Innovative Micro-CT Scanning Techniques for in-depth Assessment of Dental Students’ Tooth Cavity Preparation Skills

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Background:
Clinical skills assessment has traditionally relied on professional judgement. New imaging technology now affords the opportunity for both enhanced qualitative and quantitative assessment.

Aims & Objectives:
To investigate the contribution of Micro-CT Scanning of student prepared plastic teeth to determine the accuracy of assessing the performance of clinical cavity preparation skills; trained traditionally versus haptically using a virtual reality simulator (hapTEL).

Materials & Methods:
Year 1 students were randomly allocated to learn caries excavation on either (a) plastic analogue teeth (Frasco) (n=96) or (b) virtual teeth using the hapTEL simulator (n=42). The total student n=138. After 10 weeks of teaching, both cohorts were required to excavate artificial carious tissue from a standardized plastic tooth which replicated caries, enamel, dentine and pulp. (Fig 3) The cavities prepared by every student were firstly assessed and graded by two dental experts (reported previously); and secondly by scanning the teeth using a Bruker 1275 Micro-CT Scanner (Fig 1 and 2) to measure precisely the cavities’ volume, depth, and surface roughness.

Results:
The previously reported expert assessments using visual judgements aided with a scoring rubric was that both cohorts performed equally well but no statistical difference. However, the micro-CT scan results of the teeth showed significant finer variations in the angulation, the roughness and volume of caries and healthy tissue removed. This enabled us to determine which cohort of students (traditional or haptically) achieved the most accurate results removing the highest volume of carious tissue without exposing the pulp or removing too much healthy tissue.

Conclusions:
MicroCT affords a quantitative volumetric analysis of the students’ cavity preparation skills and progression in their learning, which has the advantage of both quantitatively and qualitatively (by visual analysis) measuring the surface roughness of the cut cavities which cannot be achieved through any other presently used assessment method. MicroCT analysis maybe used both summatively and formatively in the assessment of student performance.

References