

Research Article

Analysis of root canal filling quality by undergraduate students

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Abstract

Root canal treatment is a multistep procedure, where each sequential step is dependent on the adequacy of the previous for its cumulative efficacy. The purpose of obturation of the root canals is to achieve hermetic sealing laterally, apically and coronally and to prevent the ingress of microorganisms.

The aim: of the present work is to analyze the quality of the root canal filling during endodontic treatment among undergraduate Bulgarian dental students during the academic year 22 /23.

Material and Methods: The radiographic criteria used for assessing RCF quality are: Length and Homogeneity of root canal filling. The object of this study is total of 272 root canal fillings in only the primary treatment performed by undergraded students. A part of the clinical case Root canal preparation of the teeth was performed using rotary endodontic NiTi instruments (ProTaper Gold) and root canals filled with corresponding calibrated gutta-percha points (Dentsply Sirona, Ballaigues, Switzerland. Another part of clinical cases the root canal preparation was performed using the step back technique and root canal filled with cold lateral condensation. Results for descriptive statistics were expressed as means and standard deviations (SD), frequencies and percentages.

Results: The total number of canals with overfilling length was 1,5% and those with underfilling length were 2,2% while total acceptable density of root filling was 97,8%.

Conclusion: Our study has shown that the quality of root canal filling performed by Bulgarian undergraduate students is high quality and acceptable and comparable to that of other undergraduate dental students.

Keywords: Root Canal Filling Quality, Undergraduate Students, Endodontic Treatment, Errors.

1. Introduction

The quality of the endodontic treatment is the basis for the favorable outcome of any treatment. The difficulties of root canal treatment and obturation procedures are directly related to the individual peculiarities of the endodontic anatomy of the respective clinical case, but also depend on the knowledge and experience of the clinician. . The studies have shown that the outcome of root canal treatment is dependent on the technical quality of the root canal filling [1]. This is especially true for dental students. Lack of in-depth knowledge of endodontic anatomy is the cause of frequent serious errors in providing correct endodontic access and locating root canal orifices [2, 3]. The purpose of obturation of the root canals is to achieve hermetic sealing laterally, apically and coronally and to prevent the ingress of microorganisms. The quality of the coronal restoration is also important factor, affecting the outcome of endodontic treatment. The quality of root canal filling (RCF) is influenced by multiple factors; which include the type of root canal shaping (hand or rotary techniques) and filling methods used, the quality of shaping

and the absence of iatrogenic errors, the relationship between the type of application filler material etc. Root canal treatment is a multistep procedure, where each sequential step is dependent on the adequacy of the previous for its cumulative efficacy [4]. According to Basmadjian-Charles et al [5]. The radiographic criteria for adequate obturation of the root canal system are: the prepared root canal should be entirely filled no voids should be noted along the root canal filling material and the canal walls and no canal space should be visible beyond the end-point of the root canal filling. Similar data were reported by other authors [6]. It was reported that the technical quality of root filling is the main cause of clinical failure [7]. Inappropriate sealing leads to bacterial invasion, and then bacteria can coronally or apically ingress into the root canals after endodontic filling leading to infection and finally then the failure of treatment.

The aim of the present work is to analyze the quality of the root canal filling during endodontic treatment among undergraduate Bulgarian dental students during the academic

year 22 /23. The last year of training for Bulgarian students is for a period of 6 months and includes internship practical training - mainly working with patients in the various dental disciplines.

2. Material and Methods

The object of this study is to evaluate the quality of the root canal filling performed by students in the last year of their study during the 22/23 academic year. The undergraduate students performed their clinical training mainly under the supervision of the teacher. The practical hours in conservative dentistry are 5 academic hours per week. In this period, the mandatory minimum amount of practical work performed for conservative disease treatment for each student includes the treatment of one endodontic clinical case. However, it is desirable to carry out vital extirpation and/ or retreatment in the three cases. In the present study, howev-

er, the filling quality of only the primary treatment was analyzed. Cases of retreatment are not subject to the search. The goal is to have reproducibility in scoring the criteria. The cases of retreatment can be associated with different natures of difficulties, broken down by the individual characteristics of each clinical case. According to the European Society of Endodontology (ESE) criteria, a root canal treatment is technically adequate if the working length is as close to the apex as possible, considering an apical constriction located at 0.5 to 2 mm from the apex, and if the canal is filled with a solid or semi-solid material and sealer. [8, 9].

