Early years postgraduate learning and training in prosthodontic dentistry: 2019 and beyond

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Key points

- Provides background on the reduced clinical experience of dental undergraduates.
- Describes the changes in how prosthodontics/ operative dentistry is taught and learnt.
- Reviews the evidence base in order to find potential solutions that enhance the learning experiences.

Abstract

The intended outcome of dental education is to produce dental clinicians who have the knowledge, technical skills, personal attributes, values and professional outlook to deliver the highest level of patient care. Due to the development and improvement of dental materials and clinical techniques, combined with a steady rise in patient expectations and complaints, prosthodontics has developed into a dental speciality recognised by the General Dental Council. Going forward, there will be a requirement to provide complex and difficult operative and prosthodontic dentistry. Much will be replacement and repair of existing failing work, with the application and choice of newer materials and clinical approaches. How does the dental education sector respond to this challenge? This article attempts to discuss potential solutions for training and education, for all levels of prosthodontics in the UK.

Introduction

Many parts of dentistry could be described as craft skills, as they require the translation of knowledge into a practical skill with an output which is comparable to making or building an object. With the development and improvement of dental materials and clinical techniques, particularly in the field of restoration of natural teeth and dental implants, combined with a steady rise in patient expectations and complaints, prosthodontics has developed into a dental speciality recognised by the General Dental Council (GDC).[1] However, much of the subject matter is arguably the preserve of 'general dentistry', which is covered within dental undergraduate programmes, and built on by UK dental graduates in their foundation training (a period of training following initial qualification which aims to demonstrate a level of competence appropriate for independent practice).[2] Dental students of today and the future will require a broad range of operative and prosthodontic skills needed to serve an increasingly aging population group.[3] Such a demographic will have diverse and challenging dental needs.[4] Some of these challenges will be based on the chronic general health diseases that are associated with ageing;[5] while other challenges will reflect a population that are keeping their natural teeth and hope to continue retaining them through more complex restorations.[6]

At the same time, although oral health has improved significantly for most younger groups; resistant pockets of disadvantage and disease remain.[7] The focus of much future oral care will be on prevention of disease delivered by a multi-skilled team. However, there will also be a requirement, particularly for older patients, to provide complex and difficult operative and prosthodontic dentistry. Much will be replacement and repair of existing failing work with the application and choice of newer materials and clinical approaches. With the improvement of oral disease on the one hand and the ageing demographic of the population on the other, this creates a conundrum for those charged with providing teaching and education of the current and future workforce.

In the UK, Prosthodontics is one of 13 dental specialties recognised by the GDC.[1] To gain entry on to this specialist list, a practitioner must either satisfactorily complete a minimum of three years (not less than 4,500 hours) of recognised and approved education and training (assured by the GDC and quality-managed by Health Education England or other dental deaneries) or be judged to have attained, by alternative means, the equivalent knowledge, skills and competencies.[1,8] Many postgraduate programmes that lead to specialist recognition are expensive for the individual dentist, with course fees running into high figure sums on an annual basis. Equally, with requirements for high levels of specialist supervision and on-costs, they are very expensive for dental institutes to provide. At the time of writing, the published data from the GDC indicated that there were only 439 dentists on the prosthodontic speciality list, with the number of dentist registrants being nearly tenfold that number at 41,067.[9] This means that the majority of prosthodontics is provided by non-specialist providers.

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To successfully perform dentistry requires the practitioner to have knowledge and understanding encompassing dental and oral anatomy and physiology, prevention and treatment of general and dental disease including hereditary conditions, and modern dental materials and equipment.[10] In addition, and essential for dentistry, the practitioner must have developed the skill to operate, when indicated, on teeth within the confines of the oral cavity, often without direct visibility, necessitating the use of mouth mirrors, on conscious, and not infrequently, nervous patients. Tolerances, when preparing teeth for dental restorations, are minute and the scope for inflicting collateral, irreversible damage to other structures is extremely high.[11] For these reasons, to effectively and consistently safely operate on teeth, using the current technologies of high-speed drills and other dental apparatus, requires the practitioner to have developed their psychomotor and haptic feedback skills to a high level. One can argue, therefore, that a significant component of dentistry is a craft skill which requires constant practise and updating to perform consistently well for the different clinical circumstances that present as well as the different patients.[12]

This article sets out to explore the opportunities and challenges to developing these skills to a level that makes a dentist safe, competent and confident, with specific reference to prosthodontics as an example of an area of clinical dentistry that can cause difficulties for both the early learner and patient.

