

# Dental implant maintenance teaching in Australia – a survey of education providers

Running title: Implant maintenance teaching in Australia

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### Abstract

**Introduction:** Implant treatments and peri-implant maintenance continue apace while the evidence for implant maintenance and home hygiene continues to be developed. Information sources for dental practitioners and patients in peri-implant health maintenance and disease management are generally not known. This study investigated the implant maintenance topics taught, the discipline backgrounds of convenors and presenters, and information delivery methods within implant dentistry teaching in Australia.

**Materials and methods:** An online survey was distributed to 56 convenors of implant dentistry and maintenance education programs in Australia, garnering responses from 24 individuals which outlined 43 different education programs.

**Results:** Lectures were the main delivery method for implant maintenance information across the different course types. Peri-implant diagnostics were generally taught according to current literature recommendations, but coverage varied in topics where the evidence is yet to be established (e.g. home hygiene, professional maintenance and implant review). Some educators reported awareness of limitations in their programs.

**Conclusion:** Implant dentistry education programs in Australia vary widely in teaching implant maintenance, coverage of which should be current and evidence-based at all education levels. The structure of implant dentistry teaching at the continuing professional development level requires further development.

**Key words:** continuing education, dental education, dental implants, oral hygiene, peri-implantitis, survey

## Introduction

Peri-implant diseases affect significant proportions of patients with dental implants, with weighted mean prevalence of 43-63.4% for peri-implant mucositis and 18.8-22% for peri-implantitis at the patient level reported in recent meta-analyses.<sup>1-3</sup> The 2017 World Workshop established the most recent diagnostic criteria for peri-implant health, mucositis and peri-implantitis by consensus,<sup>4,5</sup> as research continues into the peri-implant disease process, which is not completely understood.<sup>6,7</sup> While some guidelines have been developed for peri-implant maintenance, such as those by the American College of Prosthodontists,<sup>8</sup> the quality and quantity of evidence is acknowledged to be limited. Clinical evidence is still lacking for optimal patient-performed implant home hygiene,<sup>9,10</sup> the professional maintenance of peri-implant health<sup>11</sup> (the prevalence of which has rarely been documented in clinical studies<sup>12</sup>) as well as the effective management of mucositis<sup>10,13,14</sup> and peri-implantitis.<sup>13,15,16</sup>

While the scientific evidence for implant maintenance continues to evolve, patients continue to receive implant treatments in the millions annually<sup>17</sup> and practitioners must provide preventive services; surveys of practitioners' clinical preferences in implant maintenance and patient home habits have begun to report on current clinical practice.<sup>18-21</sup> A cross-sectional survey of 51 patients in private practice in Australia showed that lack of interproximal cleaning at home was significantly associated with greater peri-implant disease prevalence, but the patients also reported generally poor recall of any implant hygiene instructions received from their treating dentists.<sup>22</sup> Meanwhile, surveys of general dentists and oral health practitioners (dental hygienists, dental therapists, oral health therapists) in Australia showed that the latter group demonstrated a greater preventative focus in managing implant patients<sup>19,21</sup> and that for 73.6% of GDPs surveyed, continuing professional development (CPD) was their highest level of implant training.<sup>23</sup> The information sources for practitioners in clinical practice and patient home habits are unclear, given the mixed evidence available, and many types of implant dentistry training programs are available.

