Five years of experience teaching preclinical endodontics using the EAL-supported simulation model

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Objective: The implementation of electrometry in early stages of dental education is hampered by the lack of appropriate simulation models allowing for electrometric working length determination. The aim of the present concept was to establish a reliable, scientifically based learning tool, helping the students to create a sense of understanding for the issue of EAL. This report presents experiences gathered in the 5-year period after initial implementation.

Methods: The participants were students of the fifth semester of the phantom-lab course (Figure 1). Training sessions focussed on trepanation, electronic working length determination, instrumentation, shaping, and obturation of the instrumented training teeth. Each simulation model (Figure 2) was composed of 12 extracted human teeth embedded in self-cured resin (using a conductive medium). Eleven extracted human teeth were used as training teeth; one remaining single rooted tooth was selected for the final examination.

The second investigation addressed the accuracy of root canal preparation (Figure 4) taking into account the postoperative status of the apical constriction.² For this purpose electronic working length determination (group 1; EAL) and radiologic plus initial electronic working length determination (group 2; GS) preceded manual root canal preparation of both groups (n=36).

Results: Statistical analysis revealed sufficient accuracy with a tendency to estimate the electronically determined apical point of endodontic instrumentation short (y = 0.0844 x + 0.0747 mm; R² = 0.0298) of the anatomical apex (Figure 4). In the second investigation the EAL- and radiologic-supported instrumentation revealed no significant differences regarding the distance between master cone tip and apical constriction (Table 1, Figure 5). Among the EAL samples, 83% of the master cones terminated at or close to the apical constriction (± 0.5 mm), whereas no impairment of the minor apical diameter’s integrity was observed. Since initial implementation 450 students have been trained. The developed endodontic simulation model was able to implement the electronic method of working length determination, and proved as a practicable tool for undergraduates (Figure 6).

Figure 1: Course structure and modules overview.

Figure 2: Endodontic simulation model, with human teeth embedded in autopolymerising resin.

Figure 3: Longitudinally ground human tooth. Working length marked with silverpoints according to radiographic length determination and EAL. Same specimens evaluated after 3D-scanning with bluecam technology.

The implementation of the simulation model was accompanied by several investigations concerning the accuracy of the EAL-supported working length determination achieved during the course and the postoperative integrity of the apical constriction after the use of EAL. The accuracy of radiographic and electronic working length determinations (Figure 3) performed by undergraduates (n=44) were investigated using digital photography and 3D CAD software.¹

Conclusions: The established model is able to implement the EAL, is practicable for undergraduates and yielding high acceptance among students and faculty personnel. Moreover, this didactic approach is scientifically underpinned by comparing the accuracy of working length measurements achieved by electrometrical and radiographic methods, and ensures a high accuracy concerning the postoperative integrity of the apical constriction.

2. Wolgin, M., Grundmann, MJ., Tchorz, J., Frank, W., Kielbassa, AM.: Ex vivo investigation on the postoperative integrity of the apical constriction after the sole use of electronic working length determination. Journal of Dentistry, 2017