Learning a craft skill

Many consider the delivery of practical dentistry, and particularly operative dentistry, as an amalgamation of knowledge, skills and craftsmanship. MacQueen (1951) proposed a list of the key features of a craft skill:

'Familiarity with the materials of the craft, particularly in terms of suitability and workability, knowledge of techniques, skill in the use of tools and appliances, knowledge of the necessary science as well as possession of character qualities of integrity, resourcefulness and determination coupled with the ability to respond intelligently to constantly changing circumstances in the work as it proceeds'.[13]

These attributes can be seen to directly relate to dentistry. Indeed, it would be relatively easy to map the above areas to current undergraduate and postgraduate curricula; understanding dental materials and equipment, their application and having the aptitude and capability for the manual skills to apply them. Dentists must understand the link with other healthcare professionals and have awareness of the working environment which includes effective teamwork. For prosthodontic care, any training should also cover knowledge and experience of laboratory techniques as well as technical elements of both fixed and removable prostheses.[8,14] Dealing effectively with dental team members such as effective communication with laboratory technicians, understanding the materials and technologies available for dental prostheses, and carrying out appropriate tooth preparations, are all part of the prosthodontic speciality curriculum and align well with the description of a craft skill provided.[14]

An additional important facet is the ability to diagnose a variety of problems and the ability to communicate effectively with patients and other team members. Communication involves listening and processing information as well as delivering information. The nuances of clinical-type communication to patients may also start within a classroom but will be enhanced through apprenticeship experience within the clinical workplace.[15,16] Relevant education literature points to the role of previous experience of clinical situations in learning and improving both communication and clinical skills.[17,18]

Educational theory put forward for understanding how clinicians come to a diagnosis postulates the use of 'scripts', which in the medical education field have been described as known associations between clinical situations, signs and symptoms.[19,20] Schmidt *et al.* suggested that as learners experience real life clinical situations, they begin to combine their theoretical knowledge with the clinical symptoms and signs that they observe, and put together a 'script' for that particular clinical scenario.[21] With increasing encounters, experience and self-assessment (subconscious reflection), the number of 'scripts' gradually build. There then follows modification and 'upgrade' of existing scripts with increased exposure to a variety of challenges. This further consolidates the linking and connecting of scripts which in turn aids the final decision-making stage.[22] This process highlights the importance of increasing exposure to different clinical challenges, both in terms of range and number, to build upon the 'bank' of scripts available.[17]

Educationalists, and associated researchers, vary in their opinion on whether past exposure in itself is sufficient in aiding diagnosis and whether a rich background in theoretical knowledge is essential in putting together and linking scripts, which aid in diagnosis.[23,24] What is clear is that early learners do appear to rely on utilising theoretical knowledge in the diagnostic process, with this reliance reducing as learners progress from 'novice' to 'expert'.[23] This can be extrapolated to needing knowledge that can be translated or applied to practical tasks in all aspects of operative dentistry.