Dental practitioners in Australia must have adequate training supporting their scope of clinical practice.<sup>24</sup> In implant dentistry, dental graduates in Australia are suggested to be able to demonstrate competence in restoring non-aesthetic single crowns and implant-retained removable mandibular prostheses, maintaining peri-implant health, diagnosing peri-implant pathology, and treating peri-implant mucositis, as per curriculum consensus across Australian universities since 2010.<sup>25</sup> This constitutes only part of the wider range of skills and treatments that can be provided. Dentists who graduated prior to 2010 as well as graduates from non-Australian universities are likely to have received highly variable coverage of implant dentistry and implant maintenance in their initial degrees. Oral health practitioners (OHPs) may also have received varying levels of information especially with changes in the programs offered by universities over the past 20 years. Further learning can be sought by practitioners at different levels: specialist qualification, non-specialist postgraduate diploma, or non-award CPD from various sources (such as universities, dental associations, dental societies, privately-run institutes and implant companies). These non-award programs are not currently required to be accredited or to meet any competency standards such as those suggested upon graduation, although it has been recommended in Australia<sup>26</sup> and in Europe.<sup>27</sup> In Australia, it is currently at each practitioner's discretion as to whether their training is sufficient for them to include implant treatments within their scope of practice. Furthermore, the coverage of implant maintenance in education programs and whether

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practitioners' scopes of practice are adequately updated to include implant maintenance is not known. Some surveys of implant dentistry teaching have been performed in Europe,<sup>28-32</sup> the United Kingdom<sup>33</sup> and North America,<sup>34,35</sup> primarily of university-run programs, but the coverage of implant maintenance has rarely been reported upon.

This survey aimed to document and describe the teaching of implant maintenance topics within the implant dentistry-related education programs available to dental practitioners and students in Australia in the last 5 years.

## Materials and methods

This study received ethics approval from the Health Sciences Human Ethics Sub-Committee of the University of Melbourne (Ethics ID 1443625). An online survey hosted on SurveyMonkey™ (San Mateo, CA, USA) was electronically distributed to persons known to be involved in implant dentistry/maintenance teaching in Australia via their publicly-available email addresses. They included:

1. periodontal and implant dentistry department convenors for undergraduate/graduate dentistry, oral health therapy and dental hygiene degrees
2. convenors of postgraduate implant dentistry diplomas (GradDip) and Doctor of Clinical Dentistry periodontology specialisation programs (DCD)
3. convenors of implant-focused CPD organised by universities, Australian Dental Association state branches, the Australian Society of Implant Dentistry, Australian Osseointegration Society state branches, private institutes which advertised publicly via ADA newsletters, implant companies and dental equipment companies

They were asked to outline the organisations for which they developed implant education programs within the last 5 years, and their intended audiences or the course type of which each program was a part. For each audience/course type, they outlined the program length, main teaching topics, the position/role/background of the person determining and/or delivering the content and the coverage of factors affecting peri-implant pathology. They were also asked to indicate whether specific content regarding implant home-care oral hygiene instructions, peri-implant diagnostic procedures, maintenance and treatment procedures were covered and how this information was delivered. Comments regarding implant maintenance teaching were welcomed. One reminder email was sent 4 weeks after the initial invitation to participate. Data were collected from May to July 2018.

Data were described in overall trends as well as by comparing the six different intended audiences/course types for which the programs were intended (henceforth referred to as different course types): undergraduate/graduate dental degrees, undergraduate hygiene/oral health therapy degrees, GradDip, DCD, CPD for dentists, CPD for OHPs.

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## Results

From the 56 individuals contacted for this survey, 24 responses were received (42.8% response rate). Of the 19 who were based in a university setting, 6 respondents were involved in convening programs for multiple course types (up to 4). The non-university responses were received from convenors of programs organised by professional associations (n=2), implant companies (n=2) and dental equipment companies (n=1), which were also intended for multiple course types. In total, 43 programs across the six course types were reported upon by the respondents, comprising 10 programs targeted towards undergraduate/graduate dental students, 8 for undergraduate OHP students, 6 for GradDip students, 7 for DCD students, 10 for dentists attending CPD programs, and 2 for OHPs attending CPD programs.

Implant maintenance content in all formal university qualification types and university-based CPD was usually determined by university heads of department or program convenors and delivered by specialists (mostly periodontists and some prosthodontists). One university-based CPD program also reported working with the syllabus from the International Team for Implantology (an internationally-recognised implant dentistry global education provider, with a relationship to the Straumann® implant company). Where commercial companies were involved, including in programs for undergraduate/graduate dental students, content was generally determined by the company representatives together with the convenors/presenters. This also applied in dental association or commercial company CPD programs, where implant maintenance content was delivered by whoever was presenting the program (periodontist, prosthodontist, oral surgeon, or experienced general dentist).

