

New developments in assessment in orthodontics

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As part of the 'cutting edge' series in the Journal of Orthodontics this paper aims to describe current practice in assessment, suggest how assessment in orthodontics will change in the future and place this change in the context of changes in medical and dental education.

Introduction

As orthodontists we have all been subject to assessment of our knowledge and skills. This might be assessment as part of our training; examinations in universities or colleges, assessment of our clinical work from colleagues, the critical eye of our patients or their parents. Revalidation of specialists will certainly involve some form of assessment and therefore changes in the way assessments are seen as part of the education process is of interest to us all.

Over the past 20 years we have seen significant developments in medical and dental education. Since these two disciplines have much in common, principles and techniques developed for one may be transferred to the other. In particular, there are initiatives currently being developed in medical education that may prove very useful in dentistry. These include improvements in curricula, teaching, learning and assessment.

One of the main driving forces for these changes in medical education has been the establishment of the Postgraduate Medical Education and Training Board (PMETB)¹ as the UK statutory authority for standards in postgraduate medical education, with a remit that covers the content and delivery of training and examinations.

In response to the PMETB principles and standards, the medical Royal Colleges have made major and innovative improvements to their curricula and examinations. Until recently many postgraduate medical courses did not have a curriculum at all. Even when a curriculum existed, examinations often bore little relationship to it. Much of what was in the curriculum was not assessed, and sometimes much of what was assessed was not in the curriculum.

Royal College assessments and other assessment in medical education have usually followed a criterion referenced structure. Criterion referenced assessments measure how well a student performs against a standard

or criterion rather than the performance of another student. Although occasionally new assessment techniques were introduced, little account was taken of the effectiveness or educational impact of these approaches. Indeed, some examinations taken early in the undergraduate medical course had a negative educational impact, driving what was learned and how it was learned in quite the wrong direction – for example, the rote learning of isolated facts. Moreover, some traditional widely used assessment methods were very unreliable and had other poor psychometric characteristics. Dressel² summed up criterion referenced assessments as:

‘An inadequate judgment by a biased and variable judge of the extent to which a student has attained an ill-defined level of mastery of an unknown proportion of an indefinite material’.

This picture has now changed significantly and the influence of PMETB on this process has been substantial. Although PMETB has no remit in respect of dental education, we can learn from the change process it has promoted in medical education and be guided by the PMETB principles and standards for curricula and assessment.

At its best, contemporary medical and dental education draws on a substantial and growing evidence base covering such aspects as curriculum design and delivery, the theory and practice of adult learning, assessment theory and exam psychometrics. One of the major recent changes has been to see assessment as an integral part of the curriculum. This is currently seen in the best examples of both medical and dental education and removes the problem outlined above of a mismatch between the curriculum content and the content of the examination.

The purpose of assessment

For many years the main purpose, indeed often the only purpose, of assessment was to distinguish between those

who had reached a required standard and those who had not. Pass/fail assessments of this type are known as *summative* assessments and they were almost exclusively high-stakes examinations in which the standard was represented by a numerical pass mark. Unfortunately, the current politically driven obsession with ‘standards’ in education is perpetuating this rather narrow view of the purpose of assessment.

Apart from a summative pass/fail function, there are two other important characteristics of assessment. These are assessment as a *prediction* of future performance and the use of *formative* assessment. Formative assessment, rather than leading to pass/fail decisions, checks on progress and informs the educational process. Formative assessment might, for example, consist of spot tests, mock examinations, or observation of the trainee at work. This type of worked based assessment is becoming an increasingly important part of the educational process. This is particularly true in craft professions such as dentistry and making an assessment of clinical skills gained on the course in the context of clinical practice is recognized as an essential component of a comprehensive assessment programme. Formative assessments allow students to check on their own progress and look forward to the next phase of their course. Summative assessment looks back at what has been achieved and ensures the students know or can do what their course purported to teach them. It is possible for a single assessment to serve more than one of these purposes – for example, workplace-based assessments can be both formative and summative.

Principles of assessment

PMETB has led to widespread and beneficial changes in medical education and can provide us with useful guidance as we continue to develop dental education. In particular, based on sound educational principles, PMETB has set out a clear set of standards for assessment.¹

Curriculum purpose and development

Standard 1 The purpose of the curriculum must be stated, including linkages to previous and subsequent stages of the trainees’ training and education.

The appropriateness of the stated curriculum to the stage of learning and to the specialty in question must be described.

The assessment system must be fit for purpose

Standard 2 The overall purpose of the assessment system must be documented and in the public domain.

