

Quality of Root Canal Fillings Performed by Undergraduate Students at the College of Dental Medicine, University of Sharjah, UAE

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Abstract

Aim: The aim of this study was to assess the technical quality of root canal fillings performed by undergraduate students in the first clinical case assigned to them in their clinical years at the College of Dental Medicine, University of Sharjah, UAE.

Material and Methods: Radiographs of 108 root canal treated teeth were examined to determine the quality of root canal fillings performed by undergraduate dental students on their first clinical case of endodontic treatment on a single-rooted tooth. Evaluations of the root-filled teeth were classified as being acceptable, under-filled or over-filled and with or without the presence of voids. The presence or absence of perforation and fractured instruments were also examined.

Results: Results showed that out of 108 teeth treated, 84 cases(78%) were classified as acceptable, 9 (8%) as under filled and 15 (14%) as overfilled respectively. 31 (29%) cases had voids present within the root canal filling and 85% of the root canal fillings showed good taper.

Conclusion: The learning experience provided to students through theoretical instructions and in-vitro laboratory exercises were able to achieve the expected clinical competency in endodontic for the novice general dental practitioners in undergraduate teaching clinics.

Keywords: Undergraduate; Dental education; Root filling; Endodontic treatment; Quality

Introduction

Endodontology is a mandatory educational requirement for the training of dental students, as described by the European Society of Endodontology [1-3]. These guidelines state that the graduating student will be expected to demonstrate the ability to perform satisfactory nonsurgical root canal treatment on single and multi-rooted teeth. This must include cleaning, shaping and appropriate filling of the root canal system. There are clear educational guidelines regarding the experience that dental undergraduates should ideally achieve in the area of root canal treatment, as stated in the General Dental Council [4]. The lack of time devoted to endodontology in the undergraduate curriculum, lack of specialist faculty supervising the students and the lack of frequent formative assessment at the undergraduate level may cast a doubt as to whether the student has achieved competency in performing root canal therapy or not [2]. Studies on vocational trainees' views of their undergraduate endodontic training reported that they were unhappy with their undergraduate experience in endodontics [5]. A review of literature indicates that the quality of root canal fillings performed by undergraduate and general dental practitioners (GDPs) is inadequate (Table 1).

Success or prognosis of root canal treatment has been shown to depend on many variables. Among these is the technical quality of the root canal filling [6,7] reported that the method of canal preparation and the length of the root canal filling relative to the radiographic apex significantly affect the success of conventional root canal therapy. More recently, [8] found that a higher success rate (87%) was associated with root fillings 2mm short of the radiographic apex compared to those that were greater than 2mm from the radiographic apex (77%). The correlation between the density of the root canal filling and the prognosis is not as clear as the proximity of root canal filling to radiographic apex. A couple of studies reported no difference in prognosis between adequately and inadequately compacted root canal fillings [9,10]. However, other studies have demonstrated

that root canal fillings with homogenous mass and with no voids are strongly co-related with a lower risk of post treatment disease [11,12]. Several other studies conducted to evaluate the prevalence of apical periodontitis and the technical quality of root canal fillings performed by the GPs showed poor root canal fillings performed by the GPs, and high incidence of apical periodontitis in root-filled teeth is often associated with inadequate root filling [13,14].

The current dental undergraduate curriculum observed a voluminous input of biological sciences for dental practice in the 21st century. Outcome of clinical competencies, derived from correct skills demonstrated in pre-clinical laboratories under controlled conditions is supported by theoretical knowledge of anatomy, physiology, pathology and endodontology. Pre-clinical exercises are the stepping stones for perfecting the mechanical skills in endodontics [15]. Students at our dental college begin their preclinical endodontic training in the third year of the program which is then continued in fourth and fifth year clinical program. The modes of learning in the third year begin with lectures followed by exposure to pre-clinical laboratory exercise at the end of the year where they perform complete endodontic treatment on single and multi-rooted extracted teeth before they are allowed to embark on clinical cases. Limited endodontic teaching received at dental schools may be the reason for relatively poor technical standards of root canal treatment among GDPs [16]. A study conducted in Trinidad reported that over 97% of general dental practitioners who responded wanted to attend continuing education courses in endodontics [17]. Therefore an investigation into the possible relationship between pre-clinical education in endodontics and the effectiveness of the clinical work performed by undergraduate students would be beneficial. The aim of this present study was to evaluate the effectiveness of pre-clinical educational approach in endodontics for undergraduate students at the our college, by examining the quality of their first root canal fillings done on single-rooted teeth in the clinical practice following pre-clinical laboratory exercises.