Lectures were the most common method of implant maintenance content delivery, used in 57.1-100% of programs in the various course types (Table 1). Journal articles were most common in GradDip and DCD programs (>70%), with some usage (40%) in teaching dental students and dentists attending CPD. CPD programs lacked any supervised practice or student observation. Among the formal university qualifications, supervised practice occurred in about one-third of undergraduate and GradDip programs and 57.1% of DCD programs that respondents reported upon. Observing/assisting patient treatment was rarely included except for dental students (40%) and GradDip programs where 50% involved private clinic-based mentoring.

After brushing, flossing and interdental brush use were the most recommended implant oral hygiene techniques, covered by ≥50% of programs in all course types (Table 2). Superfloss™ and circumferential flossing were taught more to dental and GradDip students (≥60%) and less in the other course types (≤30%). Mouthwash was more commonly taught to dental and OHP students (50%) than in the other course types (≤33.3%). Oral irrigation was taught in 20-33.3% of the various formal university qualifications. About 30% of GradDip and DCD programs did not cover any specific implant oral hygiene techniques.

In general, peri-implant diagnostic procedures (oral hygiene, soft tissue condition, pocket depth, bleeding on probing, suppuration, recession, radiographic, implant mobility assessments) were well covered by all course types (Table 3), but recession and implant mobility were covered by fewer programs and particularly fewer CPD programs.

Teaching of specific maintenance instruments or procedures varied considerably. Floss, plastic/carbon curettes and titanium curettes were most commonly taught, covered by more than half the programs in almost all course types (Table 4). Air powder and rubber cup polishing were taught next most commonly, in 30-60% of formal university qualifications and 30-50% of CPD programs. Plastic ultrasonics were covered in 50% of GradDip and CPD programs, about 40% of initial dental and OHP degrees and only 14.3% of DCD degrees. Topical antimicrobials were taught in 50% of initial dental and OHP degrees and OHP CPD programs but less so elsewhere. There was little coverage of systemic antibiotics except in DCD (42.9%) and CPD (50-60%) programs. Local antibiotics were very rarely taught in general, and stainless-steel curettes were taught in 50% of the GradDip programs.

Within all the implant education program types (i.e. not just those with an implant maintenance focus), respondents reported a generally high coverage of peri-implant pathology risk factor topics (Table 5). Of other factors which can impact peri-implant health and diagnosis, crown retention system, frequency of implant review and frequency of routine radiograph were frequently covered. Splinted or separate crowns were covered least of all, mentioned in half of the GradDip programs but seldom in the other course types.

Respondents were asked for additional comments regarding implant maintenance teaching, and it was acknowledged as an area that was "identified as requiring updating" within one oral health therapy degree, and "underrated and too-often overlooked" in one dental degree. Another dental degree program reported including a one week block devoted to implant complications with peri-implantitis as a core topic. A convenor of professional association lecture evenings reported a greater focus on professional maintenance and treatment rather than home care.

## Discussion

Several surveys of implant education, primarily in Europe and North America, have been conducted in the last two decades, including European consensus workshops in 2009<sup>36</sup> and 2014.<sup>27</sup> Most of these studies surveyed opinion and/or faculty leaders on the teaching of implant dentistry in undergraduate/predocloral degree programs,<sup>29,30,32-35</sup> generally reporting on the topic areas included, expected competencies or clinical requirements, specialty departments/faculty involved and challenges/limitations. A few surveys reported on implant dentistry inclusion in postgraduate specialty programs<sup>29,30</sup> and implant-focused CPD programs.<sup>28,31</sup> The CPD-focused publications also explored the need and/or desire for accreditation and standardisation, as recommended in Workshop consensus statements in Europe<sup>27,36</sup> and similarly in Australia.<sup>25</sup> Only two of the above surveys briefly reported on the inclusion of implant maintenance or recall in the predocloral curriculum.<sup>33,35</sup> This study aimed to investigate this area in more

detail, as it has not been reported upon previously, and focused on the content developers, presenters, delivery methods and inclusion of specific implant maintenance topics.

