

Quality of Obturation Performed by Undergraduate Students Attending College of Dentistry at King Khalid University, Abha, Saudi Arabia

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ABSTRACT

Aim: To evaluate and compare the quality of root canal filling performed by junior and senior undergraduate students attending College of Dentistry at King Khalid University (KKUCOD).

Materials and methods: A total of 460 radiographs of teeth treated by two different levels of students were eligible for the study. Undergraduate students under the close supervision of endodontists following KKUCOD endodontic protocol performed all randomized controlled trial (RCTs). Three different examiners independently evaluated the radiographs after 4 weeks training with endodontists on radiographic analysis with the good interexaminer agreement. The quality of root canal filling was evaluated in regard to length, density, taper and encountered procedural errors during treatment having the final outcome as either acceptable or not-acceptable root canal filling.

Results: The percentage of root canal obturation with adequate length of was 57% for lower-level students and 69.3% for higher-level students. A higher proportion of students in lower-level performed obturation with inadequate density compared to higher-level students. Inadequate tapering was significantly more in lower-level student. Considering tooth type, overall RCT quality was similar in anterior and premolars between different student levels while it was significantly inadequate in molars among lower-level students.

Conclusion: The quality of root canal filling was satisfactory compared to other similar studies in Saudi Arabia. Teaching crown-down technique and rotary instrumentation training are recommended. Finally, Molars and multirrooted premolars should be referred to specialists.

Clinical significance: It is highly important to closely monitor undergraduate students in performing RCTs to increase the quality of treatment. This will increase the success of treatment performed by general practitioners, reduce a load of referral to specialists and decrease the long waiting lists in dental service centers in Saudi Arabia.

Keywords: Density, Length, Obturation, Quality, Taper, Undergraduate.

World Journal of Dentistry, (2019): 10.5005/jp-journals-10015-1616

INTRODUCTION

Successful endodontic treatment is determined by the radiographic and clinical normalcy of the periapical tissue.¹ Adequate access, perfect cleaning and shaping, and three-dimensional obturation are mandatory for successful root canal therapy. Evaluating the quality of obturation is a main assessment standard of the root canal therapy.

Technical quality of endodontic treatment is commonly assessed by radiographic evaluation.^{2,3} Quality of obturation is influenced by multiple factors; which include the relation of filling material to the radiographic apex, filling material density and canal taper. Sjogren et al. reported the best success rate when filling material terminated within 0–2 mm short of the radiographic apex.⁴ Root canal fillings with voids in the middle and apical thirds showed comparatively decreased survival rate.^{5,6}

Continuous tapering of the root canal apically from the orifice facilitates proper cleaning, shaping, and obturation.⁷ Schilder suggested a continuous tapering of root canal preparation while maintaining the anatomy of the root canal.⁸

Root canal therapy has become a routine general practice. Hence, the undergraduate students were trained to perform endodontic treatment. The undergraduate endodontic training program at King Khalid University is delivered in three different levels, which includes a preclinical training for 6 months and clinical training for 1 year, in lower and higher level 6 months each.

This study aimed to compare the quality of root canal obturation in the anterior and posterior teeth performed by the

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How to cite this article: Alobaid AS, Meerasahib MA, Alsafi ZA, Alamri FA, Mohammad AB, Alqaisi AY. Quality of Obturation Performed by Undergraduate Students Attending College of Dentistry at King Khalid University, Abha, Saudi Arabia. *World J Dent* 2019;10(2):119-122.

Source of support: Nil

Conflict of interest: None

undergraduate students at lower-level (junior) and higher-level (senior) attending College of Dentistry at King Khalid University (KKUCOD), Abha, Kingdom of Saudi Arabia.

