDPs cited for implant oral hygiene instructions (OHI), by decade of graduation (Table 8). More recent graduates recalled implant OHI information in their initial dental degrees (up to 66.2% in the most recent graduation decade) compared to fewer than five percent of those who graduated prior to 1996 ($p < 0.001$). The most recent graduates were least likely to report learning implant OHI from journal articles ($p = 0.001$). When comparing different CPD program types (cited by those who had ever attended each type), ≤ 1985 graduates recalled learning implant OHI from each program type at higher rates than other decade groups. Within the 2006-2015 graduate group, implant company CPD was reported as a learning source half as often (30.2%) as university-based CPD (64.3%), whereas the other graduation decade groups were more consistent. A small proportion of earlier graduates volunteered that they considered their clinical experience or knowledge of periodontal management to be applicable to implant OHI.

Non-providers who had attended implant-company CPD had a particularly low recall (15.4%) of learning implant OHI from these programs compared to implant providers ($p = 0.025$), while no difference was found for the other CPD program types. Nearly one in five non-providers did not list any sources of implant OHI, compared to 2.6% of implant providers ($p < 0.001$).

Discussion

This study found that among the GDPs who participated in the survey, higher levels of implant training after graduation from dental school were significantly correlated to implant treatment provision, greater complexity of such (i.e. performing surgical placement in addition to restoration) and higher estimated annual case volumes. This is consistent with previous research in Victoria⁷ where any training and higher levels of training were significantly correlated to willingness to treat more complex cases. No other studies are known to have investigated the relationship between implant training level and treatment provision levels, and overall, few studies have surveyed dentists on their implant training.^{4, 5, 17, 18}

When comparing overall implant training attendance and implant service provision trends, GDPs in this study appeared to establish a knowledge base wider than the clinical treatments provided, i.e. not all of those who have attended training end up providing the services in clinical practice, most markedly at the surgical training level. The reasons influencing implementation in clinical practice subsequent to training warrant further investigation and may include the need for longer term learning, modular programs, practical experience, mentorship and clinical supervision, as suggested by participants in a study of university-based CPD where implant program attendees put their new skills into practice at a lower rate than rotary nickel-titanium endodontics program attendees.¹⁹

Three-quarters of GDPs surveyed were implant providers, a greater proportion than 66.4% found in another recent Australia-wide survey,⁶ and 50.6% found in Victoria in 2008,⁷ perhaps reflecting the increasing popularity of implant provision among GDPs and/or increased patient awareness and demand over time. This trend has also been found in serial surveys of dentists in New Zealand^{5, 17} and Hong Kong.⁴

Surgical implant placement was performed in this study by twice the proportion of GDPs reported in a 2006 USA random-sample survey.²⁰ No other published proportions of the overall GDP workforce providing restorative and/or surgical implant services are available for comparison. Among implant-providing GDPs, the proportions in this study offering restorative and/or surgical services were similar to other recent surveys in Australia⁶ and Hong Kong.⁴

Six implant providers in this study (2.6%) did not report any attendance at implant training after graduation, while citing some sources of implant OHI information, but this finding was lower than the 12% found in the 2008 Hong Kong study who were self-taught from “books and manuals on implants”.⁴ The proportions of implant providers with formal postgraduate or CPD highest training levels in this study were otherwise similar to those in the Hong Kong study.

This study also found a similar caseload to that reported in Hong Kong, with the majority of implant providers treating ≤ 20 cases per year.⁴ If most dentists are performing implant treatment relatively infrequently, the rigor of training, appropriate case selection and clinical supervision or mentorship need to be at a high level. Ongoing research should track the provision of implant treatments globally in terms of practitioner involvement and case volume, as the field of implantology and its education structure continue to evolve, which may provide information regarding outcomes and minimum training standards. A recent survey of 1015 implant-providing participants of an implantology Massive Open Online Course (MOOC) had respondents from 84 countries and is one of the first to provide a global perspective of implant providers.²¹

Graduation decade affected the level of implant training attended by respondents in this study, with recent graduates less likely to have attended any at all, similar to results found in New Zealand in 2004¹⁷ and 2014⁵

and the 2008 study in Victoria.⁷ Recent graduates are most likely establishing their general skills before upskilling into implantology with restorative training first, reflected by their lower attendance at surgical programs. Graduates from 1986-2005 had the highest participation in formal postgraduate degrees in this study, having been at the stage of their careers to expand their skillset when these programs became available in Australia in the 2000s. Meanwhile, graduates from ≤ 1985 may have compensated for graduating before implants became available, with the highest reported rate of attendance at CPD training. Respondents were not asked specifically if they had received implant training in their initial dental degree, although this is unlikely for those who graduated prior to 2000.