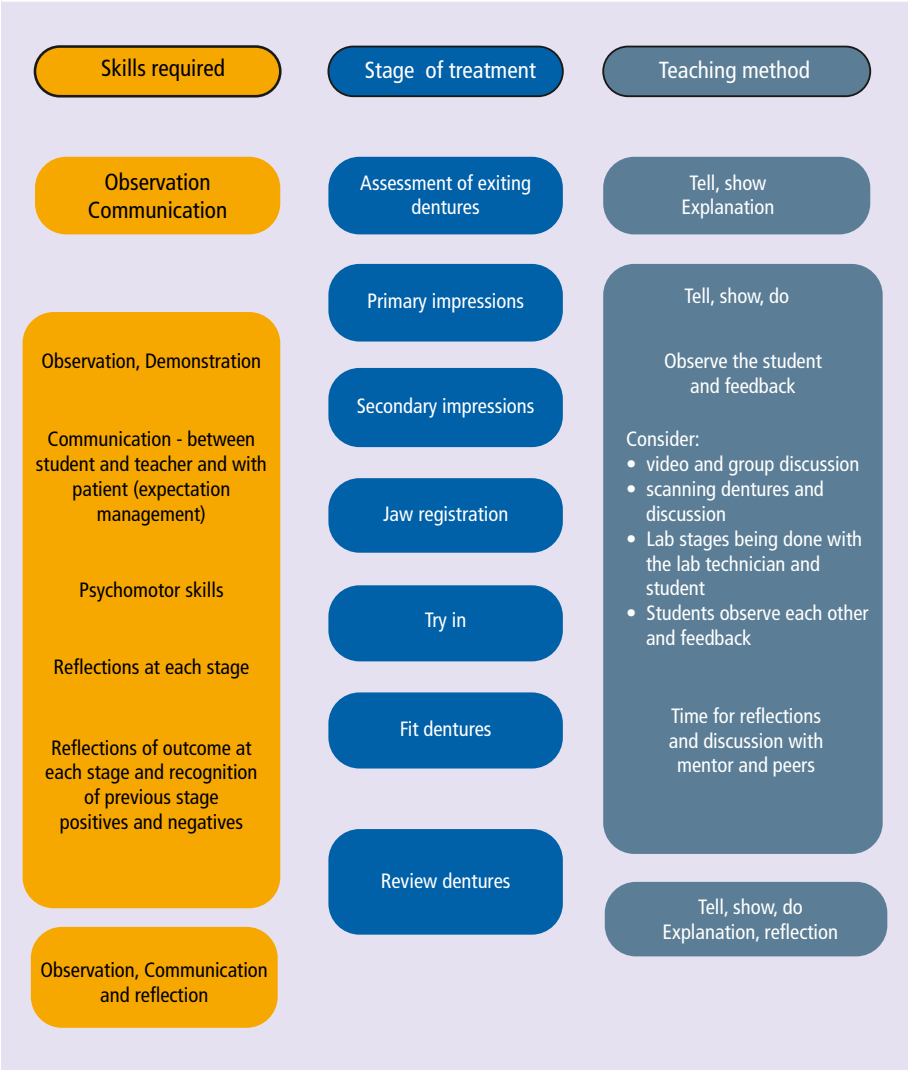
If craft skills were simply a matter of honing manual dexterity skills, then repetition and a focus on repeating the skill would be sufficient. Simply practising something a number of times does not in itself suffice.[25] Traditional craft skills are also learnt through a combination of theoretical knowledge and exposure to a variety of experiences, which allow with time the correct selection and use of equipment and materials according to the requirements of each particular situation.

With the ageing population there is the need to intervene to repair and re-restore failing or failed restorations associated with natural teeth. Newly qualified dentists will need to gain the experience and skills to remove failing indirect restorations (for example, crowns and bridges) often for the first time in a practice environment for a patient. Ideally, this skill set must be initially developed safely in a supervised environment at the beginning of their training before being delivered to patients without supervision. Each practical experience will start to define and build upon a learner's 'bank' of scripts or patterns. This process will be aided if initial teaching/training experience reinforces best knowledge and clinical practice, and solutions to common clinical problems are demonstrated by an experienced clinical educator.

Whether a traditional craftsman or a dentist, each will face new situations and experiences, and it is that ability to diagnose and assess a problem, to assimilate theory, build upon and utilise past experiences and then adapt it to that particular circumstance. It is the bringing together of all parts of a craft, along with an adaptation and awareness of each specific situation that makes for a successful craftsman/dentist. The difficulty that educators face is how those 'past experiences' can be reproduced, reflected upon and used for learning.

The goal is to gain more knowledge and facilitate a better understanding when faced

Fig. 1 The skills and teaching methods needed for the stages of denture construction



with similar experiences in the future. Those in support of problem-based learning suggest that by problem solving using genuine, real cases from work places, such experiences can be duplicated.[26] Certainly, having a learner-focused approach where previous knowledge is extended to new problems through self-directed reflection, research and practise in solving a problem will aid in critical thinking.