Author	Country	Practitioners	Total of treated Root Canal	No of acceptable canal (%)
Segura-Egea, et al. [6]	Spain	UGS	93	31 (34.4)
Eleftheriadis & Lambrianidis [7]	Greece	UGS	620	343 (55.3)
Lynch & Burke [3]	Ireland	UGS	100	63 (63)
Moussa-Badran, et al. [8]	France	UGS	304	92 (30.3)
Balto, et al. [9]	Saudi Arabia	UGS	550	125 (22.7)
Randa, et al. [10]	Sudan	UGS	172 (max. teeth) 92 (mand. Teeth)	92 (34.7) 10 (10.9)
Reisha [11]	Trinidad	UGS	288	29 (10.1)

Table 1: Epidemiological data on the quality of root fillings performed by undergraduate students (UGS) in different countries.

Materials and Methods

The data for this study was obtained from the work done by dental students on their first clinical case of root canal treatment on a single-rooted tooth, which was submitted as a case report upon completion including pre-operative, working length, master cone and the post-operative periapical radiographs. This study was done in accordance with the World Medical Association declaration of Helsinki. During the clinical procedure, an aseptic technique with rubber dam isolation was applied in all cases. To facilitate straight line access, Gates-glidden drills no 2,3 and 4 (Premier Dental, Norristown, PA, USA) were used in most cases. Working lengths were determined with the use of radiographs (Flow Dental X-ray films, USA) on Heliodentplus X-Ray machine. All canals were prepared by the step back technique with stainless steel K-files (Denstsply, Tulsa Okla, USA) of 0.02 taper and irrigation with 1% sodium hypochlorite solution using a syringe. Subsequently the root canals were filled with gutta percha and zinc oxide eugenol sealer (Kement, Associated Dental Products Ltd, England) using cold lateral compaction technique. All radiographs were taken using the bisecting angle technique.

A total of 112 reports were reviewed. The inclusion criteria for this selection were:

- The treatment was done by an undergraduate dental student
- The treatment was completed on a single -rooted tooth
- Post-obturation radiograph was present showing the entire length of the root

Out of 112 reports reviewed, the radiographs in 4 reports were of poor quality and therefore, were discarded. Demographic characteristics of the patients and the distribution of teeth treated by students were reviewed. The postoperative radiographs were viewed on an illuminated viewer box in a darkened room using 2.5X magnification. One examiner who is specialized in endodontics was calibrated and assessed the radiographs and recorded the information. The quality of the root fillings was evaluated according to the distance between the end of the filling and the radiographic apex, the density of the filling and the taper of the root filling as described by [6]. The quality of root canal fillings were classified as outlined in (Table 2). The presence or absence of perforations or fractured instruments and the quality of obturation were also recorded. Root perforation was diagnosed when extrusion of the filling material was detected at any area of a given root [18]. All the information was coded by a single operator and the data was analysed using SPSS software version 18.0.

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

Table 2: Criteria to assess the radiographic quality of the root filling.

Results

A total of 108 reports of patients were included in this study. 60% of the patients treated were males and about 60% of them were in the age group of 21 to 40 years old. Total radiographs examined were 108 in which 58 and 50 were maxillary and mandibular teeth respectively.

Notably, there were no cases of mandibular lateral incisor identified in this group of patients. On examining the radiographs, there was no evidence of fractured instruments within the root canal system. Radiographs showed 84 teeth (78%) were classified as acceptable, 9 (8%) were classified as under-filled and 15 (14%) were classified as overfilled (Fig.1). 31 teeth (29%) had voids

present within the root canal filling and 85% of the root canal fillings showed acceptable taper. Distribution of teeth in each classification is seen in (Table 3).