Among implant providers in this study, the finding that decade of graduation did not affect the highest level of training suggests that younger dentists who took up implant training did so more quickly. In the future they may continue to do so and demonstrate higher overall levels of training than their more senior colleagues, just as they reported higher rates of implant treatment provision than their senior colleagues at the same career stage. Possible reasons for this finding may be the standardised inclusion of implant training in the initial dental degree, increasing availability of implant training programs of all types, increasing demand for implant treatment in the community and/or competitive pressure to offer a wider range of services. Basic implant training within the Australian initial dental degree programs since 2010 should include competency in some restorative procedures¹ and has likely allowed newly graduated dentists the confidence to provide simple implant treatments immediately or soon after graduation. Similarly, the MOOC participant survey identified a cluster of younger implant providers beginning to perform treatment within their first two years of practice, who had attended less formal postgraduate training than others.²¹ At the other end of the spectrum, the possible reasons for 16% of GDP respondents in this survey not providing implant treatments (excepting the most recent graduates) and whether this trend continues warrant further research.

Attendance at non-degree CPD provided by different organisations appears to have been rarely investigated in the literature. It must be acknowledged that industry support or sponsorship is intrinsic to implant training programs at all levels, and thus whether respondents considered the CPD-level programs they had attended to be organised by universities, professional associations/societies or implant companies themselves may have contained some overlap. Nevertheless, this study's findings were similar to findings in an American study of higher attendance at manufacturer-sponsored and privately-run courses compared to university-based courses,²⁰ while studies in Hong Kong⁴ and evaluating implant CPD in Europe³ did not compare attendance at different short course types. This study reported higher attendance rates at restorative and surgical CPD programs run by universities compared to the 2008 study in Victoria,⁷ while implant company CPD attendance rates remained similar. While this comparison may represent the different sample groups or

differences between Victoria and Australia as a whole, university-based CPD attendance may have increased from 2008 to 2016 and this trend should continue to be investigated. Dentists' motivations for attending a particular program might include availability, accessibility, cost and brand-related factors (e.g. where a practice already uses a certain brand of implant equipment).

CPD was the highest level of implant education attended by most implant providers in this study, yet it is classified as pre-clinical training for knowledge and understanding, lacking the structured curriculum, quality assurance and student assessment recommended for basic clinical competence levels.² Universities are recommended to play "a leading role" in implant education for GDPs¹ and as "basic clinical education level" programs² (which do not currently exist as a formal training and qualification pathway) are developed, understanding why university-based CPD might be less frequently attended than other sources of CPD would be useful. The lack of university-led provision of education options at a level lower than formal postgraduate training was also similarly espoused in the recent study of global MOOC participants.²¹

This study is one of the first to investigate respondents' sources of implant OHI information and it is not surprising that the initial dental degree and work-based mentorship figured much more strongly for more recent graduating groups. Comparing the type of CPD provider, implant company CPD was the most popularly attended and yet was cited least as a source of OHI information, particularly in the most recent graduation group, for whom university CPD was a much more frequent source. While a small percentage of GDPs overall (6.6%) did not cite any sources of implant OHI information, this proportion increased to almost one in five (18.4%) non-providers in this study, and indicates a need to better distribute information to those who have less interest in the field of implantology but who will still encounter implant-related disease in clinical practice.

It is interesting to note the varied sources of implant OHI information given the sparse literature and minimal clinical research available on the best evidence-based implant home hygiene techniques^{15, 16} and lack of standard control protocols in peri-implant disease intervention research.²² The recent Clinical Practice Guidelines from the American College of Prosthodontists²³ did not make specific recommendations on hygiene technique and acknowledged that the guidelines are to be modified as higher quality evidence is established.

Nobel Biocare® and Straumann® are consistently found to be the most frequently used implants in recent surveys of dentists,^{4, 5} a finding confirmed in the present study. Evaluation of brand loyalty in this study showed that GDPs could be moving away from Nobel Biocare® compared to its dominance in training usage and 2008 leading market position in the USA (approximately 28% market share²⁴), with a 25% leading market share claimed by Straumann® in 2018.²⁵ In brands other than Nobel Biocare®, reported clinical usage more closely reflected training usage in this study. This likely reflects the emergence of industry competitors over

time, including in their provision of training or affiliation with education systems e.g. the Straumann®/ITI education network.