However, problem-based learning does not by itself take into account the rich mixture of practical skills, knowledge and the context that constitutes operative dentistry. It may not take into account the essential interactions of the learner with those around them in the working environment and the socialisation of the learner in the community of learning, for example working with other team members such as dental nurses. Effective problem-based learning relies on being able to produce relevant and real 'problems' that stimulate learning and which are presented in the same format as they are found in professional practices. Often some scenarios can be restricted and thus potentially limit the learners' experiences.[27] Undergraduate dental students highlighted this when they reported their concerns not about actually carrying out a particular operative procedure, but why and when it should be carried out.[28] Supervisors providing insufficient explanation of the decision-making processes, which is essential for managing very complex patients in 2019 and beyond, may compound this lack of understanding. Transfer of knowledge to clinical situations is not automatic and straightforward for learners.[29] As an example, interactive clinical polls of a significant number of dental foundation trainees at month eight of their training during the 2017 BDA conference (BSSPD educational event) and the 2018 BDA Southern Counties presidential study day, revealed that many (40%) did not understand the importance of the use of a 'static' jaw registration to satisfactorily and safely manufacture an indirect crown restoration for a terminal molar tooth.[30] The same poll on a relevant clinical scenario also revealed that many were unclear of how they would execute the appropriate clinical technique. This disconnect of knowledge and clinical application to a relatively simple clinical scenario would, for many, have led to the provision of a suboptimal restoration. Possessing the theoretical knowledge is essential but being able to understand and apply that knowledge to the clinical 'script' is even more critical.

Traditionally, craft skills are acquired through observation of subject experts carrying out procedures, observation by the expert of the leaner carrying out the same task combined with active involvement and socialisation in the workplace.[31] Such learning through participation, as suggested by Lave and Wenger, involves learning craft from both experienced members of the community as well as peers, observing practices and gradually participating in this community.[31]

Participation in a community of learning can result in mentorship and facilitate learning through the interpersonal interactions that occur both via peer support and through the relationship built with a more experienced mentor.[31] Mentors increasingly engage newcomers in meaningful work activity;[31] such mentorship can lead to skills-based learning, increased cognitive learning outcomes as well as lead to knowledge transmission.[32,33] There is also some evidence to suggest that mentors themselves learn from their mentees.[34]

Teaching prosthodontics as a craft skill

Prosthodontics, like many other craft skills, can be difficult to learn from reading books or problem-based learning, but potentially easier to learn by observation of an expert, discussion and reflection. The cyclical model of observation (observing, doing and being observed) is a core element of the traditional apprenticeship style of craft skills learning.[35]

Evidence might suggest better motor skills are gained by imitating observations (demonstrations), and observations lead to better motor skills as compared to following verbal or written directions.[36] It also appears that knowing that you will have to repeat a task after observing it results in increased activity in motor cortices.[37] Reflective learning and practise will be an integral part of this process.[38]

For prosthodontics, it is important to complete all steps in a task, such as is associated with the making a partial denture and then reflecting on/assessing the outcome, in order for the previous steps to make sense in the overall scheme of treatment (Fig. 1).

The same expert that provides opportunities for observation can also undertake 'supervision' 'mentorship' and 'assessment'. However, whereas supervision reflects direct professional practise which incorporates assessment of performance and promotes reflective discussion, mentorship is based on voluntary participation in reflective and analytical discussions. If the teaching of prosthodontics allows the opportunity for such mentoring relationships to be made, by viewing learning as an active and social process, then the opportunities arise for a rich exchange of ideas, dialogue and self-reflection, as well as integrating theory and practice.[19]

If supervisors and learners switched from a 'supervision' mode to operating a 'mentorship' relationship, this may lead to enhanced learning from clinical opportunities. Learners would appreciate the need not to be simply handed a 'recipe' for learning and mentors would provide the space for the learner to reflect, explore and question clinical decision-making.

To enhance the learning of clinical decision-making, it is important for both the mentor and the mentee to voice their thought processes and exchange ideas. Making explicit both the application of knowledge and the associated context is fundamental in the way knowledge is developed and applied. The learning process aligns itself with the principles of adult learning, as put forward by Knowles, so encouraging reflection in a meaningful and practical way becomes embedded throughout lifelong learning.[39]

It also appears that knowing that you will have to repeat a task after observing it, results in increased activity in motor cortices.[35,37] Within the context of prosthodontics, learners have expressed preference for such a method when learning the different stages of removable partial denture procedures.[40]

Of course, the counter argument to an apprenticeship style of learning, with the learner having a close mentoring relationship with the expert, is that it is costly in terms of both time and finances. For example, teaching the clinical stages of a complete denture construction will require initial teaching in a seminar classroom, followed by showing learners on a patient and then observing the learner closely as they carry out the clinical procedure on a patient, is time consuming and resource heavy.[41,42] However, to drive quality and improve patient outcomes, this is what may be necessary to produce the best outcomes for learners and patients.