Content of the curriculum

Standard 3 The curriculum must set out the general, professional, and specialty – specific content to be mastered, including:

- the acquisition of knowledge, skills, and attitudes demonstrated through behaviours, and expertise;
- the recommendations on the sequencing of learning and experience should be provided, if appropriate;
- the general professional content should include a statement about how *Good Medical Practice* is to be addressed.

The content of the assessment will be based on curricula for postgraduate training which themselves are referenced to Good Medical Practice

Standard 4 Assessments must systematically sample the entire content, appropriate to the stage of training, with reference to the common and important clinical problems that the trainee will encounter in the workplace and to the wider base of knowledge, skills and attitudes demonstrated through behaviours that doctors require.

Managing curriculum implementation

Standard 5 Indication should be given of how curriculum implementation will be managed and assured locally and within approved programmes.

Model of learning

Standard 6 The curriculum must describe the model of learning appropriate to the specialty and stage of training.

Learning experiences

Standard 7 Recommended learning experiences must be described which allow a diversity of methods covering, at a minimum:

- learning from practice;
- opportunities for concentrated practice in skills and procedures;
- learning with peers;
- learning in formal situations inside and outside the department;
- personal study;
- specific trainer/supervisor inputs.

Assessment system methods

Standard 8 The choice of assessment method(s) should be appropriate to the content and purpose of that element of the curriculum.

Supervision of the trainee

Standard 9 Mechanisms for supervision of the trainee should be set out.

Role of the assessor

Standard 10 Assessors/examiners will be recruited against criteria for performing the tasks they undertake.

Assessment feedback to the trainees

Standard 11 Assessments must provide relevant feedback to the trainees.

Standards for classification of trainees' performance/competence

Standard 12 The methods used to set standards for classification of trainees' performance/competence must be transparent and in the public domain.

Documentation will be standardised and accessible nationally

Standard 13 Documentation will record the results and consequences of assessments and the trainee's progress through the assessment system.

Curriculum review and updating

Standard 14 Plans for curriculum review, including curriculum evaluation and monitoring, must be set out.

Resources

Standard 15 Resources and infrastructure will be available to support trainee learning and assessment at all levels (national, deanery and local education provider).

Lay and patient involvement

Standard 16 There will be lay and patient input in the development and implementation of assessments.

Equality and diversity

Standard 17 The curriculum should state its compliance with equal opportunities and anti-discriminatory practice.

Assessment programmes

Until recently the main, indeed often the only, component of assessment was a formal examination.

Contemporary best practice, by contrast, utilizes a wider variety of assessment methods than is usual in an examination, and requires that assessments are carried out fairly frequently throughout the course. This enables progress to be monitored, feedback provided, and any remedial action to be properly planned. Unlike individual assessments or the traditional one-off examination, assessment programmes are multi-faceted; cover a wide spectrum of knowledge, skills and behaviours and gather evidence in a number of settings, from a variety of stakeholders, over a significant period of time.

Assessment programmes are designed specifically for an individual curriculum, and are an integrated part of that curriculum. They will, therefore, vary between courses or even between different years of the same course. For example, a curriculum might require a substantial amount of formative assessment in the early stages, as students learn the basics. This early part of the course might conclude with a high-stakes assessment that has good predictive validity to ensure that students successfully completing this stage are likely to complete the whole course. By contrast, towards the end of the course, students are likely to be putting a final polish on their skills and so less formative assessment will be required. However, in the interest of good patient care and high professional standards, the final assessment should cover a wide range of professional competencies and students must be able to demonstrate they can make reliable and safe clinical decisions. Ideally, it should also be able to provide educational feedback to all candidates, not just those who fail or ask for feedback.

Clearly, for assessments to carry out all these functions across the curriculum, the assessment programme must be properly designed, use a variety of methods (both in the examination hall and the workplace) and be carried out by examiners who have the training and experience needed.

Teaching, learning and assessment

The relationship between teaching, learning, assessment and evaluation has been described in the orthodontic literature.³ Students' perceptions of what is rewarded and what is ignored by assessment will have a substantial impact on their behaviour and hence on the outcomes of their training.⁴ In orthodontics this assessment focus is by no means limited to the student body. Orthodontic educators at all levels will be influenced by the requirements, format and timing of the MOrth/IMOrth examination. The freedom to modify our approach to assessment is something to be cherished and protected, but carries a heavy responsibility.

Choosing what we are trying to achieve, the way we try to get there, what facts are important and which are not and how to test our students illustrates the power and influence of assessment in curriculum design.