The response rate in this study (2.1% of the registered GDP workforce in Australia in 2016)²⁶ was lower than another country-wide survey of implant provision (7.6%),⁶ both surveys being unable to access the national register to generate a randomly selected sample. Previous research has shown that web-based surveys of dentists receive lower response rates than do mailed surveys,²⁷ and those of younger age may have been more likely to complete an online survey. The demographics of the respondents in this study were nevertheless similar to the latest available proportions of employed dentist workforce in the country (2013),²⁸ with slightly more females and graduates from Australian universities in this cohort. As the study focused on the area of implantology, non-response bias may be present if those with a lower interest did not participate, and a survey also relies on participants' recall and accuracy of self-reporting. The questionnaire did not survey the hours that GDPs worked (i.e. full- or part-time), which may affect their involvement in providing implants or more complex treatments. The results and trends reported in this study should be interpreted in light of these limitations but are in general agreement with initial global observations and other similar surveys.

Overall, the implant training preferences and provision of implant treatments by dentists in Australia should continue to be tracked as the field of implantology, its education structure, and understanding of long-term peri-implant pathology develop over time.

Conclusions

This study highlighted the cumulative implantology training trends and current practice patterns of general dentists in Australia who responded to the survey, finding that dentists may be providing implant treatments increasingly earlier in their careers and respondents with more training were significantly more likely to perform more complex procedures. About 16% of GDPs surveyed are not involved in implant treatment once established in their careers. The rapid development of the field and standardised inclusion in initial degree programs in Australia since 2010 may be reflected in the differences in post-graduation implant training programs attended by respondents in varying stages of their careers. University-based CPD programs were attended at a low level by respondents compared to programs from dental associations or societies and implant companies. With the current CPD framework of non-compulsory, self-directed and non-standardised learning prior to providing implant treatment, challenges for the profession lie in ensuring that all are

practising according to evidence-based standards, especially in the basic areas of prevention and patient education, including reaching dentists who are not interested in providing implant treatments themselves.

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Tables

GDPs overall (n=303)	Implant providers (n=227)	Non-providers (n=76)	p value (<0.05)
Male (n=164)	86.6%	13.4%	<0.001
Female (n=139)	61.2%	38.8%	
Practice owner (n=120)	61.7%	38.3%	<0.001
Non-owner (n=183)	95.0%	5.0%	
Private practice only (n=253)	81.0%	19.0%	<0.001
Any public sector (n=50)	44.0%	56.0%	
Metropolitan practice only (n=214)	75.2%	24.8%	
Any rural/regional practice (n=68)	72.1%	27.9%	
Graduated from Australian university (n=255)	74.9%	25.1%	
Graduated from non-Australian university (n=48)	75.0%	25.0%	

Table 1. Demographics of GDPs overall and by implant provision status. p values <0.05 shown

	Training program focus	
	Restorative	Surgical
Formal university postgraduate training	7.9%	6.6%

University-based CPD	36.0%	20.5%
Association/society CPD	58.7%	27.4%
Implant company CPD	60.7%	27.7%
Work-based mentorship	36.3%	13.5%
No programs cited	20.5%	53.8%

Table 2. GDPs' reported historical attendance at restorative and surgical implant training program types (multiple selections permitted), n=303

	Overall (n=303)	Implant provision		Decade of graduation				Providers with implant experience performing:	
		Implant providers (n=227)	Non- providers (n=76)	≤1985 graduates (n=58)	1986- 1995 graduates (n=45)	1996- 2005 graduates (n=67)	2006- 2015 graduates (n=133)	Restoration only (n=139)	Surgery and restoration (n=73)
Formal postgraduate level	7.9%	10.6%	0.0%	1.7%	15.6%	14.9%	4.5%	2.9%	27.4%
CPD program level	73.6%	86.8%	34.2%	87.9%	68.9%	77.6%	66.9%	96.4%	71.2%
No formal postgraduate or CPD implant training	18.5%	2.6%	65.8%	10.3%	15.6%	7.5%	28.6%	0.7%	1.4%
p-value		<0.001		<0.001				<0.001	

Table 3. GDPs' highest level of implant training attended. p values <0.05 shown

CPD provider	Overall (n=303)	Implant provision		Decade of graduation				Providers with implant experience performing:	
		Implant providers (n=227)	Non- providers (n=76)	≤1985 (n=58)	1986- 1995 (n=45)	1996- 2005 (n=67)	2006- 2015 (n=133)	Restoration only (n=139)	Surgery and restoration (n=73)

University	38.0%	48.0%	7.9%	60.3%	46.7%	46.3%	21.1%	47.5%	56.2%
Dental association or society	60.7%	75.8%	15.8%	84.5%	66.7%	71.6%	42.9%	74.8%	84.9%
Implant company	62.0%	77.1%	17.1%	77.6%	71.1%	71.6%	47.4%	77.0%	84.9%

Table 4. GDPs' reported historical attendance at CPD program types (multiple selections permitted)