While the previous studies of implant education in universities have reported on the involvement of various specialty departments, including specifying the departments teaching implant prosthodontics or surgery,<sup>34</sup> this study presents the involvement of different disciplines in teaching implant maintenance. From this study, implant maintenance teaching in formal university qualifications and university-based CPD programs in Australia appears to have very strong involvement of dental specialists and periodontists in particular. Comparatively, the backgrounds of content developers and presenters of other CPD-providing organisations were more varied and included commercial company representatives. This information does not appear to have been reported upon elsewhere.

Lectures appeared to be the primary method of implant maintenance information delivery in this study, apart from the greater direct contact with the literature reported in formal postgraduate qualifications (GradDip and DCD). Greater exposure to the current literature for dental/OHP students and CPD attendees could enhance understanding of the importance of implant maintenance and its current limitations. This information could be provided using online teaching formats (which have been found to be surprisingly uncommon<sup>28</sup>), such as online courses, webinars or informative bulletins. Further, the inclusion of more clinical teaching or observation of implant maintenance procedures (and not just implant placement and restoration) may be of value across all course types, particularly in the CPD sector which reported none in this survey. The finding of 30-40% of dental degree programs offering clinical practice or observation of implant maintenance in this study was similar to the limited literature available. In a survey of 13 UK dental schools, four (30.8%) offered hands-on experience and seven (53.8%) provided observation in “restorative or maintenance stages”,<sup>33</sup> while 36.2% of 47 North American dental schools included maintenance/recall in their clinical requirements.<sup>35</sup> Otherwise, the modes of delivery of implant maintenance information have rarely been reported previously in the literature.

Regarding the implant maintenance content reported by educators in this study, comparison is made below to current recommendations from the literature. The mixed quality of current evidence in the topic areas of home oral hygiene and professional maintenance are reflected in this study’s findings.

The quantity and quality of evidence for implant-specific oral hygiene for performance by patients at home is low.<sup>9,10,15</sup> It is not surprising therefore that the educators surveyed appeared to be taking their cues from the periodontal literature. Interproximal cleaning was particularly emphasized, with the high recommendation of interdental brushes in line with the conclusions of systematic reviews,<sup>37,38</sup> whereas the quality of evidence for flossing efficacy is widely acknowledged to be weak.<sup>37,39</sup> Patient-performed interdental brush efficacy around implants remains to be quantified in clinical research. One study of patients with full arch implant-supported restorations found that interdental brush use increased most compared to other methods after OHI was given, but that overall cleaning ability remained poor.<sup>40</sup> The adjunctive use of mouthwash is likely to be another recommendation appropriated from the periodontal literature, and chlorhexidine gluconate is included as “the oral topical agent of choice” for implants in the Clinical Practice Guidelines from the American College of

Prosthodontists.<sup>8</sup> However, the limited evidence for its use in implant home plaque control<sup>41,42</sup> is mixed and it did not improve outcomes when included as part of peri-implant mucositis treatment.<sup>43,44</sup>

Implant diagnostics are strongly established in the literature, with the latest recommendations by consensus<sup>5</sup> building upon previous reviews and recommendations.<sup>45,46</sup> The educators surveyed in this study reported generally high adherence to current recommendations and this should continue as the literature evolves. One interesting finding in this study was the lower coverage of recession measurement, as it can be easily performed during pocket probing. The development of recession is a possible sign of peri-implantitis<sup>4</sup> and assessment is an essential part of pocket depth probing and bone level assessment, as the mucosal margin is the reference point itself. As with the other diagnostic procedures, changes over time may represent the development of pathology,<sup>47</sup> and from the patient's perspective, recession may cause aesthetic concerns. This survey's findings appear consistent with recent surveys of the clinical preferences of dental practitioners in Australia, where 56.0% of GDPs surveyed and 85.6% of OHPs surveyed measured recession, at lower rates than the other diagnostic procedures.<sup>20,21</sup> The development of a standardised reference point could be considered in future diagnostic recommendations e.g. measuring the height distance from the contact point area or cemento-enamel junction of an adjacent tooth.

