

Undergraduate endodontic education: what are the challenges?

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IN BRIEF

- Informs about current challenges in endodontic education and in delivering endodontic treatment to the population in the future.
- Acknowledges our predecessors.
- Creates an understanding of factors influencing treatment needs for patients in the future.

To deliver the knowledge and skills required to equip undergraduate students for practice is a significant responsibility; graduates must be familiar with the diagnosis and treatment of pulpal and periradicular diseases and the preservation and restoration of pulpally compromised teeth. A greater understanding of the microbiological processes involved in endodontics and developments in instruments and materials have transformed our approaches to root canal treatment. Information technology has revolutionised certain aspects of education and has had an effect on endodontic teaching. Dental graduates will be expected to treat an increasingly elderly population and will enter a climate in which remuneration for root canal treatment could have a significant effect on the number of cases treated and the pattern of referral. Teachers of endodontics at the majority of dental schools are taxed by competing demands for time in packed curricula, a lack of availability of natural teeth for classroom exercise and a lack of suitable patients. The debate as to whether endodontics should be a specialist subject in its own right has rumbled on for three decades. Compared with the situation in the 1970s, there are now well defined curricula guidelines to which those involved in teaching can refer and map teaching in their schools against agreed norms. These create the potential for students to graduate with the knowledge and skills at a sound level of competence to carry out endodontic procedures and with a deeply engrained understanding of the need for continuing professional development.

INTRODUCTION

Despite our greater understanding of the aetiology of endodontic-related pathology and significant technological advances in recent years the standard of root canal treatment may be less than ideal. There is evidence that many practitioners are unaware of the factors that influence the outcome of root canal treatment and that some do not conform with the principles of best practice.

Graduates of today are faced with an increasingly elderly patient profile. The proportion of over 65-year-olds in the population continues to rise while the number of those aged under 16 fall. If the current trend continues then in 2033, 23% of the population will be 65 or older, 18% being 16 and younger.¹ More significantly still is the prediction that by 2028 only 4% of the population will be wearing full dentures

so it is clear that maintenance of the older dentition will become an ever greater component of our clinical work. Treatment of the older patient in general and the more specific technical challenges associated with tooth related age changes present the practitioner with considerable challenges.² At a population level, the most recent Adult Dental Health Survey makes interesting reading for the graduates of tomorrow. In 2009, 37% of dentate adults had crowned teeth. There was significant variation with age; only 5% of the 16- to 24-year-olds having crowns compared with those aged 45-74. For those with crowns, on average there were three per person, amounting to an estimated 47.6 million crowns across England, Wales and Northern Ireland. An unknown proportion of these teeth will be root filled but the potential number of teeth to become non-vital in the next decades is open to conjecture and has consequences for dental treatment. Other findings from the survey indicated that in the crowned teeth group, root or recurrent caries was present in just over one third of teeth and potential endodontic implications are seen in the 7% of dentate adults having one or more pulpally exposed tooth, sinus or abscess.³

Endodontic specialists provide a valuable service, but there are clear financial implications for the patient. The ever increasing threat of litigation related to endodontic procedures makes the potential situation more alarming.

The teaching of endodontics is influenced by a wide range of factors, some of which are fixed and provide a framework around which education is provided, others are variable. The dental school and university structure and local trust regulations provide the structure around which an undergraduate dental curriculum is developed. Benchmarking documents such as the European Society of Endodontology curriculum guidelines,⁴ the European Society of Endodontology quality guidelines⁵ and the General Dental Council's *Preparing for practice*⁶ provide invaluable references against, which curricula and standards can be mapped.

Superimposed on this structure are the insidious but significant changes associated with endodontics over the years, which include our ever greater understanding of the relevant microbiological and immunological systems, changes in treatment modalities and above all, an appreciation of the need to work within an evidence-based framework.

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In a similar way, the approach to teaching has moved from a didactic style to a more evidence based method. The integration of IT into almost all aspects of undergraduate teaching has been revolutionary; students are highly IT literate, can access and work remotely and the potential for simulation exercises on 'virtual' teeth in simulation exercises is promising.⁷

The practical skills of endodontics are based on a foundation of sound knowledge. Development of the knowledge base may include inputs from a range of media including lectures, seminars, online learning, dialogue and reading.

Finally, local challenges which, although school specific, are almost universally shared between the majority of schools in the UK include the lack of availability of suitable extracted teeth for pre-clinical exercises and an ever dwindling number of appropriate patients.

This paper aims to reflect on the teaching of endodontics in the past and to highlight the challenges involved in delivering this important component of the curriculum

A HISTORICAL PERSPECTIVE

More than any other subject in the undergraduate curriculum, the teaching of endodontics has challenged those involved in delivering the knowledge and skills required for an undergraduate to be competent at carrying out straightforward endodontic procedures. The course of history has resulted in significant changes in endodontic education yet some of the key challenges that were reported at the first workshop for teachers in endodontics in 1979 still remain, as will be shown below.