Over the past few decades, medical and dental education has seen the active involvement of educationalists and social scientists in developing healthcare curricula, with one of their focuses being on incorporating formal, structured teaching of communication skills, as a means of improving patient outcomes.[43,44] Healthcare students, including dental students, are taught how to be 'empathetic' and how to break bad news. The appropriate use of non-verbal skills such as good eye-contact as well as a variety of other communication skills are developed in the early years of training.[45] These skills form parts of various training curricula at both at undergraduate and postgraduate level.[14] The challenge is to make this relevant for team and patient interaction within the clinical workplace. Some research suggests that often an observer, in any assessment, can be far more critical of a learner's communication style compared to the views of patients who express greater satisfaction, and there is limited evidence to support a positive influence as a result of this training on patient relationships.[46,47] Formal teaching and assessment of communication skills outside clinical environments may improve the learners skills but may do little to prepare learners for unanticipated situations and reactions such as patient aggression and complaints.[48,49] Formal teaching can fail to focus on active listening and processing of information. Active listening and self-awareness has been demonstrated to be linked to an increase in empathy, which may result in an improvement in patient-centred care.[50]

Communication is also an important element of teaching delivery as well as the learning of any craft skill. This can be verbal and non-verbal, including listening and delivering information.[51] By observing mentors/experts and peers as they work and interact in real life situations, there is absorption of how to professionally communicate and interact as part of 'situated' learning.[31] Many clinicians develop an individual 'act' to communicate with patients in a professional setting. Exposure to these acts will help early learners to develop their own. Learning about communication becomes an integral part of the overall clinical learning process, rather than a separate entity. It also provides the opportunity to observe and learn how to deal with unanticipated situations and behaviours, rather than simply learn how to deal with 'staged' scenarios.

Does volume matter?

Medical literature, in particular surgical medicine, reveals an abundance of research to support a solid relationship between procedural volume undertaken and satisfactory patient outcome.[52,53,54,55,56] Although volume in itself is not a guarantor of successful patient outcomes, it does appear to be a necessary arm in the path to achieving the goals of operative dentistry training to a consistently good standard.[57] This is similar to the development of the skills by repetitive practise needed to play a musical instrument to a high level.[58] However, repetitive practise in itself was found not to be enough, as although a strong relationship between musical achievement and the amount of formal practise undertaken has been established, the link between informal practise and achievement is far more tenous.[58]

It is, therefore, important that alongside volume, consideration should be given to 'deliberate practise'; a concept put forward by Ericsson *et al.*, who identified a set of conditions that resulted in practise improving performance.[59,60] These conditions included establishing clear goals, providing incentives for motivation and improvement, allowing time for reflection as well as feedback, while also ensuring sufficient opportunities to practise, repeat and gradually refine.[59] Ericsson also suggested the importance of challenging learners to ensure continued learning and improvement. Repetition of a procedure at an acquired skill level does not in itself lead to further progression; only when faced with a more challenging set of circumstances will the learner improve, if capable of doing so.[59]

There is evidence that confirms that healthcare learners, including dentists, were most confident about those procedures which they had had the opportunity to practise more at both undergraduate and postgraduate level.[61,62,63] Undergraduate students also reported that increased clinical experience in prosthodontics was beneficial to them, with increased exposure increasing their confidence levels.[64]

In what direction should teaching of prosthodontics go?

