Original Article

Root Canal Therapy

Quality of Root Canal Therapy (RCT) Performed by the Undergraduate Students at the Qassim University, Kingdom of Saudi Arabia (KSA)

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ABSTRACT

Objective: To evaluate the technical quality of root canal therapy using periapical digital radiographs performed by undergraduate dental students at the Qassim University College of Dentistry, Kingdom of Saudi Arabia.

Study Design: Retrospective study

Place and Duration of Study: This study was conducted at the college of Dentistry, Qassim University, Saudi Arabia from 2014-2017.

Materials and Methods: Digital periapical radiographs of endodontically treated teeth were collected to examine the parameters (length, density and taper) of root filling. The length of the root canal filling (RCF) was categorized as adequate, overfilled, and short to the radiographic apex. Density and tapering of the filling based on voids and uniform tapering from the orifice to the apex. Chi-square test was used to determine association between different variables. (tooth type, gender and year of student).

Results: The length of root canals fillings was acceptable in 89.6% (n=361) teeth. The poor density and tapering of RCF were more frequently found in premolars 26.1%, 22.8% respectively than molars and anterior teeth. The acceptable density of RCF was more in 5th year students and male students. The poor taper was significant in RCF performed by 4th-year students as compared to the 5th-year students (P = 0.013).

Conclusion: The radiographic quality of the root canal therapy performed by undergraduate students in the College of Dentistry, Qassim University has been found acceptable. However, there is a need to update the techniques of RCT at preclinical and clinical levels.

Key Words: Radiographic evaluation, root canal treatment, undergraduate students, digital radiography, technical quality.

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INTRODUCTION

According to European Society of Endodontology, the graduating students should be able to perform satisfactory nonsurgical RCT on single and multi-rooted teeth.[(1)]It has been found that standard and quality of RCT performed by general practitioners is poor. (2) One of the reasons for poor quality treatment in general practice may be inadequate clinical and preclinical training of under-graduate students.[(3)]

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There is a wide range between 13% -70% of good quality of endodontic therapy performed by undergraduate students.[(4-7)]

Several studies have shown that adequate root filling is associated with lower incidence of apical periodontitis, [(8-10)] so this factor has to be taken into account for evaluating the success of root canal therapy. Radiographic evaluation of technical quality of root canal treatment is determined by a number of factors. It includes length, density and taper. Obturation length 0-2mm from the radiographic apex is considered acceptable. Obturation density is considered adequate if the root filling is homogenous with no visible voids within or between the filling and the root walls (Fig-1).[(11)]

Many studies showed inadequate RCT performed by undergraduate students. [(3-7)] The objective of this study was to evaluate technical quality of RCT performed by undergraduate students in the dental clinics of college of dentistry in the Qassim University, KSA. No such study has been done before in this setting. It will help to assess the adequacy of clinical skills of students in Endodontics.

MATERIALS AND METHODS

After the approval from Ethical Review Committee, 543 dental records including periapical radiographs of patients treated by 4th year and 5th year students were retrieved during the academic period of 2014-2017. Radiographs with poor quality, incomplete data of the patients, patients under 18 years of age, Teeth with no coronal restoration were excluded. Final sample was consisted of 403 periapical radiographs. Two senior endodontists (DS, MZA) evaluated the quality of radiographs. Twenty one periapical radiographs not included in the study were used to calibrate the examiners agreement. With regard to the evaluation of the root canal filling length, density and taper, inter-examiner reliability was determined by computing Cohen's Kappa value. The k-values were (0.88 and 0.84 and 0.60) respectively that was adequate and acceptable. After that, the radiographs were examined. The parameters used to assess radio graphical quality of root fillings are length, density and taper, previously described by Barrieshi-Nusair, Al-Omari [3](Table-1).

The data were entered into the computer in an MS Excel sheet and exported to SPSS 21 (Chicago, IL, USA) software.) for analysis purpose. Chi-square analysis was used to determine association of the technical quality of RCT with different variables e.g. tooth type, gender and year of student. *P* value of less than 0.05 was considered statistically significant at 95% confidence interval.

RESULTS

The root filling length was adequate in 361 (89.6%) of 403 teeth (Table 2). The majority of acceptable working length fillings were observed in premolars teeth 39.7%, whereas 3.2% were over extended in anterior teeth. The association between the tooth type and length was not statistically significant ($P > 0.05$). No voids were present in 72 (17.9 %) teeth. There was statistically significant association between density of the filling among the different tooth groups $P < 0.05$. The poor density and tapering of the root canal filling were more frequent in premolars than other teeth with 26.1%, 22.8% respectively. (Table 2).

