Quality Assessment of Root Canal Treatment Performed by Dental Students at Western University, Thailand

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Abstract

Dental students should have quality to perform RCT efficiently. The assessment root canal treatment (RCT) performed by the dental students is important to improve the clinical skill and dental education.

The objective of this study was to access the quality of RCT performed by undergraduate dental students in Faculty of Dentistry, Western University, Thailand.

A retrospective was conducted at Faculty of Dentistry, Western University, Thailand to access the RCT performed by undergraduate students. After obtaining the ethical approval, the study was conducted from September till December 2017. Intraoral periapical radiographs of 120 patients (a total of 134 teeth) who were treated with RCT were studied by one Endodontist. The evaluation criteria of the RCT were root canal obturation length, obturation density (homogeneity), and obturation taper. Microsoft Excel 2010 and SPSS version 20 (IBM Company, Chicago, USA) were used for the descriptive statistics and expressed as mean and percentage. Chi-Square test (for nominal data) was done to see the significant difference (P <0.001) among unacceptable, slightly acceptable, acceptable, perfect length of RCT. Pearson's correlations will be done of length, density and taper of RCT with different teeth.

For the length of RCT, the majority of the root canal filling had good length of filling with perfect length 66 (49.3%) and acceptable length 59 (44%) but only 2 (1.5%) showed unacceptable length. For the density of RCT, 66 (49.3%) had perfect density and 59 (44%) had acceptable density of root canal filling but only 4 (3%) showed unacceptable density. For the taper of RCT, majority 121 (90.3%) showed perfect, 11 (8.2%) showed acceptable and 2 (1.5%) showed unacceptable. Finally, of 134 root canal treated teeth, 3 (2.24%) had unacceptable and slightly acceptable quality, 30 (22.39%) had treatment of acceptable quality, and 98 (78.13%) teeth had perfectly acceptable quality.

The quality of RCT performed by undergraduate students in Western University, Thailand was satisfactory to good. Still, to obtain more better results, emphasis can be given on the technical quality of RCT.

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Introduction

Retention of a natural teeth is becoming more popular in modern society due to increase in elderly population.[1] Hence, endodontic therapy, also known as root canal treatment (RCT) is becoming an increasingly routine part of general dental practice which is generally done for carious tooth involving pulp, trauma involving pulp, prosthetic enhancement, etc.[2,3] Success of RCT has been shown in the range between 53% and 94%.[4,5]

RCT consists of a combination of biomechanical instrumentation of the root canal system and obturation of the canals with an inert material designed to treat or prevent the development of AP in the periradicular tissue.[6] Obturation of the root canal seals it completely to prevent the ingress of bacteria and their toxins and their flow into the periapical tissues.[7]

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Schilder mentioned that the ideal root canal obturating material should be well adapted to the canal walls and its irregularities and that the entire length of the canal should be densely compacted with a homogeneous mass of gutta-percha.[8]

An association between root-canal-specific training as an undergraduate and improved quality of root canal obturation by dental graduates has been reported.[3,9,10] As the RCT is taught in undergraduate degree, it is necessary to evaluate the success rate of endodontic treatments performed by undergraduate students in Thailand. From various studies, it was also found that there were difficulties reported primarily by undergraduate students. In such cases, proper guidance of the students should be done in a simple working sequence that would provide an initial sense of achievement. This would allow students gain confidence in performing RCT. In other studies, the RCT performed were optimal. Hence, our study is aimed to evaluate the technical quality of RCT performed by undergraduate dental students at the Faculty of Dentistry, Western University, Thailand.

Materials and methods

A retrospective was done at Faculty of Dentistry, Western University, Thailand to access the RCT performed by undergraduate students. After obtaining the ethical approval, the study was conducted from September till December 2017.

Intraoral periapical radiographs of 120 patients (a total of 134 teeth) who were treated with RCT were studied by one Endodontist. The evaluation criteria were root canal obturation length, root canal obturation density (homogeneity), and root canal obturation taper from radiographs as mentioned by AlRahabi.[13] A specific score (0, 1, or 2) was assigned to each parameter. The interpretation of the intraoral periapical radiograph of the root canal treated cases was be done by one Endodontist.

Microsoft Excel 2010 and SPSS version 20 (IBM Company, Chicago, USA) were used for the descriptive statistics and expressed as mean and percentage. Chi-Square test (for nominal data) was done to see the significant difference (P <0.001) among unacceptable, slightly acceptable, acceptable, perfect length of RCT. Pearson's correlations will be done of length, density and taper of RCT with different teeth.

Results

The incidence of RCT related to age and gender in this study is shown in Tables 1 and they can be expressed in terms of mean and percentage (%).