A 'tell, show, do' model is too simplistic for the increasingly complex prosthodontic challenges presented to an increasingly older patient group and cannot guarantee appropriate learning by the learner; it may also lead to the replication of bad habits and unwanted outcomes.[65] To maximise learning and ensure transferability to unknown situations, the education should provide both structured guidance but also instructional interventions such as questioning.[66] Such interventions can not only help the learner in transferring and applying knowledge already gained to new situations but can also help with the motivation of learners, ensuring they maintain their focus and concentration.[67] Involvement of learners and allowing their views on their training to be heard also increases learner motivation.[68]

A further dimension that is increasingly overlooked and undervalued is the entire 'community of learning', which in dentistry encompasses the whole dental team. Much can be learnt from dental care professionals as well as practice managers and reception staff, yet resource limitations can prevent for example, the use of dental nurses as routine learning/teaching partners during early years' development within training environments. For prosthodontics, dental nurses provide an invaluable input into areas such as triangulation of performance feedback, validating decisions on shade choice, impression quality, laboratory prescription, overall aesthetics and providing post-operative instructions including how to care for appliances.[69]

In formal training settings, such as foundation training, there is currently a requirement for protected teaching time for timetabled tutorials.[2] In 2019 and beyond, the focus might need to shift to protected clinical supervision time, which should allow the learner to gain new learning experiences with structured feedback under closer supervision within the relevant clinical workplace.[70] Direct observation of real-life clinical procedures in workplace environments provides an authentic context. The understanding that observations of an educator will be followed by genuine practise and observation of the learner should be made implicit at the start of the learning cycle.

Practical points

To enhance the learning opportunities for prosthodontic teaching, problem-based learning can be delivered within a classroom setting. However, to maximise learning, it will be essential to create effective 'problems' that stimulate learning, presented in a fashion relevant to the clinical setting found in professional dental practices. It is important to provide learners with multiple contexts to aid their transfer of knowledge into clinical reasoning.[71]

To be able to make the connections between theoretical knowledge and practical application, exposure to clinical cases is essential.[72] This should take the shape of the learner initially observing the educator undertaking clinical cases, followed by close supervision of the learner as they attempt to undertake a similar clinical case. If both the teacher and learner utilise a 'thinking aloud' approach, to articulate their thought processes and reasoning, it will allow for better understanding of clinical cases.[73] This process will allow learners to understand why and when a procedure should be carried out and the important drivers for clinical decision-making, which in 2019 with more complex problems is essential. Pattern recognition, which is second nature for experienced clinicians and teachers,[74] can become a transparent learning process if educators 'think aloud' and explain their thought processes in a stepwise fashion.[73]

Pattern recognition can also be fostered through repeated exposure of learners to varying cases. This allows the learner to gradually appreciate a range of different presentations.[75] The learner should be encouraged to reflect on the similarities and variations of each case; a process which will help the learner put theoretical knowledge into clinical practice.[75] Educators can aid this process by the use of prompts and examples,[76] as well as visibility in their own thought processes.[73]

Given that dental learners report most of their learning takes place in a clinical environment,[76] the importance of sufficient exposure to volume and mix of clinical cases cannot be underestimated. It is essential for the purposes of patient safety that close supervision is provided.[77] Such close supervision not only ensures patient safety, but also provides the opportunity for enhanced learning through positive role modelling and mentoring.[78] Specific cognitive feedback, which encourages learners to reflect and takes place in the form of a dialogue rather than a monologue, will also help the learner in translating knowledge into clinical application.[75,79]

Conclusion

Even within a background of evidence of improving oral health of the UK population, a significant element of dentistry remains craft skill-based. This had become increasingly complex in recent years, as it more commonly involves ageing and medically compromised patients as well as the repair/replacement of restorations. Patients also have high expectations and expect consistently good clinical outcomes. Craft skill learning involves a pathway to include group teaching and demonstrations, followed by the early learner 'doing' and 'reflecting' with the tutor and peers. There must be both a volume and mix component to craft skill learning, as deliberate practise is needed to become fluent and refined in most practical vocations. Time must also be made available to reflect and act on the identified reflections.

Teaching prosthodontics will be a combination of teaching (relaying information), the learner processing that information, and then translating and applying it into clinical practice. Then the tutor/clinical supervisor will observe the clinical practice and provide independent, reflective feedback. This will also be discussed together, as there has to be feedback and discussions to clarify issues and encourage deeper learning and understanding. Repetition of this process, for as many times as is needed (which will vary for different learners), once understanding has been demonstrated, will allow the measurement of competency at achieving a set outcome. All of this requires skilled teachers and adequate resources.

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