Discussion

Root canal treatment is a part of the undergraduate curriculum in most dental schools around the world and is now a “core skill” of the general dental practitioner (GDP). Although many GDPs may decline to do this procedure on teeth with complex anatomy like molars, most GDPs would perform this treatment in a single rooted tooth. Therefore, it is interesting and important to monitor the quality of root canal fillings performed by future GDPs. It is difficult to compare the results of this study with those performed in other educational institutions because of different criteria used in the evaluation, tooth type included, number of teeth examined, educational curriculum and different year students performed the treatment. In our study we only include the cases performed by fourth year students on their first clinical case after completion of theoretical lectures and laboratory exercises. Several other studies [14,19] examined cases performed by 4th and 5th year students. The type of teeth examined has a great impact on the result [13] reported slightly higher acceptable fillings detected in cases performed by the 5th year students (57%) as compared to cases performed by the 4th year students.

Undergraduate students in our college, complete a pre-clinical course in endodontics which begins in year 3 before commencing clinical endodontic training and treatment in year 4. During this course, students receive 12-14 hrs of lectures and gain 20-24 hrs of experience in the preclinical laboratory by the end of year 3. The pre-

clinical exercises performed by our students in the school is comparable to students from the UK where they receive 8hrs of lectures and 24 hrs of practical exercises, in Palestine 16 hours of lecture and 32 hours of practical [14]. However the number of hours for pre-clinical endodontic training is higher in Cork (48hrs), Western Continental Europe (38hrs) and North America (41hrs), [16]. The staff to student ratio for the our pre-clinical laboratory course is 1:8, which is comparable with the ratio in Dental School, Arab American University, Palestine (1:8), [14], University Dental School and Hospital, Cork (1:8) [3] & Scandinavia (1:9) [16,20,21]. However, in the clinical setting at undergraduates performing endodontic treatment are not always supervised by specialist practitioners. All patient contact occurs in large multidisciplinary clinics manned by a number of full-time academic and part-time general practice-based staff. Whilst in other countries, studies have shown that teaching of undergraduate endodontics is carried out by endodontic specialists. In the UK, it is normally performed by academic consultants with special interest in endodontics, accompanied by part time general dental practitioners [15]. At our institution, students use only hand instruments to prepare the canal space, and the working length determination is performed by the radiographic method. All the canals were prepared using the “step-back” technique. Most of the roots were relatively straight and none displayed excessive curvature. This technique is taught first to students and certain level of competency must be achieved before a student is taught more complex obturation techniques. The root canals were obturated using the lateral compaction technique with finger spreaders, standardized GP cones, accessory cones and zinc oxide eugenol sealer.

Tooth type	Acceptable		Underfilled		Overfilled		No voids		Taper		Total
	n	%	n	%	n	%	n	%	n	%	
Maxillary central incisors	13	12	2	2	3	2.8	13	12	15	13.9	18
Maxillary lateral incisors	9	8.3	1	1	2	1.9	8	7.4	10	9.3	12
Maxillary canines	14	13	0	0	2	1.9	13	12	10	9.3	16
Maxillary second premolars	10	9.3	0	0	2	1.9	10	9.3	9	8.3	12
Mandibular central incisors	3	2.8	1	1	1	0.9	5	4.6	4	3.7	5
Mandibular canines	3	2.8	0	0	0	0	0	0	3	2.8	3
Mandibular first premolars	11	10.2	0	0	3	2.8	8	7.4	12	11.1	14
Mandibular second premolars	21	19.4	5	5	2	1.9	20	18.5	22	20.4	28
Total	84	77.8	9	8	15	14.1	77	71.2	85	78.8	108

Table 3: Distribution of teeth in each classification.