Table 3 showed the quality of root fillings done by 4th and 5th year students in relation to anterior and premolar teeth. We exclude the molar teeth from the comparison because it was done by 5th year students only. Thus, the sample consist 150 teeth done by 4th year and 176 teeth by 5th year. However, the higher proportion of root fillings of acceptable length and lower proportion of root fillings of adequate density were observed for both 4th and 5th year students. No significant difference was observed for the length and density in 4th and 5th year students while there was significant difference in the taper. The poor taper (P = 0.013) was more prevalent in cases of the 4th-year students compared to the 5th-year students.

Table No.1: The criteria to record information from radiographs.

Variable	**Criteria**	**Definition**
Length of root canal filling	Acceptable	Root filling ending <2 mm short of radiographic apex.
	Over	Root filling ending beyond the radiographic apex.
	Under	Root filling ending >2 mm short of radiographic apex.
Density of root canal filling	Acceptable	Uniform density of root filling without voids and canal space is not visible.
	Poor	Not uniform density of root filling with clear presence of voids and canal space is visible.
Taper of root canal filling	Acceptable	Consistent taper from the coronal to the apical part of the filling, with good reflect to canal shape.
	Poor	Not consistent taper from the coronal to the apical part of the filling.

Table No.2: The length, density and taper by tooth type

		Length			Density		Taper	
Tooth Type	Total	Acceptable	Over	Under	Acceptable	Poor	Acceptable	Poor
Anterior	149 37.0%	129‡ 32.0%	13 3.2%	7 1.7%	65* 16.1%	84 20.8%	79* 19.6%	70 17.4%
Premolar	177 43.9%	160 39.7%	7 1.7%	10 2.5%	72 17.9%	105 26.1%	85 21.1%	92 22.8%
Molar	77 19.1%	72 17.9%	3 0.7%	2 0.5%	48 11.9%	29 7.2%	54 13.4%	23 5.7%
Total	403 100.0%	361 89.6%	23 5.7%	19 4.7%	185 45.9%	218 54.1%	218 54.1%	185 45.9%

*** Statistical difference in density and taper between tooth type (P>0.05)**

‡ No statistical difference between tooth type and length of root filling (P<0.05)

Table No.3: The length, density and taper of root canal fillings in relation to the student's level.

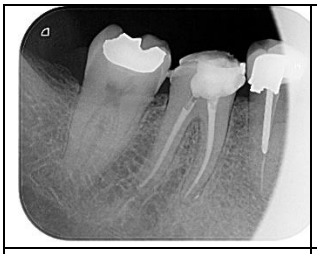
Student's level	Total	Length			density		taper	
		Acceptable	Over	Under	Acceptable	Poor	Acceptable	Poor
4th year	150 46.0%	133‡ 40.8%	10 3.1%	7 2.1%	57* 17.5%	93 28.5%	65* 19.9%	85 26.1%
5th year	176 54.0%	156 47.9%	10 3.1%	10 3.1%	80 24.5%	96 29.4%	99 30.4%	77 23.6%
Total	326 100.0%	289 88.7%	20 6.1%	17 5.2%	137 42.0%	189 58.0%	164 50.3%	162 49.7%

*** Statistically significant difference in density and taper among 4th year and 5th year students (P=0.009). (P=0.001) respectively.**
‡no significant difference in length between 4th year and 5th year students (P>0.05)

Table No.4: The length, density and taper of root fillings in male and female students

Student's gender	Total	Length			density		taper	
		Acceptable	Over	Under	Acceptable	Poor	Acceptable	Poor
Male	195 48.4%	174‡ 43.2%	11 2.7%	10 2.5%	99* 24.6%	96 23.8%	118* 29.3%	77 19.1%
Female	208 51.6%	187 46.4%	12 3.0%	9 2.2%	86 21.3%	122 30.3%	100 24.8%	108 26.8%
Total	403 100.0%	361 89.6%	23 5.7%	19 4.7%	185 45.9%	218 54.1%	218 54.1%	185 45.9%

- *** Statistically significant difference in density and taper between male and female students (P=0.03). (P=0.008) respectively.**
- **‡no significant difference in length between male and female students (P>0.05)**



a: Mandibular First Molar with acceptable length, taper and density.

b: Maxillary Right Central Incisor with poor taper and density of root filling.

c: Maxillary Right Central Incisor with over extended root filling.

d: Mandibular Second Molar with short root filling in distal canals.