	Number (n)	Percentage (%)
Age (years)		
• <20	13	9.70
• 20-30	26	19.40
• 31-50	50	37.31
• 51-70	41	30.60
• >71	4	2.98
Gender		
• Male	59	44
• Female	75	56

Table 1. Incidence of RCT related to age and gender.

It shows that more number of RCT was done in age range of 31-50 years (50, 37%) followed by 51-70 years (41, 30.60%). Least RCT was done in >71 years (4, 2.98%) followed by <20 years (13, 9.7%). Table 2 shows the distribution of RCT in different teeth. It was seen that the maximum number of RCT was done in upper incisors (69, 48.25%) followed by upper premolars (29, 20.27%), whereas, the least number of RCT was done in upper molars (1, 0.69%) and mandibular molars (2, 1.39%).

Tooth Type	Number (n)	Percentage (%)
Upper incisors	69	48.25
Lower incisors	6	4.20
Upper canines	10	6.98
Lower canines	4	2.79
Upper premolars	29	20.27
Lower premolars	13	9.09
Upper molars	1	0.69
Lower molars	2	1.39

Table 2. Distribution of RCT in different teeth.

Reasons	Number (n)	Percentage (%)
Dental caries	95	70.9
Trauma	15	11.2
Prosthetic reasons	2	1.5
Other causes	22	16.4

Table 3. Reason for the RCT.

Table 3 shows the reason for the RCT. Dental caries account for the highest (95, 70.9%) followed by others (22, 16.4%), trauma (15, 11.2%) and prosthetic reasons (2, 1.5%). The details of the pulpal and periodontal diseases in root canal treated teeth are presented in Table 4.

Reasons	Number (n)	Percentage (%)
Pulpal disease		
❖ Normal pulp	6	4.5
❖ Irreversible pulpitis	0	0
❖ Irreversible pulpitis		
• Symptomatic	12	9
• Asymptomatic	19	14.2
❖ Pulp necrosis	79	59
❖ Previously initiated therapy		
• With adequate RCF	11	8.2
• With Inadequate RCF	7	5.2
Periapical disease		
❖ Normal pulp	24	17.9
❖ Apical periodontitis		
• Symptomatic	57	42.5
• Asymptomatic	31	23.1
❖ Apical abscess		
• Chronic	18	13.4
• Acute	4	3

Table 4. Details of the pulpal and periodontal diseases in root canal treated teeth.

For pulpal disease, normal pulp was present in 6 (4.5%), symptomatic pulpitis in 19 (14.2%), asymptomatic pulpitis in 12 (9%), pulp necrosis in 79 (59%), previous initiated therapy with adequate root canal filling (RCF) in 11 (8.2%) and previous initiated therapy with inadequate RCF in 7 (5.2%). For periapical disease, normal pulp was present in 24 (17.9%), symptomatic apical periodontitis was present in 57 (42%), asymptomatic apical periodontitis in 31 (23.1%), acute apical abscess in 4 (3%) and chronic apical abscess in 18 (13.4%). The radiographic interpretation of the periapical region at follow up is shown in Table 5. The asymptomatic lesion was still present in 57% whereas, it was absent in 42.5%.

Periapical features	Number (n)	Percentage (%)
Absence of lesion	57	42.5
Presence of lesion	77	57.5

Table 5. Radiographic interpretation of the periapical region at follow up.

Aspects of RCT	Mean	Percentage (%)	P-value
A. Length of RCT			
• Perfect	66	49.3 %	
• Acceptable	59	44 %	<0.001
• Slightly Acceptable	7	5.2 %	
• Unacceptable	2	1.5 %	
B. Density of RCT			
• Perfect	109	81.3 %	
• Acceptable	21	51.7 %	<0.001
• Unacceptable	4	3 %	
B. Taper of RCT			
• Perfect	121	90.3 %	
• Acceptable	11	8.2 %	<0.001
• Unacceptable	2	1.5 %	

Table 6. Different aspects RCT (length, density and taper). Significant difference at P-value <0.05.

Table 6 shows different aspects RCT (length, density, and taper). For the length of RCT, majority presents perfect (66, 49.3%) and acceptable (59, 44%), whereas, less number presents unacceptable (2, 1.5%) and slightly acceptable (7, 5.2%). For the density of RCT, majority presents perfect (109, 81.3%) followed by acceptable (21, 51.7%) and unacceptable (4, 3%). Similarly, for the taper of RCT, majority presents perfect (121, 90.3%) followed by acceptable (11, 8.2%) and unacceptable (2, 1.5%). Chi-Square test (of nominal data) shows that there was significant difference (P <0.001) among unacceptable, slightly acceptable, acceptable, perfect length of RCT. In addition, there was significant difference among unacceptable, acceptable, perfect density and taper of RCT.