There are no evidence-based standardised instrumentation protocols for implant maintenance, whether in maintaining health<sup>11</sup> or treating peri-implant mucositis<sup>14</sup> and peri-implantitis,<sup>13</sup> and this was reflected in the mixed teaching of maintenance instruments/techniques found in this study. There was understanding from most educators in this study that stainless steel instruments are less appropriate, having been shown to cause significant surface scratching.<sup>48-52</sup> However, curettes of different materials have theoretical advantages but unproven efficacy. Limited evidence has shown that titanium curettes also cause scratching,<sup>48,50</sup> although perhaps to a lesser extent,<sup>53</sup> and plastic curettes may be ineffective at removing plaque<sup>54</sup> as they may be too large.<sup>55</sup> Their popularity in the education programs described in this study is therefore not strongly supported by the literature. In contrast, there are some studies supporting the cleaning efficacy and lack of damage caused by plastic ultrasonics<sup>56,57</sup> and air powder polishing.<sup>58,59</sup> Yet their coverage in education programs in this study was slightly lower than that of the plastic and titanium curettes. In recent surveys comparing current preferences of GDPs and OHPs for these four instrument options, plastic curettes were most popular (used by 43-53%), followed by plastic ultrasonics (26-44%).<sup>20,21</sup> Titanium curettes (12-30%) and air powder polishing (9-30%) were used at much lower levels.<sup>20,21</sup> Interestingly in this study, plastic ultrasonics were rarely taught in DCD programs. Whether this finding reflects teaching by specialists who have habitually used other instruments or found them to be more effective is unknown and may warrant further investigation. Rubber cup polishing appeared to be more popular among practitioners (60-74%) than educators in this survey, and its use in the literature is not widely described, other than being suggested as a possible method for maintaining peri-implant health.<sup>60</sup> Floss was both most commonly taught by the educators surveyed and used in practice by the practitioners surveyed<sup>20,21</sup> but it is not usually mentioned as a professional maintenance method in the treatment literature. Systemic antibiotics have no proven protocol but are commonly used<sup>61,62</sup> due to the difficulty of treating peri-implantitis. Correspondingly, some DCD students in this study were taught about them but their higher inclusion in CPD programs may be a concern (if included as part of the theory of peri-implantitis



treatment, as there was no supervised clinical teaching or clinical observation). Overall, further research into efficacious peri-implant maintenance armamentarium should continue, and educators should ensure their programs reflect the latest evidence.

Some risk factors for peri-implant disease are well-established in the literature, such as poor oral hygiene,<sup>63-66</sup> poor compliance to regular supportive maintenance,<sup>63,67,68</sup> active periodontal disease or residual pockets,<sup>69-71</sup> extent of peri-implantitis,<sup>2</sup> and systemic factors such as smoking.<sup>66,68</sup> The influence of some factors such as keratinised mucosal margin and occlusal overload are less conclusive in the literature.<sup>47,72</sup> There are still other factors which may impact upon peri-implant disease that require further investigation (e.g. smoking, diabetes mellitus, metabolic diseases). Coverage of these factors within the overall topic areas of oral hygiene, periodontal/peri-implant history and medical history was encouragingly high overall in this study. The slightly lower coverage reported in the DCD programs could perhaps be due to a more self-directed learning structure.