MATERIALS AND METHODS

This retrospective study was carried out in KKUCOD. A random sample of 700 patient records from the academic period 2015–2017 was selected from both male and female campuses. Intraoral periapical radiographs of 460 teeth that had their RCT done at lower-level (junior) and higher-level (senior) students clinics were evaluated. The sample size of 460 was calculated according to a previous study done in the same area.⁹ Patients with medical records that did not include pre- or postoperative periapical radiographs, those for whom the endodontic treatment was not

completed, and those for whom the radiographic quality was poor were excluded. All periapical radiographs were downloaded from radiovisiography (RVG) records after obtaining IRB approval of the ethical committee in the college of dentistry. The final sample consisted of 143 anterior teeth, 169 premolars, and 148 molar teeth. In this sample, 186 teeth were treated by junior students and 274 teeth were treated by senior students. All root canal treatments were performed under the supervision of an endodontist of assistant professor grade with a staff to student ratio of 1:9. Teeth were isolated with a rubber dam, working length was determined by the radiographic method, cleaning and shaping was done using the step-back technique. Two percent (0.02) taper stainless steel K-files, 3% sodium hypochlorite solution and 17% EDTA were used during chemomechanical preparation. Cold lateral compaction was the method of obturation with gutta-percha and resin sealer (AH26). Treatment protocol followed was the same in both levels which follow the KKUCOD endodontic protocol as mentioned above.

Radiographs were evaluated by three independent, experienced endodontists. Inter and Intraexaminer reliability were tested on 24 periapical radiographs that were not included in the study. The collective agreement was (0.635: Kappa value) which is considered good.

Obturation quality was evaluated according to the criteria proposed by the American Association of Endodontics.¹⁰ We mainly focused on the relation of root canal filling material and radiographic apex as short, accepted, flush or overextended. Also, we evaluated the density of the filling and the presence of voids, as well as the adequacy of the root canal, filling taper¹⁰ (Table 1).

Procedural errors were evaluated according to the following:

- *Ledge formation*: Where the obturation material did not follow the original shape of the canal, e.g., a curved root canal with straight obturation.

Missed Canal

When a clearly missed canal is clear in the radiographs or when the filling material was not at the center of the root or when there is a radiographic indication for an extracanal or root.

Gouging

When the access cavity was overextended in any direction with unnecessary removal of the tooth structure that can be clearly seen in the radiographs.

- *Separated instrument*: When a small part of a file or an instrument can be seen as a radioopaque object occupying any part of the root canal system.
- *Perforation*: When there is a radiolucent area in the furcation area or a complete absence of the pulpal floor or when it can be seen on the side of the root canal system or at the apical region.

A comparative evaluation of the quality of obturation of the anterior, premolar, and molar teeth was performed, and the procedures were classified as adequate or inadequate according to the abovementioned criteria; if any of these criteria is marked inadequate or not acceptable, the obturation is considered inadequate.

Data were entered in an Excel sheet and sent for statistical analysis. Statistical package for social sciences (SPSS) statistical software (IBM Statistics Inc., Chicago, USA) was used for analysis. A beta error was set for 80% and alpha error (level of significance) was 5% (*p* value 0.05). Pearson's Chi-square test was used to evaluate levels of differences.

RESULTS

Table 2 showed obturation length percentages where it was 57% for junior students and 69.3% for senior students. Table 3 compared the density of root canal fillings between levels. A higher proportion of lower-level students performed inadequate density treatments compared to higher-level students. Table 4 shows that inadequate taper was significantly clear in root canal filling performed by junior students (26.3%) compared to senior students. Table 5 showed the overall adequacy of root canal obturation in different tooth types. According to tooth type, inadequate root canal filling was comparable between the two all students regardless of the student level in the anterior teeth and premolars. However, it was significantly inadequate in molars among the treatments performed by lower-level students. The incidence of procedural errors is shown in Table 6. Procedural errors were equally found in both levels without significant difference, with perforation being

Table 1: The criteria for the assessment of radiographic quality of root canal filling

Parameter	Criteria	Definition
Length of root canal filling	Adequate	Oburation is short of radiographic apex by 0–2 mm
	Inadequate	Obturation is shorter more than 2 mm or beyond the radiographic apex
Density of root canal filling	Adequate	No voids present in obturation
	Inadequate	voids present in obturation or between the filling and canal wall
Taper of root canal filling	Adequate	Consistent taper from the coronal to the apical part of the filling
	Inadequate	No consistent taper from the coronal to the apical part of the filling