Average quality of RCT	Mean	Percentage (%)
Perfect	98	73.13 %
Acceptable	30	22.39 %
Slightly acceptable	3	2.24 %
Unacceptable	3	2.24 %

Table 7. Average quality of RCT length, density and taper.

Table 7 shows the average quality of RCT length, density and taper of RCT with different teeth. Of 134 root canal treated teeth, 3 (2.24%) had RCT of unacceptable and slightly acceptable quality, 30 (22.39%) had treatment of acceptable quality, and 98 (78.13%) teeth had RCT of perfectly acceptable quality.

	Length	Density	Taper	Tooth
Length	1	0.116 (0.183)	0.131 (0.132)	0.102 (0.239)
Density	0.116 (0.183)	1	0.163 (0.60)	0.018 (0.833)
Taper	0.131 (0.132)	0.163 (0.60)	1	0.075 (0.388)
Tooth	0.102 (0.239)	0.018 (0.833)	0.075 (0.388)	1

Table 8. Pearson's correlations of length, density and taper of RCT with different teeth. Significant Correlation at P-value <0.05.

Table 8 shows the Pearson's correlations with P-value of length, density and taper of RCT with different teeth. It shows that very weak positive correlation which was no significant (P >0.05) was found of RCT length, density, and taper with different teeth.

Discussion

This study is the first study done in Thailand to access the quality of RCT performed by undergraduate dental students in Faculty of Dentistry, Western University. An association between root-canal-specific training as an undergraduate and improved quality of root canal obturation by dental graduates has been reported.[3,9,16,18,19]

Burke et al.[11] highlighted that the length of root canal filling is the most important factor for survival of endodontically treated teeth. On the other hand, Chugal et al.[12] mentioned that the level of root canal preparation is important for treatment success but that preoperative diagnosis is the most important factor.

In this study, majority of the root canal filling had good length of filling with perfect length 66 (49.3%) and acceptable length 59 (44%) but only 2 (1.5%) showed unacceptable length. The results of our study are better compared to study done by Ilgüy et al.[13] in Turkish undergraduate students and, Moradi and Gharechahi[9] in undergraduate Iranian students. Ilgüy et al.[13] found only 54.2% acceptable length and 37.3% short, 7.8% overfilled, and 0.6% was unfilled; 2.5% were observed with broken root canal instruments. Moradi and Gharechahi[9] found only 38% of teeth had acceptable root canal filling but adequate length in 73% of teeth. AlRahabi[15] in Saudi undergraduate students found that 58 (22.4%) perfectly acceptable length of filling and 96 (37.1%) acceptable length of filling and 105 (40.5%) unacceptable length. But, Vukadinov et al.[15] in Serbian students found better results than ours, 89.73% of teeth had adequate length in their study.

Adequate density of root canal filling is an important factor for long-term success of endodontic treatment. In this study, 66 (49.3%) had RCT of perfect density and 59 (44%) had acceptable density of root canal filling but only 4 (3%) showed unacceptable density. The results of our study are similar to the study done by Moradi and Gharechahi[9] in Iranian undergraduate students. Moradi and Gharechahi[9] found adequate density in 66% of teeth and 38% of teeth had acceptable root canal filling. AlRahabi[14] in Saudi undergraduate students found that 118 (45.6%) perfectly acceptable density of filling and 113 (43.6%) acceptable density of filling and 28 (10.8%) unacceptable density of filling. But, Vukadinov et al.[15] in Serbian undergraduate students found better results than ours, 92.6% of teeth had adequate density.

For the taper of RCT, majority 121 (90.3%) showed perfect, 11 (8.2%) showed acceptable and 2 (1.5%) showed unacceptable. These results are better than the results found by AlRahabi[14] in Saudi undergraduate students. They found that 127 (49%) showed perfectly acceptable, 109 (42.1%) showed acceptable and 23 (8.9%) showed unacceptable. But, Awooda et al.[16] found better results; 60 (98.4%) acceptable, 1 (1.6%) unacceptable (poor) for the anterior teeth and 104 (92.9%) acceptable, 8 (7.1%) unacceptable (poor) for the posterior teeth.

Overall Quality of RCT

In this study, we found that majority of treated teeth 98 (78.13%) had RCT of perfectly acceptable quality, 30 (22.39%) had treatment of acceptable quality but, only 3 (2.24%) had RCT of unacceptable quality. The results of our study are better than the study done by AlRahabi[14] in Saudi dental students. They found that of 259 endodontically extracted teeth, only 29 (11.2%) teeth had RCT of perfectly acceptable technical quality, 42 (16.2%) had treatment of slightly acceptable technical quality, 50 (19.3%) had treatment of acceptable technical quality, and almost half, 138 (53.3%) had RCT of unacceptable technical quality. Vukadinov et al.[15] studied in Serbian dental students and found that adequate root canal fillings were found in 74.22% of the teeth. Fractured instruments and ledges were present in 16 root canals (2.8%), while the presence of missed canal and apical transportation was observed in 2 cases. Similarly. Khabbaz et al.[17] in Greek students found acceptable root fillings were found in 55% of canals. Table 9 shows the results of quality of RCT done by undergraduate dental students in different countries.