Figure No. 1 Radiographic interpretation of teeth with adequate quality (a), Poor taper and inadequate density (b), Over extended root filling (c), and short root filling (d).

Table 4 shows comparison between male and female students according to the quality of root fillings. Density and taper has been found better in RCF performed by male students. It showed significance association in the density (P = 0.03) and taper (P = 0.00) of RCF done by male and female students, but no significant association existed in length of RCF done by male and female students, however overall percentage of acceptable length of RCF was more common in procedures done by female students (46.4%) than male students (43.2%).

DISCUSSION

Root canal therapy is one of the most important skill that students learn during their undergraduate course. The present study was conducted to assess the quality of root canal therapy performed by 4th year and 5th year students. Primarily three criteria, obturation length, density in terms of presence of voids and taper of the root filling were considered for evaluation. The root canal filling length is a much more reproducible quality parameter than others because it can be easily measured.[12] In the present study, the percentage of root fillings with acceptable length was 89.6%. This percentage were superior when compared with other studies 61.3%, 67.4%, 73%, 75%. [3, 13-15] This relatively high percentage may be the result of the fact that students use apex locator to estimate the working length along with the radiographs. Similar to some schools in Western Europe, Scandinavia and North America were routinely teaching the usage of electronic apex locators to aid in determination of working length.[16]

Radiographic density of root filling is one of the criteria used to estimate a potential defect of the root canal sealing.[17] Inadequate density may lead to failure of RCT due to micro leakage along the root filling. [12] Root fillings with homogenous mass of filling material and with no voids are strongly correlated with a lower

risk of post-treatment disease.[17] Similarly Erisen & Bjertness stated that prevalence of apical periodontitis was higher in root filled teeth with poor densities. [18] In this study, poor density in root canals (54.1%) had a higher percentage than other parameters. Poor density is an indication of lack of condensation of gutta percha. Obturation technique used by students in the Qassim university is cold lateral condensation.

Taper of the root filling is one of the most important factor considered for adequate quality of RCT. According to the European Society of Endodontology [1], the prepared root canal should be tapered from crown to apex. The importance of maintaining the original shape of a root canal during and after cleaning and shaping in order to promote periapical healing in endodontic cases has been demonstrated in several studies. [19] The clinician's inability to maintain the original shape and to develop the proper taper of canals can result in procedural errors such as ledges and perforations. The taper of root canals is a more subjective criterion that may explain why only a few reports have been published on this matter.[3] Adequate taper in this study has been observed in 54.1% of teeth. It was comparatively lower than the results of previous studies. Barrieshi-Nusair, Al-Omari [3, 4, 13]

Our percentage of overall quality was 26.8% less than the reports from Turkey (33%), Jordan (50%), and Libya (53.9%), (3, 4, 20) but greater than reports from Saudi Arabia (23%) and Rafeek et al.(10.9%). [13, 21] Although it is difficult to compare this finding with those of other studies because of the differences in outcome criteria used, sample sizes, and design. For example, when taper of the root canal filling was used as additional criteria for evaluation, the overall percentage of accepted root fillings was low.[13, 21] The type of teeth examined has a great impact on the results. Lynch and Burke used only single-rooted teeth and reported overall 63% fillings were judge to be accepted .[22] Root canal procedures at the college of dentistry, Qassim University are done under supervision of endodontics faculty. The preclinical endodontic training is delivered to students in the fourth year for six months with one-hour lecture and three hours' preclinical lab per week. Extracted human teeth are used for practice. At the end of each semester, students are required to pass a written exam and practical exam for complete root canal treatment in order to progress to the course. Preclinical practice is held by specialists in endodontics at a 1:10 teacher-to student ratio, which is comparable to other colleges. In Reims (France), Turkey and Cork University this ratio was 1:11, 1:10 and 1:8, respectively.[4, 6, 22] The students in our dental college use conventional manual techniques of root canal preparation (step-back & crown down) and cold lateral condensation technique for obturation. Studies have reported reduced errors during root canal treatment when students used rotary NiTi instruments compared to using conventional stainless-steel instruments[23, 24]

CONCLUSION

The radiographic quality of the root canal therapy performed by the undergraduate students in the College of Dentistry, Qassim University, Saudi Arabia, has been found comparable to other similar studies. However, there is need to improve curriculum and technical aspects of the endodontics in preclinical and clinical courses.

Recommendation: To enhance the clinical program of the undergraduates, changes can be in incorporated in the preclinical program.

- Increase staff-student ratio in preclinical training sessions
- Crown down technique and thermo-plasticized obturation technique
- Training for rotary instrumentation of the root canal system

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