

Radiographic technical quality of root canal treatment performed by undergraduate dental students at the Academy Dental Teaching Hospital, UMST, Sudan

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Abstract

Aim: To radiographically evaluate the technical quality of root canal treatment performed by undergraduate dental students and compare the findings with other institution's work. **Materials and Methods:** A retrospective, cross-sectional study was conducted at the Academy Dental Teaching Hospital involving postoperative periapical radiographs of patients who were endodontically treated by batch #14 undergraduate dental students of final year (2013–2014) from UMST, Sudan. The total number of the students was 21, while periapical radiographs fulfilling the required criteria were 173. The radiographs of each case were evaluated in terms of length, density, and taper of the root canal filling. Procedural errors such as presence of a ledge, perforation, and a separated instrument were also recorded. Chi-square test was used to determine statistically significant differences between variables, with the level of significance set at $P \leq 0.05$. **Results:** The overall quality of performed root canal treatment was adequate in almost half (55.5%) of the evaluated teeth. The length and taper of the root canal filling were found to be significantly associated with maxillary and mandibular posterior teeth with $P = 0.018$ and 0.006 , respectively. No associations were found between the density and presence of separated instrument in the maxillary and mandibular posterior teeth, $P = 0.314$ and 0.480 , respectively. **Conclusion:** The radiographic quality of root canal treatment performed by undergraduate students of batch #14 UMST was acceptable in 55.5% of the cases. Special emphasis must be placed on the educational methods and training of students for providing root canal treatment on molar teeth.

Key words: *Periapical radiograph, RCT quality, UMST, undergraduate dental students*

INTRODUCTION

Endodontic treatment outcome cannot be judged only by clinical signs and symptoms, however, radiographic evaluation is considered cardinal. The technical quality of root canal treatment (RCT) and coronal restoration have an important bearing on the periapical health of root-filled teeth.^[1] Teaching undergraduate

endodontics is recognized as one of the most formidable challenges across all dental subjects.^[2] Many studies have evaluated the technical quality of RCT performed by undergraduate students, with a range of acceptable outcomes.^[3-8]

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Radiographic evaluation of the density of an accurate length of RC filling terminating within 1–2 mm of the radiographic apex,^[9] and the taper of root canal preparation have all been used to assess the quality of RC filling.^[10] Failure of at least one of these criteria carries a high risk of unsuccessful RCT, with a subsequent development or persistence of periapical pathosis.^[11]

In Sudan, the only study that assessed undergraduate quality of RCT by using radiographs was done in 2011 in a public university. A good quality RC filling was found in 24.2% of all evaluated teeth, and the incidence of unacceptable RCT was high.^[12] However, no study has been done in a private university with a smaller number of students and better facilities.

This study was designed to radiographically evaluate the technical quality of RCT performed by undergraduate dental students in the Endodontic Department Clinics at the University of Medical Sciences and Technology (UMST), Sudan.

MATERIALS AND METHODS

A retrospective, cross-sectional study was carried out during the period from July 2014 to December 2014 at the Academy Dental Teaching Hospital, which belongs to the Faculty of Dentistry, UMST. Postoperative digital periapical radiographs of patients endodontically-treated by batch #14 undergraduate dental students of final year (2013–2014) were included in this study. The total number of students was 21, while periapical radiographs fulfilling the required criteria were 173. Incomplete cases of RCT, missing postoperative radiographs, patient under 18 years of age, and unreadable radiographs were excluded. The study was approved by the ethical committee of the UMST. Permission was obtained from the Department of Conservation as well as from patients to use their clinical records. Students were informed that their records will be used for the purposes of the study, and all of them agreed and signed the informed written consent. Privacy of information was protected and the data was kept in the Radiology Department.

Teeth were classified as anterior (maxillary and mandibular incisors and canines), premolars (maxillary and mandibular), or molars (maxillary and mandibular). All the RCT cases were biomechanically prepared by hand instruments using stainless steel hand files step back technique and filled with gutta-percha and zinc oxide eugenol sealer (Zycal sealer, Prevest Denpro limited, Jammu, India) through cold lateral condensation technique.

The radiographs of each case were evaluated by three observers (two postgraduate endodontic students and one consultant endodontist) according to the following radiographic variables: length, density, and taper of the root canal filling. Procedural errors such as presence of a ledge, root perforations, and presence of separated instrument were recorded. Before evaluation, intraexaminer and interexaminer calibration was performed by examining 10% of the post-obturation radiographs reviewing the defined criteria and reevaluating them after 3 weeks. Main assessment was done by the two postgraduate students, while the consultant was asked to check random samples of the radiographs; the results were compared with the original observations. In difficult borderline cases, a consensus was reached by negotiation of disagreements. Kappa values for interexaminers and intraexaminer reproducibility was approximately 80–90. All the periapical radiographs were stored in a hard disc with a high resolution display screen, having a sensor with a special cursor that measures the accurate length of the root canals.