The lack of using lentulo spirals to coat the canal walls with sealer and inadequate lateral compaction could explain the high percentage of voids in the filling (29%). The continuous taper from coronal to apical region was observed in 85% of the cases showing that circumferential filing with hand instruments was employed to prepare the canals. A study by [21] where an audit of root canal treatment by undergraduate students at the University of Wales, College of Medicine Dental School showed that only 13% of the teeth examined showed satisfactory root fillings in terms of both radiographic quality and distance of the root filling from the radiographic apex. A study by Chugal NM, et al. [22] at the School of Dentistry, Faculty of Medical Sciences, The University of West Indies also showed that the overall acceptability of the root fillings having adequate length, taper without voids and without any fractured instruments was found in 10.9% of the cases. In a similar study at the University of Khartoum, the percentage of acceptable root canal fillings performed by undergraduate students in relation to length, density and taper was found to be only 24.2% [23]. However, in a study by Kelbauskas, et al. [24], at the University of Medicine in Lithuania, they found that the root canal fillings performed by undergraduates were of good homogeneity in 71.4%.

Step back preparation and cold lateral compaction are the standard techniques that are taught to our undergraduate students. Recently [16] found that a number of schools in North America, Scandinavia and Western Europe have incorporated the use of Nickel titanium hand instruments into their routine pre-clinical teaching. When studies included the lateral adaptation of the root filling as criteria, there was a general agreement that if a void is present between the filling and the canal wall, the filling would be categorized as inadequate. Eckerbom & Magnusson [25] also demonstrated that reliability of one ortho radial radiograph was poor when evaluating the adaptation of the filling to the root canal walls. This should be evaluated in images with a mesial and distal angulation to get a realistic estimate of the quality of the filling. In our study the radiographs were taken without a mesial or distal shift. However, there is a demonstrated association between the technical quality of root fillings on bucco-lingual periapical radiographs and the outcome of root canal treatment [26,27].

The length of the root canal filling is a more reproducible quality parameter than lateral adaptation as it is easier to measure lengths than detect voids on a radiograph. The apical limit of the root canal has been a

topic of discussion for decades but most studies indicate that the apical constriction should be the apical limit of the root canal filling. In the present study, the length was acceptable in 77.8% of the teeth, which is higher compared to other studies - 10% [22], -22.7% [28] and also -55.3% [18]. This might be explained by the fact that this study was carried out only on single rooted teeth while other studies included both single rooted and multi-rooted teeth. One study showed that 63 root fillings out of 100(63%) performed by undergraduate students on single rooted teeth were considered acceptable [3]. In that study, which was similar to the present study, the evaluation of the technical quality of the root filling was performed on a small number of teeth with one straight canal. Although the ratio in the present study is higher, this does not reflect the real clinical skills of the undergraduate student because they also have to assess their skills in endodontic therapy of multi-rooted teeth. In this study, radiographic technique used in the estimation of the length of the filling was not reproduced accurately in the post-operative radiographs as those radiographs were taken by students using the bisecting angle technique. Fosberg [29] demonstrated that root fillings are projected shorter i.e. more coronally on the radiograph exposed with the bisecting angle technique than with the paralleling technique. This study however could have produced more valuable results if more than one examiner was employed as well [30,31].

One of the aims of all academic teachers is to improve knowledge and skills of students through improvement of the educational program. The quality of education is a result of many factors such as time devoted to theoretical and practical teaching and training in both pre-clinical and clinical, the supervisor to student ratio, the level of supervisor whether they are specialist endodontics or not, teaching and assessment method, etc. [13]. In order to enhance the clinical performance of undergraduate students in endodontics, changes have been made to the pre-clinical endodontic curriculum, which include better theoretical teaching and laboratory exercises and special training for staff that has interest in endodontic teaching. These changes have led to the following:

- a. Increase in the laboratory training time
- b. Improvement of the student-teacher ratio with the involvement of specialist endodontists in pre-clinical education.
- c. Application of contemporary endodontic instruments and devices such as NiTi rotary instrument systems and electronic apex locators

- d. Application of an assessment system composed of theoretical and practical exams on extracted teeth prior to entry into the clinical setting.

It will be of great interest to repeat the same research in the future to monitor the performance of undergraduate students in treating single and multi-rooted teeth using the modified educational protocol.

Conclusion

The quality of root canal fillings performed by undergraduate students at the College of Dental Medicine, University of Sharjah was classified as 'acceptable' in 77.8% of the cases which is higher than other studies. The learning experience provided to students through theoretical instructions and in-vitro laboratory exercises were able to achieve the expected competency in endodontics.

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