By the late 1970s it was recognised that of all subjects under the umbrella of 'conservative dentistry' endodontic teaching was the most inconsistent. At this time there had been an unprecedented increase in the number of endodontic procedures carried out in the NHS, mirrored by a fall in the number of extractions. In a quest 'to question what we teach' and 'to consider why we teach some of the things that we do', the first workshop dedicated to endodontics took place in 1978.⁸ It was recognised that at the time 'most of us probably know fairly well what is taught under the general heading of endodontics in our own school, but are not very well acquainted with the situation in other schools'. At this time, inconsistency in teaching was acknowledged and there was little interchange of ideas between schools; the techniques taught often being of individual choice and not evidence-based. So it was that a survey was carried out of all of the dental schools in the UK providing

results that gave the first opportunity for peers to gain some insight into endodontic education at other establishments, to debate, challenge and affirm their own practices. Gutta percha and silver points were being used as filling materials and the use of both setting and non-setting paste materials was taught, as was the placement of camphorated monochlorophenol as a routine medication. Stainless steel reamers were used in the majority of schools. The use of Giromatic type files was used in all schools apart from one. Interestingly, and an issue which continues to be contentious, is that of the amount of endodontic treatment expected of the undergraduate student in the 1970s. The number of roots filled ranged from 4–25, with an average of 10.6. In over half of the schools students were expected to treat at least one multi-rooted tooth before graduation, 'an encouraging trend'.⁹

Much of the discussion at this workshop highlighted the challenges associated with ensuring that the aim for students to achieve the highest standards was made possible and they should not be encouraged to use techniques that were of 'political expedience' because of the low fees paid in general practice. The use of paraformaldehyde-containing paste materials for canal obturation is one such example. It was reported that it was critical for teachers to understand what happens in practice and to take an active role in influencing the governing bodies to address poor remuneration for root canal treatment in the NHS by raising fees. This was felt to have the consequential effect of improving standards in endodontics and raising job satisfaction for those disillusioned with practice.

Dissemination of the findings from the 1978 workshop had significant repercussions and motivated the British Endodontic Society to carry out a review of endodontics in general practice in the UK, the findings of which were published in 1983.⁹ This survey revealed some interesting facts, such as 95% of NHS practitioners and 60% of private practitioners not using rubber dam for treatment. Stock proposed that the unacceptable standard of root canal treatment continued to be due to poor teaching in the dental schools and also unsatisfactory remuneration in the health service.¹⁰ He suggested that the way forward could be addressed by allocating more teaching time in the undergraduate curriculum and to run courses for teachers of endodontics and vocational trainers. This paper stimulated much discussion, most being centred around the practicalities of managing a population with an increased need for root canal treatment and educating endodontic teachers.

At this time, the number of root treatments carried out in the NHS was increasing rapidly; ten years after the 1978 workshop it had risen from 838,000 to 1,449,000.¹⁰ In 1995/96 it was over 1,200,000 in England and Wales.¹¹ In 2012 to 2013 some 1,128,000 courses of treatment including endodontics were recorded in England.¹²

In an attempt to measure the effect of endodontic guidelines and to monitor progress against the recommendations of the first workshop, a second workshop on endodontic teaching took place.¹³ There was now a greater consistency between schools in endodontic techniques and filling in the form of step back preparation and lateral condensation. As at the previous workshop, concern was raised regarding limited time within the undergraduate curriculum for endodontics and of particular note was the variation between schools in this respect. At this critical time, a significant source of reference for those involved in teaching in the form of the first curriculum guidelines for endodontics was published¹⁴ and has since been revised twice.^{4,15} These guidelines formed the first 'gold standard' reference against which endodontic curricula can be mapped and have been updated on a regular basis ever since.

It was disappointing then, that, following two workshops on undergraduate teaching, the publication of the first curriculum guidelines and guidelines on standards in endodontics, the standard of root canal treatment in the UK continued to be reported as being unreliable.¹⁶ Curious to determine whether the European guidelines had had any influence on teaching in the UK, a detailed survey of all 14 dental schools was conducted with a 100% response rate.¹⁷ There were certainly differences but this was also at a time when our understanding of biological processes was rapidly increasing, as was the development of cleaning and shaping techniques consequent to developments in metallurgy and manufacturing. The crown-down approach using flexible K files was almost universally adopted and sodium hypochlorite was used in all schools. Reflecting conflicting evidence in the literature at the time, there was found to be division between the schools advocating use of calcium hydroxide as an inter-appointment medicament with almost a 50% split. Signs of acceptance that coronal seal could play a significant role in success were seen in a small number of schools advocating that adhesive cements should replace the conventional zinc oxide eugenol temporary restorations. All schools taught that teeth should be filled using cold lateral condensation of gutta percha.

It was concluded that time and the priority of teaching endodontics had increased since the previous study yet there were anticipated to be further significant influential changes. These included the introduction of specialist lists, one of which would be in endodontics with the potential to influence teaching by employment of specialists in undergraduate education; the vision of 1973. In 2014 we continue to reflect and develop. Most undergraduate dental students use rotary instrumentation, certainly on pre-clinical skills courses and often on patients. The crown-down philosophy is maintained. Sodium hypochlorite remains the irritant of choice.