The Evaluation of radiographs was made in accordance with the criteria reported by García-Guerrero, et al [10]. The radiographic criteria used for assessing RCF quality are presented in the table 1:

Table 1: Radiographic criteria used for assessing RCF.

1 Length of root canal filling
Acceptable -Root filling ending 0-2mm short of the radiographic apex;
Over - Root filling ending beyond the radiographic apex
Under - Root filling ending more than 2mm short of the radiographic apex.
2 Homogeneity of root canal filling
Acceptable - Uniform homogeneity of root filling without voids and canal space is not visible.
Poor - Not uniform homogeneity of root filling with a clear presence of voids and root canal walls are visible.

Two professors independently evaluated the radiographs taken at the end of the treatment by the undergraduate students.

The object of this study is total of 282 root canal fillings in only the primary treatment performed by undergraduated students. However, 10 root canal fillings were excluded and the final group involved 272 root canal fillings. Main reasons for the Exclusion criteria were incorrectly radiographic images. All patients had signed informed consent forms. A part of the clinical case Root canal preparation of the teeth was performed using rotary endodontic NiTi instruments (ProTaper

Gold) and root canals filled with corresponding calibrated gutta-percha points (Dentsply Sirona, Ballaigues, Switzerland. Another part of clinical cases the root canal preparation was performed using the step back technique and root canal filled with cold lateral condensation.

Results for descriptive statistics were expressed as means and standard deviations (SD), frequencies and percentages. The data are presented tabularly and graphically.

3. Results

The results are presented in the table 2 and diagram 1.

Table 2: Results

	Frequency	%
Underfilling		
Acceptable -Root filling	266	97,8
Under- Root filling	6	2,2
All treated root canals	272	100
Voids		
Acceptable -Root filling	266	97,8
Poor-Homogeneity	6	2,2
All treated root canals	272	100
Overfilling		
Acceptable -Root filling	268	98,5
Over- Root filling	4	1,5
All treated root canals	272	100

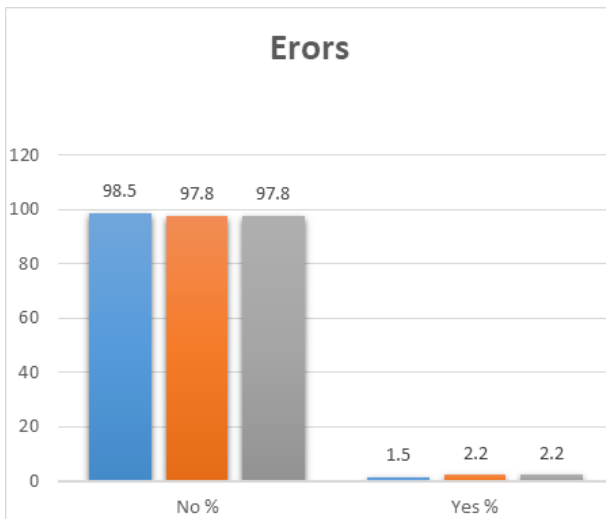


Figure 1: The quality of the root canal filling by undergraduate Bulgarian students.



Figure 2: Case of overfilling.

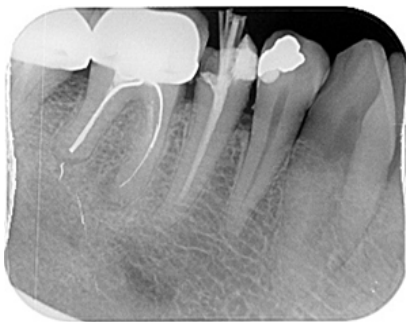


Figure 3: Case of underfilling.



Figure 4: Case of voids.