Prosthetic factors are also known to impact peri-implant disease, such as the greater incidence of biological complications where implants have been cemented rather than screw-retained,<sup>73-75</sup> and inflammation and disease related to cement retention.<sup>76-78</sup> However, the impact of other prosthetic factors such as prosthesis design, embrasure shape, or splinting of adjacent implants upon peri-implant disease have not been established, and clinical guidelines are lacking, although the importance of cleaning accessibility in prosthesis design has been established.<sup>12,47,65,79</sup> For example, adjacent implants restored with splinted or separate crowns have both shown negligible crestal bone loss after 5-10 years in a few studies,<sup>80-82</sup> but separate crowns were preferred by patients in a recent split-mouth prospective study.<sup>83</sup> The literature is evidently still developing. For example, occlusal overloading was of investigative concern in the 1990s<sup>84</sup> and is now considered to have no evidence as a peri-implantitis risk factor,<sup>72</sup> and splinted crowns were described as “current practice” in a 2008 review article,<sup>85</sup> while ongoing recommendations of oral hygiene to be a primary consideration have been made.<sup>86-88</sup> In this study, splinted or separate crowns for adjacent implants were covered by 20-50% of programs for dental students/dentists in the various course types. Educators must ensure that current literature regarding all aspects of these types of prosthetic decisions are included in education programs, so that implant maintenance factors are considered within the current paradigm of restoration-driven implant dentistry.

There is little evidence for the frequency of implant review in the literature, other than a 6-monthly recommendation in recent American College of Prosthodontists Clinical Guidelines.<sup>8</sup> Radiographic assessment “to discriminate between health and disease states”<sup>5</sup> is recommended in the case of pathological signs<sup>46</sup> and otherwise lacks a routine recommended frequency, e.g. every 2 years. One should perhaps be considered, as the possibility of bone loss in the absence of detected signs/symptoms was acknowledged in a recent review,<sup>72</sup> and was reported in a recent clinical study of patients in the general community.<sup>22</sup> Diagnostic criteria for this situation does not yet exist. The mixed coverage of implant review and radiograph frequency in this study may reflect the ongoing uncertainty in the literature.

The inclusion of implant maintenance information appropriate for each education program type and level of implant service provision (including no provision) should be mandatory given the prevalence of peri-implant diseases,<sup>1-3</sup> and the acknowledgement by some educators in this study of the inadequacy of their current content. The implant maintenance knowledge and competency requirements for graduating dentists in Australia since 2010<sup>25</sup> is an existing suggested standard which could be considered a baseline level of competency for all dentists. However, there are no current requirements for CPD implant training programs to deliver this content. While this survey was limited to the size of the implant education sector in Australia and received only small numbers of responses from non-university sources, the findings support suggestions from Australian and European reviews of CPD for accredited and assessment-based implant dentistry training at the CPD level.<sup>25,27,36</sup> Possible delivery formats could include a university-led Graduate Certificate award program to be considered a minimum clinical competency training level,<sup>26</sup> or a structured modular format suiting a learner-directed personal development plan.<sup>27</sup> While implant maintenance has been recommended to be covered in undergraduate and specialist training,<sup>27</sup> its inclusion in CPD training and attempts to reach dentists who have little interest in providing implant treatments nor attending implant training should not be neglected. A recent survey of 303 Australian general dentists found that CPD was the highest level of implant training attended by 73.6% of respondents, 18.5% had not attended any formal postgraduate nor CPD implant training and approximately 15% were not involved in providing implant treatments when established in their careers.<sup>23</sup> The latter low-interest group may also be of significant size in other countries; these dentists will nevertheless have contact with patients with implants and should have basic clinical competencies in diagnostics and maintenance. Profession-wide distribution of implant maintenance information should therefore be considered in planning implant dentistry teaching, such as with the online teaching formats suggested previously (online courses, webinars or informative bulletins).

This study was limited in scale due to the small size of the implant dentistry education sector in Australia and the challenges of maximising a response rate with a voluntarily submitted online survey. Nevertheless, it provides initial insight into the current position of implant maintenance within implant dentistry teaching as a whole, and improvements needed as reported by respondents. Teaching in non-university environments in particular varies widely even among the small number who responded. There may be some non-response bias, where implant maintenance may have been of lesser interest to those who did not complete the survey. As is known and was confirmed in this study, there was significant overlap whereby a single respondent may coordinate training programs for several different audience groups and course types. Developments in this sector should be followed as the importance of implant maintenance continues to be established, as it directs the evolving knowledge and clinical practice of dental practitioners.