The following criteria of radiographic interpretation were adopted from Barrieshi-Nusair *et al.*:^[13]

Length of root canal filling

- Acceptable: Root filling end 0–2 mm of the radiographic apex.
Overfilled: Root filling ending beyond the apex.
Under filled: Root filling ending >2 mm short of radiographic apex.

Density of root filling

- Acceptable: Uniform density of root filling without voids or space.
Poor: No uniform density of root filling with clear space visible.

Taper of root canal filling

- Acceptable: Consistent taper from the coronal to the apical part (good reflect to canal shape).
Poor: No consistence taper from coronal to apical part.

The criteria for the detection of procedural errors (mishaps) have been adopted from Eleftheriadis and Lambrianidis^[9] as follows:

- Ledge formation was diagnosed when the root filling was shorter than the working length and deviated from the original canal curvature without communication with the periodontal ligament.

- Presence of fractured instrument was diagnosed when a fractured instrument was detected inside a root canal or with its tip extending into the periapical area.
- Root perforation was diagnosed when extrusion of materials was detected in any area of the root (lateral wall or the foramen of the root).

Data analysis

The data were analyzed using Statistical Package for Social Sciences (SPSS) version 17 (SPSS Inc., Chicago, IL, USA). Data were expressed as frequencies and percentages. Differences in categorical variables were assessed using Pearson’s chi-square test and the significant level was set at $P \leq 0.05$.

RESULTS

The overall quality of performed root canal treatment was adequate in 55.5% of the evaluated teeth. The Quality of RCT according to the teeth position was inadequate among posterior teeth. Length, density, and taper of the root canal filling in association to each tooth group and the presence of separated instrument is shown in Table 1. The results showed that the length of the root canal filling is significantly associated with maxillary and mandibular anterior teeth ($P = 0.01$), whereas there was no significant association between the density of the root canal filling and maxillary and mandibular anterior teeth ($P = 0.607$). An association was found between the taper of the root canal filling and maxillary and mandibular anterior teeth ($P = 0.023$) [Table 2]. The length and the taper of the root canal filling were found to be statistically significantly associated with maxillary and mandibular posterior teeth, with $P = 0.018$ and 0.006 , respectively [Table 3]. Separated instruments were detected among 6 teeth (3.5%) out of the total [Table 1], and no associations were found between the density and presence of separated instrument in the maxillary and mandibular posterior teeth $P = 0.314$ and 0.480 , respectively.

DISCUSSION

Studies from different countries assessing the outcome of endodontic treatment performed by undergraduate students are not only important from an epidemiological point of view but also play an important role in the assessment of competency and detection of inherent obstacles related to the preclinical and clinical endodontic training. Studies regarding this issue in Sudan are inadequate. Although the present study was limited to one private school with a small number of students and small number of RCT teeth with 55.5% acceptable results, this poor result jeopardized generalization of findings, it can provide a clue about the RCT performed in Sudanese population. This will necessitate implementation of self-assessment of quality of RCT performed in both private and public health services.

The criteria used to assess the radiographs were adopted from previous studies.^[9,13] These criteria were sufficient and standardized for quality assessment when using radiographs,^[12,14-18] although assessing technical quality by radiographs was considered unacceptable by some studies because they cannot dictate conclusive failure of RCT. Other factors such as following aseptic techniques during treatment, quality of canal preparation, materials used, and treatment routines including antibacterial regimen are among the many prognostic factors that remain inconclusive from epidemiological studies,^[19,20] thus limiting the findings of this study.

In this study, the quality of performed RCT was adequate in 55.5% of the entire evaluated teeth. These findings when compared with previously reported studies were either comparable,^[4,21] less,^[3,11] or superior.^[6,9,13,19] Nevertheless, it was difficult to compare some studies because of the differences in study design, standardization of methods, evaluation criteria, as well as interexaminer variability.

The adequacy of root canal filling in posterior teeth was less than that in the anterior teeth. This result was

Table 1: Frequency and quality of root canal filling on the radiographic assessment based on maxillary and mandibular teeth