The total number of canals with overfilling length was 1,5% and those with underfilling length were 2,2% while total acceptable density of root filling was 97,8%. The highest acceptable density is probably due to the rotary instrumentation of the root canals and subsequent obturation with corresponding calibrated gutta-percha points [11]. The most frequent mistake made when using the lateral condensation method is the poor compaction of the used gutta-percha points to the walls of the root canals. It has been reported that cold lateral condensation was associated with more voids compared to other filling technique [12]. And the reason for overfilling the length of canal filling is the poor shaping of the apical stop zone.

4. Discussion

The technical quality of root preparation and obturation is an important indicator and this key skill is taught to dental students in their academic and clinical training. We are convinced that knowledge, and practical skills acquired during this period are transferred to a later period of independent dental practice. Therefore it is important and necessary to assess of the adequacy of the taught skills and knowledge of the graduates dental students. The program of conservative dentistry in Bulgaria includes a preclinical course, starting from the second year up to the third year and a clinical course starting from the fourth year. In the preclinical training the students perform endodontic treatment on extracted teeth from different groups.

The endodontic undergraduate clinical course in faculty of dental medicine in Sofia Bulgaria began in the six year of study. Students must have one clinical case of a patient with comprehensive practical restoration of oral health and treatment of all available pathologies in the patient's mouth. Before the treatment, a complex treatment plan is drawn up for the respective clinical case. This plan has been checked and approved by lecturers. The final result of the treatment is reported to a committee of lecturers in various areas of dental science. The technical quality of RCT plays a highly important role in healing outcomes and, consequently, in maintaining tooth functionality for a long time [13]. It should be noted that image ratings in this study were limited to intraoral radiographs that provide two-dimensional (2D) views, without buccal-palatal dimension and possibly take into account the risk of masking errors in root fillings in this plane by superimposing anatomical structures.

Underfilling of root canal obturation was resulted from inaccuracies in working length determination. The students were estimated the working length on the basis of an electronic apex locator X-ray alone without using control by X-ray. Underfilling results in voids in the apical region of the canal which subsequently provide spaces for bacterial colonization. The sealer extrusion plays an important role in the foreign body type reaction.

Undergraduate studies in Europe show a wide range of acceptable qualities, varying from 13 to 84,1% [14]. A possible reason for these differences is related to the different programs and hours of training. Literature had shown variable

percentages of root obturation quality performed by undergraduate students as low as 35% and as high as 80% [15, 16].

Our data show a high level of root canal filling quality in only the primary treatment. Similar data were also reported by others [17]. For the period between 2012 and 2014 quality of root canal filling performed by undergraduate students at the Federal University of Espirito Santo 93.8% of the cases the root canal filling was considered adequate. They find inadequate root canal density only in 3% of the cases. Our reported inhomogeneity of canal filling was only in 2,2%. According to Wen Yun Ng et al [18] were reported acceptable obturation quality was reported 71.3% by undergraduate students in the School of Dental Sciences, Universiti Sains Malaysia. They showed that the overall acceptable root canal obturation quality is significantly higher in maxillary arch (78.7%). A high rate of 54% of inadequate root canal filling was found by Lena IM, Diefenbach et al [19]. However, they report at a high rate 89% of the evaluated teeth presented a homogeneous root filling, the teeth after rotary preparation of the root canal. Similar conclusions have been established by other authors [20]. Alshehri T an Et al were found the clinical success of root canal filling made by V course students at 47.5%. Alshehri T A. Et al *Cureus* 15(1): e33483. DOI 10.7759/cureus.33483). And according to Agwan MAS, et al [21] the root canal therapy performed by undergraduate students in the dental clinics of Liaquat College of Medicine and Dentistry, Karach was found to be less than optimum in terms of technical quality (Agwan MAS, Sheikh A, Shaikh S. Qualitative analysis of root canal treatments performed by undergraduate students: a retrospective study. *Pesqui Bras Odontopediatria Clín Integr.* 2021; 21: e0260. <https://doi.org/10.1590/pboci.2021.156>) The adoption of engine-driven root canal preparation systems may affect the technical quality of treatments. Few studies have focused on that, and, therefore, there is little evidence that rotatory instruments favor the technical quality and outcome of RCT [22].

5. Conclusion

Our study has shown that the quality of root canal filling performed by Bulgarian undergraduate students is high quality and acceptable and comparable to that of other undergraduate dental students.

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