The impact on students' behaviour in relation to the content, format and timing of assessment is known as *consequential validity* or the educational impact of the assessment. For both teachers and learners, the real curriculum – the one that is taught and learned, rather than the one published in a booklet or on the web – is determined by the assessment programme. This must assess the right things, what it is we want the students to know or be able to do, in the right way.

Assessment in orthodontics

This culture of enhanced accountability and responsibility for assessment in postgraduate medical education has led to the recognition that the current system of assessment in surgery is not sensitive enough to modern concepts of educational theory.⁵ This is also true of assessment in orthodontics at least, in part, because of the diversity of qualities that need to be assessed. The best way forward is to ensure orthodontic educators use a wide variety of assessment methods. It can be argued the greater the diversity in the methods of assessment, the fairer the assessment is for our students.⁶

In contemplating any changes to assessment in orthodontics it will be critical to retain the high level of professional confidence enjoyed by IMOrth/MOrth as the most significant and robust part of the GDC's requirements for inclusion on the UK specialist list.

A variety of assessment techniques can be matched to the current learning outcomes written for orthodontics. These include essays, multiple choice, constructed response questions and multiple short answer questions to test knowledge and its application; checklists, Objective structured clinical examinations (OSCEs) and structured clinical operative tests (SCOTs) which test performance and portfolios which assess qualities such as professionalism that are not easily assessed by other methods.⁷

In orthodontics it should be argued that, as in medical education, the task for the future is to ensure the learning outcomes are wide and long and deep.⁸ If learning outcomes include technical competencies it is important these are balanced by outcomes in knowledge and behaviours that contextualize these skills. The outcomes of specialist training are much more than technical competencies and must attempt to capture the essence of the specialist orthodontist. Clinical competencies are not a shopping list which if acquired will add

up to an equivalence with a fully trained specialist because individual competencies and technical skills are only small aspects of the performance of a specialist and can not be taken out of this context.

To be effective assessment needs to reflect programme content and be valid, reliable, fair, feasible in respect of the time and resources available, and, if necessary, defensible if challenged.

Validity has several components including face validity, construct validity and consequential validity. Face validity is a non-expert judgement of the content and the level of the assessment – does the assessment appear to be testing the right things in the right way? Construct validity is an expert view of the nature and organization of the assessment. Consequential validity, now accepted as a very important characteristic, is about the influence that assessment has on the behaviour of the learners – in other words, its educational impact.

Reliability is concerned with the accuracy and reproducibility of assessment, and identifying and quantifying sources of measurement error. Thus, validity is judged qualitatively whereas reliability of an assessment is calculated mathematically.⁴

It has been suggested that in postgraduate medical training, the final validation step is to determine that those doctors successful in postgraduate medical tests subsequently actually have a more positive influence on the health outcomes of their patients.⁹ Research into the impact on the dental health of a community by the provision of specialist orthodontic treatment represents the ultimate validation of the training programme that produces specialists caring for that community. This takes us into the area of predictive validity that may come to feature more strongly in the literature over the next few years as quality assurance procedures extend into this area.

Methods of assessment

Methods of assessment should, as far as is practical, be consistent across and throughout orthodontic programmes. Assessments should allow the student to evidence the knowledge, skills and behaviours they have gained on the programme and to demonstrate that the learning outcomes essential to inclusion on the orthodontic specialist list have been met. This requires a specifically-designed programme of assessments using a variety of methods.

In some instances, traditional methods are found to be unsuitable for inclusion in such programmes. For example, one method no longer seen as suitable is the 'traditional' long case examination in which the student

would examine a patient they had not seen previously. The student would then describe their findings, diagnosis and treatment plan to the examiner. It was believed that this would demonstrate application of knowledge and mirror professional practice. However, among the problems were inconsistency and lack of control over the situation, with patients varying in availability, complexity and co-operativeness. Some would be poor historians, whilst others would give away the treatment plan under the mildest cross examination. It was quite possible, indeed highly likely, for different candidates to be faced with very different cases for this part of the examination, raising serious questions about reliability, validity and fairness.

Essays or short answer questions

Although traditional essays can reflect the depth of student learning, allowing students' freedom to express their individuality, essay-writing is an art in itself and this subjectivity makes consistent marking difficult. It might be argued essays reward linguistic skills which, however desirable, may not be directly related to the learning outcomes for orthodontic Specialist Registrars. Knowledge based written essays cannot measure many things that are important to orthodontists, such as patient management skills, oral communication skills to patients, parents and colleagues, practical skills and the ability to apply knowledge to solve clinical problems. In postgraduate medical assessment written tests are now focused around objective and reliable multiple choice and extended-matching questions (MCQs and EMQs), which allow much more widespread sampling of the curriculum.⁵ Examples of these are available on the web <http://www.umap.org.uk>. EMQs, in particular, were developed as a replacement for short answer questions and can be designed to test higher-order thinking. Short answer questions have not been shown to test anything other than that which is tested by an MCQ or EMQ and are much less convenient to mark.¹⁰ The success of a short answer paper will be determined by careful selection of questions for content and for detail of response required. To simply ask for a definition would encourage a surface approach to learning and memorization without understanding, thus undermining the consequential validity. Short answer questions are usually marked against a model answer provided by the question setter. Despite the best of intentions, in reality this does not guarantee the accuracy or consistency of the marks, although it does seem to be more valid, reliable and fair than the traditional essay format marked subjectively. Nevertheless, it is possible

