ENDODONTIC LENGTH MEASUREMENTS USING CONE BEAM COMPUTED TOMOGRAPHY WITH DEDICATED CONVENTIONAL SOFTWARE ORIGINAL RESEARCH

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ABSTRACT

Introduction: Exact measurements are very critical in endodontic treatments. Hence we investigated endodontic length measurements using cone beam computed tomography with dedicated conventional software.

Material and methods: We conducted invitro study on 500 extracted human teeth. The actual lengths (AL) and electronic lengths (EL) were calculated using the ruler and electronic apex locator (EAL). Teeth were scanned using the CBCT for different voxel sizes (0.075, 0.10, and 0.15 mm). Root canal lengths were calculated by 3D Endo with projected length (3D-PL) by software, corrected length (3D-CL), Romexis Viewer.

Results: The ProPex Pixi measurements found the highest accuracy in the range of ± 0.5 mm. There was arrangement between the 3D-PL and the 3D-CL with AL measurements at voxel size of 0.15 mm and at voxel size of 0.10 mm, respectively. The CBCT Romexis Viewer measurements agreed with AL at three voxel sizes.

Conclusion: The conventional CBCT measurements using Romexis Viewer and dedicated software did not reach to the 100% accuracy in the range of ± 0.5 mm.

Key words: Endo software, Conventional CBCT, Endodontic length.

I. INTRODUCTION

Cone-beam computed tomographic (CBCT) scan can overcome shortcomings in conventional radiographic methods. Recently, 3D Endo software has been developed for endodontic treatment planning with high complex situations. The virtual canal pathway displayed on the screen of the computer assists the operator in effective visualization and management of the root canal instrumentation. One of the most important of CBCT data is the voxel size used for scanning. This parameter can affect the image quality and the accuracy of the endodontic length measurement. The smaller voxel size is, the higher radiation dose the patient burdens, and whether there is a most appropriate voxel size that balances the accurate level of measurement, the agreement of measurement.
with the actual length, and the radiation dose. There was limit data on the accuracy of different voxel sizes in endodontic length determination and not any study on that in association with 3D Endo software. Hence we investigated endodontic length measurements using cone beam computed tomography with dedicated conventional software.

II. MATERIALS AND METHODS

We conducted an invitro clinical study after the ethics clearance for the study. We collected 500 extracted molars (human) that were free of the anomalies.

The actual lengths (AL) and electronic lengths (EL) were calculated using the ruler and electronic apex locator (EAL). Teeth were scanned by the CBCT for different voxel sizes (0.075, 0.10, and 0.15 mm). Root canal lengths were calculated by 3D Endo with projected length (3D-PL) by software, corrected length (3D-CL), Romexis Viewer.

For the statistical analysis Bland–Altman plots were applied for examining the data with the Fisher’s exact test for the changes of the percentage of measurements in the range of ± 0.5 mm among groups, the Bland–Altman plots for the agreements of measurements with the actual length.

III. RESULTS

The maximum and minimum proportion of the accuracies in the range of ± 0.5 mm was of the ProPex Pixi and Romexis Viewer (voxel size of 0.15 mm) measurements were 100% and 47.4%. The Fisher’s exact test depicted that there were significant differences among the experimental groups (P < 0.05). But for the voxel size of 0.15 mm, with the remaining two sizes of voxel, the accurate proportions of 3D-CL measurements were significantly higher than that of 3D-PL measurements. There were no significant variation in the mean differences between 3D-PL (voxel size of 0.15 mm), 3D-CL (voxel size of 0.10 mm), and Romexis Viewer (all three voxel sizes) and the AL measurements (P > 0.05), therefore, these measurements agreed with the AL. All other CBCT and EAL measurements disagreed with the AL. The Bland–Altman plots for the agreements of the four modalities with AL were displayed in the four figures, Fig1.

![Figure 1. Bland–Altman plot for the agreement of 3D-PL and AL calculations at different voxel sizes.](image)

IV. DISCUSSION

The observations of the our study showed that, in the range of ± 0.5 mm from the apical foramen, the EAL ProPex Pixi was the best precise modality among the experimental groups. Among the CBCT measurements, the accurateness in the range of ± 0.5 mm was lowest in the Romexis Viewer (the largest voxel size) quantities, using the 3D Endo software.

There was fixed bias between the ProPex Pixi and the AL measurements with the means of the EAL measurements were continually lower than the latter, across the entire range of amounts. The observations of the our study presented that there were the 3D-PL measurements at voxel size of 0.15 mm and the 3D-CL
measurements at voxel size of 0.10 mm agreed with the AL. All other 3D Endo measurements, there were fixed biases, like that of the EAL measurements.

The observations of the our study also showed that the accuracies of the 3D-CL measurements were higher than that of 3D-PL measurements at voxel sizes of 0.10 and 0.075 mm. The 3D-CL measurements were the WL after modifying the proposed lengths by the operator. The results showed that, at smaller voxel sizes, the adjustments of the rubber stop positions were easier, leading to more accurate correct lengths. This agreed with the results of the previous studies.\textsuperscript{6-10} The conventional CBCT Romexis Viewer measurements in our research obtained the more accurate at smaller voxel sizes, like that of the previous researches.\textsuperscript{6,10} The 3D Endo measurements also established the comparable results in the present study, that the smaller voxel sizes yielded more accurate measurements.\textsuperscript{10}

The Romexis Viewer measurements agreed with the AL with good mean differences, just greater than that of the best method in the present study. The 3D Endo software is an effective, quick, and easy modality for identification and visualization of canal trajectories in three dimensions.\textsuperscript{8-10}

Further studies should perform to confirm the effectiveness of the 3D Endo software with better conditions to simulate the clinical situations such as dry jaws, intact human premolars, molars.

V. CONCLUSION

The CBCT measurements by applying 3D Endo with the proposed length and corrected by the software and Romexis Viewer with different voxel sizes wasn’t very accurate in the range of $\pm$ 0.5 mm from the actual root canal length.

REFERENCES