CHALLENGES IN 2014

The undergraduate endodontic student is the benefactor of the cumulative of decades of research and developments in instruments and materials. He/she will be in a dental school in which the curriculum is ever developing yet the number of hours remains the same. There will be fiscal pressures, inherent in any teaching establishment. Typically, students might carry out endodontic treatment on a posterior tooth under the guidance of a tutor who may or may not have a special interest in endodontics. Full time senior academics with a special interest in endodontics are rare and usually have a number of other strategic university roles and clinical commitments

SOLUTIONS?

No longer do we so acutely need 'to question what we teach' and 'to consider why we teach some of the things that we do'; our predecessor teachers have done that but there is a constant need for reflection in order to progress. The European Society of Endodontics curriculum guidelines, which are reviewed every ten years, are produced by the education and standards committee of the European Society for Endodontology. This committee has wide ranging terms of reference, maintains close relations and promotes an ongoing dialogue with dental schools in Europe over undergraduate and postgraduate programmes, with member national societies and individual members with special status to encourage continuing professional development and education; and to promote education and scholarship-related events.

The proposed curriculum is presented as a list of competencies; the list of which is extensive and out with the remit of this paper. However, there has clearly been careful consideration of the challenges faced by undergraduate teachers in providing and assessing the relevant teaching material. Key concepts are that endodontic procedures

should be carried out within the context of comprehensive patient care and that teaching and supervision by specialists, although ideal, is not possible. Involvement of teachers with a special interest in endodontics is recognised as representing best practice. Recognition is made that the quality and consistency of experiences measured by competencies, rather than reliance on 'requirements' will result in optimal patient care and learning outcomes. It is recommended that upon graduation, students should be competent to undertake root canal treatment of single rooted, premolar and uncomplicated molar teeth. Any form of undergraduate education is enhanced when supported by established guidelines and a peer group network.

Within the UK, the Teachers of Endodontology Group is affiliated to the British Endodontic Society. Its remit is to enhance undergraduate education and scholarship by facilitating relationships and promoting contact between staff involved in delivering endodontic education to undergraduate students in the UK. There are no formal terms of reference as such but the group promotes dialogue between the schools, using the ESE curriculum guidelines as a reference point. Close contact between academic colleagues is enhanced and education and scholarship are supported. The Teachers' Group is formally recognised and acts as an invaluable peer support network; representatives from all dental schools are invited to attend the two yearly meetings that are funded by the British Endodontic Society

A recurrent theme in recent meetings has been related to the challenge of teaching practical endodontic skills in a climate in which alternatives to natural, extracted teeth, used for teaching endodontic practical procedures for many years, are used. The move towards the use of synthetic alternatives has been precipitated by issues related to shortage of suitable teeth, cross infection control and consent. The range and variety of synthetic teeth varies considerably, ranging from simple 'EndoVu' blocks to anatomically simulated tooth replicas. The clear disadvantage is that they do not reproduce the tactile sensation associated with instrument contact with tooth structure and that the finer intricacies of the canal system are not replicated. However, a significant advantage is that all students have the opportunity to work on a standard typodont. Another approach is the potential use of haptic technology in which three dimensional images are produced and recorded from virtual tactile data at a haptic interface. Using such a method, wearing three dimensional glasses

the user can prepare an access cavity in a virtual tooth using appropriate burs. The great advantage is that all kinematic data (such as mirror positioning) can be recorded, as can the time and accuracy of the procedure.¹⁸ To date, although used in some dental schools for intra- and extra-coronal cavity preparation, only the software for access cavity preparation is currently available. The great advantage is that reproducible procedures may be repeated until the requisite skill level is achieved, thus obviating the need to use natural teeth and students may progress according to individual need. Virtual teaching also has the benefit of offering enhanced effective use of students' time in a busy curriculum.

CONCLUSION

For as long as there have been publications on this subject, an association has been made between the less than ideal standard of endodontic treatment in practice and remuneration on the one hand, and with undergraduate teaching on the other. The role of the dental schools is to ensure that graduates have the knowledge and skills to carry out straightforward endodontic procedures. The basic principles are simple yet harder to deliver in a practical sense, largely due to the lack of availability of natural teeth and lack of suitable patients. Simulated access cavity preparation practice may have a role in the future, rotary instrumentation enables predictable results and teacher networks and guidelines are invaluable. The common and eternal challenges facing each school are time, the lack of suitable teeth for pre-clinical exercises and appropriate cases. Apart from the extracted teeth situation, the same issues raised 35 years ago remain.

It is interesting to conjecture that in 2020 students will be using haptic technology as a practical learning tool and the issues of time and suitable patients will remain. Graduates will be tested by the challenges of delivering endodontic treatment to their patients. Quite what will happen to the standards of treatment in practice is unknown; that students graduate with the knowledge and skills to carry out root canal treatment to a high standard and have the understanding the basic principles should ensure that standards are high, but will not address the increasing need for complex work required by patients of tomorrow.

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