Tooth group	No of teeth	Length			Density		Separated instrument		Taper	
		Accepted	Over	Under	Accepted	Poor	Present	Absent	Accepted	Poor
Maxillary and Mandible	61	56 (91.8%)	3 (4.9%)	2 (3.3%)	51 (83.6%)	10 (16.4%)	0 (0%)	61 (100.0%)	60 (98.4%)	1 (1.6%)
Anterior Premolars	47	34 (72.3%)	4 (8.5%)	9 (19.1%)	31 (66.0%)	16 (34.1%)	1 (2.1%)	46 (97.9%)	43 (91.5%)	4 (8.5%)
Molars	65	34 (52.3%)	6 (9.2%)	25 (38.4%)	44 (67.7%)	21 (32.3%)	5 (.7%)	60 (92.3%)	61 (93.8%)	4 (6.2%)
Total	173	124 (71.7%)	13 (7.5%)	36 (20.8%)	126 (72.8%)	47 (27.2%)	6 (3.5%)	167 (96.5%)	164 (94.8%)	9 (5.2%)

consistent with the results of Eleftheriadis *et al.*,^[9] who found that the frequency of teeth with acceptable root fillings was significantly greater in the anterior teeth (74%) than in posterior teeth. Obviously, difficult access to posterior teeth, multi-canal anatomy, and curved roots are all possible confounding factors.

The current study showed that the acceptable length of the root canal filling was significantly associated with maxillary and mandibular anterior teeth, with *P* of 0.01. Uncomplicated anatomy of anterior teeth makes them more accessible than posterior teeth with their curved multicanalled roots.

Presence of voids was detected in 47 (27.2%) cases indicating poor density. This jeopardizes the treatment outcome as inadequate density may lead to failure of RCT.^[22] There was no significant association between the density of the RC filling and the maxillary and mandibular anterior teeth *P* = 0.607. A similar result was obtained by Barrieshi-Nusair *et al.*^[13] This is difficult to explain, except for adopting similar biomechanical and obturation techniques.

Table 2: Quality of the taper of root canal filling in relation to maxillary and mandibular anterior and posterior teeth

Teeth	Taper		Total	<i>P</i>
	Acceptable	Poor		
Maxillary Anterior	54 (100%)	0 (0%)	54 (88.5%)	0.023
Mandibular Anterior	6 (85.7%)	1 (14.3%)	7 (11.5%)	
Total	60 (98.4%)	1 (1.6%)	61 (100%)	
Maxillary Premolar	21 (100%)	0 (0%)	21 (18.8%)	0.006
Maxillary Molar	28 (90.3%)	3 (9.7%)	31 (27.7%)	
Mandibular Premolar	22 (84.6%)	4 (15.4%)	26 (23.2%)	
Mandibular Molar	33 (97.1%)	1 (2.9%)	34 (30.4%)	
Total	104 (92.9%)	8 (7.1%)	112 (100%)	

An association was found between taper of root canal filling and maxillary and mandibular anterior teeth (*P* = 0.023) and posterior teeth (*P* = 0.006). This could be explained by the easiness of attaining proper taper in anterior teeth as compared to posterior teeth.

No associations were found between the density and presence of separated instrument and maxillary and mandibular posteriors.

From the obtained results, endodontics training in Sudan is acceptably better among private institutes than public ones.^[12] Facilities, time allocated to separate endodontic clinics, number of students, number of endodontics treated cases (requirements), and teacher-student staff ratio can justify the differences.

Majority of published studies in this topic insist on improving the preclinical endodontic teaching as well as the clinical level due to the poor quality of RCT performed by undergraduate students.^[23] Plans should be revised to upgrade the preclinical and clinical endodontic methods of teaching and training to fulfill the required acceptable standards. Introduction of new endodontic tools such as apex locator and nickel titanium rotary instruments will help to achieve this goal.

The services provided by supervised students, if upgraded, can help in reducing the economic burden of endodontic treatment for those who cannot afford the expenses of both public and private clinics as this is usually done with negligible fees.

CONCLUSION

Within the limitations of the present study, the radiographic quality of RCT done by undergraduate students of batch #14 UMST was acceptable in 55.5% of the cases. Special emphasis must be placed on the educational methods and training of students in performing standard RCT, especially on molar teeth. Upgrading teaching and clinical training methods will

Table 3: Quality of the length of the root canal filling in relation to maxillary and mandibular posterior teeth

Teeth	Length		Under filled in all roots	Total	<i>P</i>
	Acceptable in all roots	Overfilled in all roots			
Maxillary Premolar	17 (80.9%)	1 (4.8%)	3 (14.3%)	21 (18.8%)	0.018
Maxillary Molar	18 (58.1%)	4 (12.9%)	9 (29%)	31 (27.7%)	
Mandibular Premolar	17 (65.4%)	3 (11.5%)	6 (23.1%)	26 (23.2%)	
Mandibular Molar	16 (47.1%)	2 (5.9%)	16 (47.1%)	34 (30.3%)	
Total	68 (60.7%)	10 (8.9%)	34 (30.4%)	112 (100%)	

alleviate the burden of expensive endodontic treatment from the shoulders of many people. Further studies are required regarding this topic in relation to health provider policies.

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Conflicts of interest

There are no conflicts of interest.

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