## Conclusion

This study established an initial understanding of current implant maintenance teaching in Australia at several levels, from undergraduate degrees and CPD to postgraduate diplomas and specialisation. Respondents acknowledged a need for increased and updated inclusion in their programs. The mixed preferences of educators in teaching implant home hygiene and professional maintenance in this study likely reflects the limited evidence available. Implant diagnostic methods are strongly established and should continue to be comprehensively covered. Comprehensive and contemporaneous inclusion of implant maintenance within implant dentistry teaching as a whole is of paramount importance in the guidance of dental professionals.

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## Tables

	Undergraduate/graduate dental degree (n=10)	Undergraduate hygiene/oral health therapy degree (n=8)	GradDip (n=6)	DCD (n=7)	CPD for dentists (n=10)	CPD for OHPs (n=2)
Lectures	100.0%	75.0%	66.7%	57.1%	100.0%	100.0%
Journal article recommendations	40.0%	25.0%	83.3%	71.4%	40.0%	0.0%
Textbook recommendations	20.0%	37.5%	33.3%	28.6%	30.0%	0.0%
Hands-on workshop e.g. models, pig jaws	30.0%	12.5%	16.7%	28.6%	30.0%	0.0%
Supervised patient treatment	30.0%	37.5%	33.3%	57.1%	0.0%	0.0%
Observing/assisting patient treatment	40.0%	12.5%	16.7%	14.3%	0.0%	0.0%



Private clinic-based mentorship program	10.0%	0.0%	50.0%	0.0%	0.0%	0.0%
None	0.0%	0.0%	16.7%	14.3%	0.0%	0.0%

Table 1. Percentage of each course type group (columns) using the information delivery methods (rows) for teaching implant maintenance content

	Undergraduate/graduate dental degree (n=10)	Undergraduate hygiene/oral health therapy degree (n=8)	GradDip (n=6)	DCD (n=7)	CPD for dentists (n=10)	CPD for OHPs (n=2)
Regular brushing	100.0%	75.0%	66.7%	57.1%	70.0%	50.0%
Regular interdental flossing	90.0%	50.0%	66.7%	57.1%	60.0%	50.0%
Superfloss™ or equivalent (floss with stiff threader)	70.0%	37.5%	66.7%	14.3%	30.0%	0.0%
Interdental brushes	100.0%	50.0%	66.7%	57.1%	80.0%	50.0%
Circumferential flossing (floss looped around crown and 'see-saw' motion)	60.0%	0.0%	66.7%	14.3%	30.0%	0.0%
Oral irrigation (e.g. Waterpik)	20.0%	25.0%	33.3%	28.6%	20.0%	0.0%
Mouthwash	50.0%	50.0%	33.3%	0.0%	20.0%	0.0%
None	0.0%	0.0%	33.3%	28.6%	10.0%	0.0%

Table 2. Percentage of each course type group (columns) teaching implant-specific oral hygiene instructions (rows)

	Undergraduate/graduate dental degree (n=10)	Undergraduate hygiene/oral health therapy degree (n=8)	GradDip (n=6)	DCD (n=7)	CPD for dentists (n=10)	CPD for OHPs (n=2)
Oral hygiene assessment around implant i.e. presence of plaque or calculus	100.0%	75.0%	66.7%	57.1%	90.0%	100.0%
Soft tissue visual appearance assessment e.g. inflammation, keratinised mucosa	90.0%	75.0%	66.7%	71.4%	100.0%	100.0%
Pocket depth probing	100.0%	75.0%	83.3%	57.1%	100.0%	100.0%
Assessment of bleeding on probing	100.0%	75.0%	83.3%	71.4%	100.0%	100.0%
Assessment of suppuration	100.0%	75.0%	83.3%	71.4%	100.0%	100.0%
Recession measurement	50.0%	62.5%	66.7%	57.1%	70.0%	50.0%
Radiograph to check bone level/bone defects	90.0%	75.0%	66.7%	57.1%	90.0%	100.0%
Assessment of implant mobility	80.0%	62.5%	66.7%	57.1%	50.0%	50.0%
None	0.0%	0.0%	16.7%	14.3%	0.0%	0.0%