Decade period of starting to perform implant treatment	GDPs overall (n=303)	Decade of graduation			
		≤1985 (n=58)	1986-1995 (n=45)	1996-2005 (n=67)	2006-2015 (n=133)
1985 and before	0.6%	3.4%			
1986-1995	8.3%	27.6%	20.0%		
1996-2005	16.5%	32.8%	31.1%	25.4%	
2006-2016	45.5%	20.7%	33.3%	58.2%	54.1%
Have not provided implant treatment	29.0%	15.5%	15.6%	16.4%	45.9%

Table 5. Comparison of GDPs' decade of graduation and decade of starting implant provision

Estimated annual case volume	GDPs with implant experience (n=213)	Highest level of implant training			Decade of graduation				Providers with implant experience performing:	
		Postgraduate (n=24)	CPD training (n=187)	Neither (n=2)	≤1985 (n=49)	1986-1995 (n=38)	1996-2005 (n=54)	2006-15 (n=72)	Restoration only (n=139)	Surgery and restoration (n=73)
≤20	70.0%	45.8%	73.3%	50.0%	59.2%	65.8%	61.1%	86.1%	84.9%	41.1%
21-50	21.6%	16.7%	21.9%	50.0%	28.6%	28.9%	22.2%	12.5%	14.4%	35.6%
51-99	6.1%	25.0%	3.7%	0.0%	10.2%	2.6%	13.0%	0.0%	0%	17.8%
100+	2.3%	12.5%	1.1%	0.0%	2.0%	2.6%	3.7%	1.4%	0.7%	5.5%
p-value		<0.001			0.016				<0.001	

Table 6. Estimated annual implant case volume reported by GDPs with implant experience, p values <0.05 shown

	Brands used during training by GDPs overall (n=303)	Brands used during training by implant providers (n=227)	Brands preferred by GDPs with implant experience (n=213)
Biomet 3i®	10.6%	14.1%	3.3%
Astra Tech®	21.5%	27.8%	27.2%
MIS®	8.3%	10.6%	3.8%
Neoss®	7.3%	9.7%	8.0%
Nobel Biocare®	43.6%	56.4%	24.9%

Straumann®	33.7%	43.6%	42.7%
Other brands	15.5%	20.7%	12.2%

Table 7. Implant brands used by GDPs during training and in practice (multiple selections permitted)

	GDPs overall (n=303)	Implant provision			Decade of graduation				
		Implant providers (n=227)	Non-providers (n=76)	p-value	≤1985 (n=58)	1986-1995 (n=45)	1996-2005 (n=67)	2006-2015 (n=133)	p-value
Initial dental degree	38.0%	33.5%	51.3%	0.006	3.4%	4.4%	34.3%	66.2%	<0.001
Formal postgraduate implant training†	83.3% (24)	83.3% (24)	0% (0)	n/a	100.0% (1)	57.1% (7)	90.0% (10)	100.0% (6)	
University-based CPD†	58.3% (115)	57.8% (109)	66.7% (6)		77.1% (35)	33.3% (21)	48.4% (31)	64.3% (28)	0.007
Association/society CPD†	59.8% (184)	59.9% (172)	58.3% (12)		73.5% (49)	60.0% (30)	56.3% (48)	50.9% (57)	
Implant company CPD†	45.2% (188)	47.4% (175)	15.4% (13)	0.025	66.7% (45)	46.9% (32)	43.8% (48)	30.2% (63)	0.003
Hands-on course	6.9%	9.3%	0.0%	0.006	13.8%	8.9%	7.5%	3.0%	
Work-based mentorship	24.4%	44.0%	60.0%		15.5%	8.9%	31.3%	30.1%	0.006
Colleagues	35.0%	38.3%	25.0%	0.035	37.9%	28.9%	38.8%	33.8%	
Journal articles	36.6%	40.1%	26.3%	0.031	48.3%	51.1%	41.8%	24.1%	0.001
Textbooks	15.8%	14.1%	21.1%		13.8%	22.2%	22.4%	11.3%	
Experience or similar to periodontal management (volunteered answer)	1.0%	0.9%	1.3%		3.4%	2.2%	0.0%	0.0%	
No source cited	6.6%	2.6%	18.4%	<0.001	5.2%	8.9%	4.5%	7.5%	

Table 8. Implant OHI information sources recalled by GDPs, p values <0.05 shown

† bracketed numbers attended this type of training in each column group, out of which the percentage citing it as a source was calculated

Figures

Figure 1. Year of graduation (by decade group) of GDP respondents (n=303)

Conflict of interest statement:

The authors have no conflicts of interest to disclose.

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