to cover more of the syllabus with MCQs and EMQs than with either essays or short answer questions. This is partly because MCQs and EMQs test how fast students think rather than how fast they can write. Furthermore, well designed MCQs and EMQs move the emphasis away from memory towards the ability to interpret information and make good decisions.

Case presentation section

Presentation of the candidate's own treated cases illustrates the skills learnt by students during the patient's treatment. Candidates are encouraged to reflect on the outcome of care and critically analyse the treatment plan and its delivery. In the future these clinical cases could be included as part of a clinical portfolio. The portfolio would include data on all patients started and a reflection on the candidate's clinical experience as a whole. Portfolios can contain evidence of reflection and, importantly, of the student's development over time. They are a purposeful collection of student's work that exhibits their efforts, progress and achievement.¹¹ The portfolio must involve student participation in the selection of contents, the criterion for selection being evidence of self-reflection.

Teachers in restorative dentistry attached a high value to methods of assessment that are not always used in this specialty, but might be routinely utilised in assessment programmes in other specialties. These include; objective structured clinical examinations (OSCE), workplace based assessments and self and peer assessment. They also appreciate the educational value of portfolio-based learning, and of providing regular feedback to the students.¹² Yet, despite this, dental teachers seem less enthusiastic than their medical counterparts to develop constructive alignment of the curriculum, particularly if this involves change to the assessment strategy.

After a change to an outcomes based approach in medical education, there has been an associated need to change the timing, format and setting of assessments. A need has been identified to assess not only what students do under the strictly controlled conditions of an examination, but how they habitually behave with patients and colleagues. This requires instruments to assess professionalism and attitudes, essential qualities that are difficult to test using traditional assessment methods. Portfolio assessment is important in helping us to achieve this by providing a framework within which student performance across a range of outcomes can be assessed.¹³

Content of the portfolio will be selected by the learner. It will be indexed and include a self-evaluative

commentary which would demonstrate reflection by the learner on what they perceive to be the most important aspects of what they have learnt. Thus, portfolios, which can also reflect values as well as skills, knowledge and experience, are a powerful tool in formative assessment and in supporting effective learning.¹⁴ If portfolios are to be transferred to a summative context and used to demonstrate educational outcomes have been satisfied, the challenge lies in finding a way to retain these educational advantages, whilst ensuring sufficient rigour for summative purposes including perhaps high-stakes decision making.

Case based discussion

Unlike the traditional long case that can be compromised by the inconsistency of patient's (and sometimes examiner's) behaviour, or the varying complexity of their malocclusions, case based discussion introduces the possibility of the student demonstrating application of their knowledge using, for example, a set of orthodontic records that they have not seen before. These records can be duplicated to be seen by all the candidates or grouped into levels of complexity with set questions and responses agreed by a team of examiners before the test. This improves the fairness and reliability of the examination but is still a robust assessment for the student. This is the part of the examination most of the candidates dread and is seen as a test of character.³ Indeed, in the past it probably has been. Nevertheless, it is potentially a very important examination method, but needs careful preparation and examiner training to ensure each candidate get the same opportunity to illustrate their understanding and problem solving ability. Furthermore, for teaching purposes this format of the examination of orthodontic records can also be used as a formative assessment as part of the training process. This ability to examine an unseen case; identify the problems, formulate a practical plan of action, describe the options for and subsequent deliver of mechanotherapy and to be able to cope if all does not go exactly according to plan is an essential ability for a specialist orthodontist to be able to demonstrate.

Oral examinations: *viva-voce*

Oral examinations are prone to many errors.¹⁵ These include errors relating to the halo effect where, judgement of one attribute influences the judgement of others, errors of central tendency where all the examiners simply score around the middle grade; and errors of contrast where judgments of one candidate are

influenced by impressions of preceding stronger or weaker candidate. Candidates' marks can be related to irrelevant attributes such as appearance, confidence or gender. Agreement between examiners can be poor, despite their tendency to score at the middle of the rating scale. Averaging marks does not remove this problem; it merely conceals it, whereas the other popular procedure of awarding an 'agreed mark' tends to result in recording the view of the dominant examiner. Another major weakness of a *viva-voce* is that by necessity it lacks anonymity.