Table 2: Comparison of length of root canal fillings among junior and senior students

Length	Junior (n = 186)		Senior (n = 274)		p value
	N	%	N	%	
Adequate	106	57.0	190	69.3	0.007*
Inadequate	80	43.0	84	30.7	
Total	186	100.0	274	100.0	

**p* value <0.01

Table 3: Comparison of density of root canal fillings among junior and senior students

Density	Junior (n = 186)		Senior (n = 274)		p value
	N	%	N	%	
Adequate	143	76.9	236	86.1	0.011*
Inadequate	43	23.1	38	13.9	
Total	186	100.0	274	100.0	

**p* value <0.05

Table 4: Comparison of taper of root canal fillings among students

Taper	Junior (n = 186)		Senior (n = 274)		p value
	N	%	N	%	
Adequate	137	73.7	234	85.4	0.002*
Inadequate	49	26.3	40	14.6	
Total	186	100.0	274	100.0	

*p value <0.005.

Table 6: Comparison of incidence of various type of errors between two groups of students

Type of error	Status	Level 9 (n = 186)		Level 11 (n = 274)		p value
		N	%	N	%	
Ledge	Present	6	3.2	4	1.5	0.202 NS
	Absent	180	96.8	270	98.5	
Gauging	Present	6	3.2	8	2.9	0.851 NS
	Absent	180	96.8	266	97.1	
Perforation	Present	15	8.1	11	4.0	0.065 NS
	Absent	171	91.9	263	96.0	
Missing canal	Present	3	1.6	5	1.8	0.999 NS
	Absent	183	98.4	269	98.2	
Fractured instrument	Present	2	1.1	2	0.7	0.999 NS
	Absent	184	98.9	272	99.3	

NS: statistically non-significant

the most commonly found error. Most of the errors were found in complicated cases such as obliterated pulp chambers, severely curved canals, calcified canals and canals with apical resorption or open apices.

A significantly higher proportion of junior students had inadequate density compared to senior students (*p* value <0.05). A significantly higher proportion of lower-level students had inadequate taper compared to higher-level students (*p* value <0.01). A significantly high proportion of junior students had inadequate filling compared to senior students in molar teeth (*p* value <0.001).

The distribution of incidence of various types of errors such as a ledge, gauging, perforation, missing canal, and the fractured instrument did not differ significantly between the two study groups for the anterior and premolar teeth.

DISCUSSION

The success of root canal treatment is highly dependent on the quality of obturation and final filling. Outcome and obturation quality studies can help improving endodontic teaching programs and successively the endodontic treatment by a general practitioner. In many studies, the radiographic evaluation method is used to assess the technical outcome of endodontic treatment.^{2,3,5} The criteria followed in our study to evaluate the quality of obturation was in accordance with the guidelines proposed by the American Association of Endodontics.¹⁰

Study subjects records were collected from lower-level and higher-level students treated cases and their radiographs were collected from the RVG data. The radiographs were taken by the students during routine root canal treatments. The radiographs

Table 5: Comparison of overall adequacy of root canal treatment according to different tooth type for all students

Tooth	Filling	Junior (n = 186)		Senior (n = 274)		p value
		N	%	N	%	
Anterior	Adequate	57	81.4	60	82.2	0.906 NS
	Inadequate	13	18.6	13	17.8	
Premolars	Adequate	39	55.7	69	68.3	0.093 NS
	Inadequate	31	44.3	32	31.7	
Molars	Adequate	20	43.5	71	71.0	0.001*
	Inadequate	26	56.5	29	29.0	

*p value <0.001, NS: statistically non-significant

were assessed by three qualified and experienced endodontists after establishing a consensus on the criteria for evaluation.