Table 3. Percentage of each course type group (columns) teaching implant diagnosis procedures (rows)

	Undergraduate/graduate dental degree (n=10)	Undergraduate hygiene/oral health therapy degree (n=8)	GradDip (n=6)	DCD (n=7)	CPD for dentists (n=10)	CPD for OHPs (n=2)
Floss	90.0%	75.0%	66.7%	57.1%	50.0%	50.0%
Rubber cup/brush with prophylaxis paste	60.0%	50.0%	50.0%	42.9%	30.0%	50.0%
Air powder polishing/prophylaxis	60.0%	50.0%	33.3%	28.6%	40.0%	0.0%
Stainless steel ultrasonic scaler	20.0%	12.5%	16.7%	0.0%	0.0%	0.0%
Plastic ultrasonic tips	40.0%	37.5%	50.0%	14.3%	50.0%	50.0%
Stainless steel curettes	10.0%	12.5%	50.0%	14.3%	20.0%	0.0%
Plastic/carbon curettes	60.0%	62.5%	50.0%	57.1%	50.0%	100.0%
Titanium curettes	70.0%	75.0%	50.0%	42.9%	70.0%	50.0%
Topical antimicrobials	50.0%	50.0%	16.7%	14.3%	30.0%	50.0%
Local antibiotics	10.0%	0.0%	16.7%	14.3%	20.0%	50.0%
Systemic antibiotics	30.0%	12.5%	16.7%	42.9%	60.0%	50.0%
Bone augmentation	50.0%	12.5%	33.3%	57.1%	70.0%	50.0%
Open (surgical) debridement and/or recontouring	60.0%	12.5%	50.0%	57.1%	70.0%	50.0%
None	10.0%	0.0%	16.7%	14.3%	10.0%	0.0%

Table 4. Percentage of each course type group (columns) teaching professional maintenance instruments or techniques (rows)

	Undergraduate/graduate dental degree (n=10)	Undergraduate hygiene/oral health therapy degree (n=8)	GradDip (n=6)	DCD (n=7)	CPD for dentists (n=10)	CPD for OHPs (n=2)
<b>Peri-implant disease risk factors:</b>						
The patient's standard of oral hygiene	100.0%	87.5%	83.3%	57.1%	70.0%	100.0%
Previous periodontal/peri-implant history	100.0%	87.5%	83.3%	71.4%	90.0%	100.0%
Medical history	100.0%	75.0%	66.7%	71.4%	90.0%	100.0%
Severity of existing peri-implant condition	100.0%	75.0%	83.3%	57.1%	80.0%	100.0%
Probing depths around the implant	100.0%	75.0%	83.3%	57.1%	90.0%	100.0%
None of the above	0.0%	0.0%	16.7%	14.3%	10.0%	0.0%
<b>Other prosthodontic and maintenance preferences:</b>						
Implant crown retention system	90.0%	37.5%	66.7%	71.4%	80.0%	100.0%

Splinting or separating two adjacent implants	20.0%	0.0%	50.0%	28.6%	20.0%	0.0%
Frequency of implant review	80.0%	50.0%	66.7%	71.4%	70.0%	50.0%
Frequency of routine radiography	70.0%	62.5%	66.7%	57.1%	80.0%	100.0%
None of the above	0.0%	12.5%	16.7%	28.6%	10.0%	0.0%

Table 5. Percentage of each course type group (columns) teaching risk factors and other preferences affecting peri-implant health findings (rows)

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