Supporters of the *viva-voce* claim that the applied problem solving ability of the student is tested – the ability to 'think on one's feet'. However, it might be argued that such skills would be better tested in a clinical environment and that the *viva-voce* might lack authenticity.

Objective structured clinical examination (OSCE)

The objective structured clinical examination¹⁶ consists of a circuit made up of stations through which each candidate must pass. At each station the candidate is asked to perform a task on which they are observed and assessed by an examiner. To further improve objectivity the examiner is usually provided with a checklist breaking the task down to its component parts. However, because of the limitations of simply using a 'tick-box' approach, more sophisticated rating scales are currently being developed.

Since its introduction in the 1990s,¹⁷ the use of the dental OSCE has been growing in popularity, as has the OSCE format in medical and other skills based assessments. It allows clinical and interpersonal skills to be examined under controlled test conditions and offers some of the claimed advantages of an oral examination. The psychometric analysis of the OSCE is now sophisticated and well developed and this adds to the attraction of this approach. Stations within the OSCE can be analysed individually. If a station performs poorly because the question has been badly written or there is a misunderstanding over the instructions this station can be excluded from the exam. As well as analysis to determine how each individual station performs in an exam, we can also see how individual candidates perform.

Both of these perspectives help with test development. For example, easy stations will have a very high pass rate but will not discriminate well between strong and weak candidates. In a well-constructed OSCE such stations usually test essential competencies, such as basic

life support or other medical emergencies and therefore earn their place in the examination because of their high construct and consequential validity. By contrast, very difficult stations may have a low pass rate but allow the best students an opportunity to excel. However, we need to curb the desire to see how the best candidates can perform and remember that the purpose of our assessments is to ensure all the candidates have met the required learning outcomes. To aspire to perform at your highest standard is a desirable positive characteristic and to be selected as a prize winning student is something to be proud of. However, the construction of an assessment to identify the best student would be at odds with the outcomes approach. A well designed OSCE will give broad coverage of relevant parts of the curriculum and consist predominantly of moderately challenging stations testing essential and important competencies.

However, OSCEs are not an inexpensive form of assessment. They require plenty of room, a large number of properly trained examiners, specialist clinical equipment and usually a number of simulated patients. The organizational and administrative burdens are considerable.

Communication skills

If communication skills between an orthodontist, patients, parents and colleagues are important in terms of their professional performance, it would seem reasonable for these skills to be tested directly.

Within the medical curriculum, assessment has traditionally focused on clinical tasks, rather than softer skills including teaching, research and communication skills.¹⁸ However, there is recognition of the importance of effective communication across specialities and better links between curriculum documentation, teaching and learning methods with authentic assessment in the work place. Indeed, PMETB and several of the medical Royal Colleges currently have working groups on workplace based assessment and it seems this form of assessment is likely to feature strongly in the future.

For training in surgical specialties the trainee requires a coach, guiding reflection on practice and indicating their strengths and weaknesses to help correct any deficiencies in performance.¹⁹ This approach is appropriate for formative assessment in orthodontics in the work-place. With increasing experience gradually the trainer can begin to withdraw from a hands-on approach and become a mentor, to help trainees consolidate skills and develop judgement by reflecting on experience. However, in Orthodontic Specialist Registrar training the trainee is

following a cohort of patients through the various stages of treatment over a 2 to 3 year period. Trainees must face each stage of treatment as a new challenge hence the trainee never moves out of the position of novice. It is likely at the time the trainee faces IMOrth/MOrth their cohort of patients will be substantially incomplete and the finished cases presented will be in the minority. Trainees will have little time to reflect on skills they have gained and this should be taken into account developing an assessment programme. The nature of orthodontics makes the challenge of designing a collegiate summative assessment unique.

Conclusion

Freedom to modify or develop an assessment programme is a privilege available to very few professionals. Changes to assessments can have a profound effect on the behaviours of students, teachers, examiners and the wider professional community. Too much change, rushed in without proper thought or planning risks unforeseen and unpredictable consequences which might erode the professional credibility of specialist qualifications and the integrity of the specialist list held by the GDC. However, if an outcomes approach is followed, assessments must be developed to ensure that specialist can demonstrate that they have met and continue to meet the standards demanded of them. Our drive to continue to raise that standard ensures that the *status quo* is not an option and that we must continue to improve our outcomes for the patients we serve.

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