Previous studies state that obturation at 0–2 mm short of the radiographic apex has the best possible successful endodontic outcomes when compared to those performed far short or beyond the radiographic apex.^{6,11} Sjogren et al.⁴ and Smith et al.¹² had found that obturation within 0–2 mm from the radiographic apex reported the least post-endodontic diseases compared to those shorter than 2 mm of the radiographic apex.

The length of obturation was considered adequate in 57% of the teeth treated by junior students and 69.3% of the teeth treated by senior students. This was similar to some studies conducted by Kader et al.⁹ (50.7% for junior students and 69.3% for senior students) and Balto et al.¹³ (63.3% for the 4th year and 72.4% for the fifth year). It was comparatively superior to the other studies conducted by Alrahabi et al.¹⁴ (49.4%) and Lupipergurier et al.¹⁵ (39%).

Another factor investigated in the study was the density of obturation. Obturation with voids in between the filling and canal walls was considered as having inadequate density. Kirkevang et al.¹⁶ reported that root canal obturation with inadequate density leads to failure of treatment. In the present study, 76.9% of the teeth treated by lower-level and 86.1% of those treated by higher-level students had adequate density. The ratio of adequate restorations was greater than that in similar studies conducted by Al-Kahthaniet al.¹⁷ (55.3%) and Balto et al.¹³ (31.7% for the 4th year and 38.8% for the fifth year). The high proportion of obturation of adequate density in this study is attributed to the multiple radiographs taken by the students in between the procedure.

The percentage of adequate taper in our study was 73.7% for junior students and 85.4% for senior students, and this was higher than other studies such as Er et al.¹⁸ (68.3%) and Balto et al.¹³ (60.7% for the 4th year and 58.4% for the 5th year). This variation may be due to the more subjective assessment involved in evaluating this factor.

Procedural errors in root canal treatment jeopardize the outcome. Radiographically, it is difficult to depict all the procedural errors. In the present study, the procedural errors detected were comparatively lesser than that of similar studies by Barrieshi-Nusair et al.¹¹ and Yavari et al.¹⁹ The most common iatrogenic error found in this study was perforation, and it can be attributed to a small group of students who need more experience to improve their skills. Most of the errors were found in complicated cases such as obliterated pulp chambers, severely curved canals, calcified canals and canals with apical resorption or open apices.

Literature had shown variable percentages of root obturation quality performed by undergraduate students as low as 35% and as high as 80%.^{18,20–23} Such wide range in these studies is mainly

because of the different evaluation criteria chosen in each study. In the current study, the frequency of adequate obturation was more for the anterior teeth and premolars compared to the molars, for both levels of students. There is a statistically significant difference in the quality of obturation of molars between the two groups; higher-level students had 71% adequate restorations and lower-level students had 43.5% adequate restorations. This can be attributed to the higher-level students have more experience; however, all patients treated by undergraduates are expected to have the same high quality of endodontic treatment, regardless of the student's seniority.

To improve the treatment quality by undergraduate students and general practitioners in the future, it is recommended that junior students should have closer supervision, and case distribution is done according to the degree of difficulty. Simple cases requiring endodontic treatment (e.g., anterior teeth and premolars with straight canals) should be performed by lower-level students, whilst more complex cases (including molar teeth with a slight root curvature) should be referred to higher-level ones. Moreover, teeth that require procedures of a moderate or high level of difficulty should be referred to specialists. This will allow the junior dental undergraduates to gain adequate competency in managing simple cases prior to performing more complex cases of endodontic treatment.

This study encountered some limitations such as the retrospective design of the study. Another limitation is that a lot of missing radiographic records, in either procedure of working length or obturation, that required exclusion of such cases. Few cases were treated in both levels hence it was considered not accepted at first.

CONCLUSION

Despite the limitation of our study, it has shown that the quality of root canal filling performed by our undergraduate is acceptable and comparable to other undergraduate dental students across Saudi Arabia as well as worldwide. We recommend using crown down technique as well as rotary instrumentation training with close monitoring to increase the quality of treatment and decrease encountered errors. This will increase the success of treatment performed by general practitioners, reduce a load of referral to specialists and decrease the long waiting lists in dental service centers in Saudi Arabia.

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