In this study, it was seen that the maximum number of RCT was done in upper incisors (69, 48.25%) followed by upper premolars (29, 20.27%), whereas, the least number of RCT was done in upper molars (1, 0.69%) and mandibular molars (2, 1.39%). Khabbaz et al.[17] found that more acceptable root fillings occurred in maxillary compared to mandibular teeth (58 and 51% respectively) and in anterior compared with premolar (71 and 61%) and molar root canals (39% respectively).

Ledges were noted in 55% of cases. AlRahabi[14] found that there were no significant differences in the technical quality of root canal obturation among types of teeth.

Study	Teeth	Population	Results
This study	134	Thai	98 (78.13%) perfectly acceptable quality, 30 (22.39%) acceptable quality, 3 (2.24%) slightly acceptable and unacceptable quality.
AlRahabi[14]	259	Saudi	29 (11.2%) perfectly acceptable quality, 42 (16.2%) slightly acceptable quality, 50 (19.3%) acceptable quality, and 138 (53.3%) unacceptable quality.
Vukadinov et al.[15]	322	Serbia	Adequate root canal fillings were found in 74.22% of the teeth. Fractured instruments and ledges were present in 16 root canals (2.8%), while the presence of missed canal and apical transportation was observed in 2 cases.
Khabbaz et al.[17]	734	Greece	Acceptable root fillings were found in 55% of canals. More acceptable root fillings occurred in maxillary compared to mandibular teeth (58 and 51% respectively) and in anterior compared with premolar (71 and 61%) and molar root canals (39% respectively). Ledges were noted in 55% of cases.
De Quadros[3]	579	Brazil	Success rate at 3 years follow-up ranged from 83 % to 96 %.

Table 9. Results of different studies on quality of RCT.

In our study, the RCT performed by undergraduate Thai dental students appear to be better compared to other studies shown in Table 9. This implies that the quality of RCT performed by undergraduate students in Western University, Thailand was satisfactory to good. Still, to obtain better results, emphasis can be given on the technical quality of RCT. Normally, for root canal instrumentation, the stepback technique using stainless steel K-files is used for teaching for undergraduate dental students in endodontics. This procedure should be used carefully as apical-to-coronal steps of this technique may cause procedural accidents (ledges, canal transportation, perforation), resulting in ineffective root canal obturation.[18] At present, NiTi rotary instruments are available in endodontic practice which has made easier for the cleaning and shaping of the root canals. Due to the flexibility of NiTi rotary systems, they cause less canal transportation and alteration of working length than do stainless steel instruments.

It is found that instrumentation techniques of RCT leave 35% or more of the root canal wall non-instrumented due to the oval shape of the apical third of the root canal wall. ProTaper system produces increased root canal diameter, volume and surface area when compared to manual instrumentation.[19] Maharti et al.[20] compared the non-instrumented area at the apical 3rd of the root canal wall after preparation using Reciproc® and WaveOne® oscillation instruments. They found no significant difference between the non-instrumented area at the apical 3rd of the root canal wall after instrumentation by Reciproc® and WaveOne®. Root canal walls instrumented by WaveOne® had less non-instrumented area. Following instrumentation, intracanal medicaments are used to eliminate the residual bacteria in a root canals. Odontopaste has shown better antibacterial efficacy against *Enterococcus faecalis* followed by chlorhexidine, propolis which showed partial antifungal efficacy against *Candida albicans*.[21] In addition, for better RCT, grape seed extract solution has shown a potency for cleaning the smear layer on apical 3rd of the root canal but need long term study.[22] Hence, newer techniques should be followed for the long-term prognosis of the root canal filling.

The dental curriculum should include teaching NiTi rotary instrumentation to undergraduate students.[23,24] Furthermore, Techniques for root canal filling also play important for the success of RCT. The vertical compaction method rather than lateral compaction and preventing extrusion of the obturation material and produces more homogeneous root canal obturation.[25]

The limitation of our study is, we studied only in one University students. The success of RCT in each tooth is not considered and the comparison of RCT in each tooth is also not considered. This study will give descriptive study on the success of root canal filling done by undergraduate Thai dental students. Future study can be done to study the success of RCT in each with the comparison of RCT in each tooth done by undergraduate Thai dental students.

Conclusions

The quality of RCT performed by undergraduate dental students in Western University, Thailand was satisfactory to good with adequate root canal filling length, taper and density. Still, to obtain more better results, emphasis can be given on the technical quality of RCT.

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Declaration of interest

The authors report no conflict of interest.

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