

# Evaluation of the quality of root canal treatment performed by undergraduate dental students

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## Abstract

**Aim:** The aim of this study is to retrospectively evaluate the quality of root canal treatments performed by fifth year undergraduate dental students at the Department of Endodontics, Faculty of Dentistry, Gaziantep University.

**Material and Methods:** A total sample of 584 records of patients was investigated. The technical quality of 523 root canal fillings providing criteria was evaluated according to the distance among the end of the filling and the radiographic apex, density of the filling and the quality of the obturation. All examined periapical radiographs were taken during the procedure. A root canal with acceptable quality was defined as having acceptable length and density.

**Results:** The highest quality in maxilla and mandible was found in incisors (64% and 64.8% respectively) and the lowest quality was found in molars (44.8% and 43.5% respectively). There was a statistically significant difference between the incisors and molars in the maxillary and mandibular jaws ( $p < 0.05$ ). The teeth with adequate length were 72.3% and the teeth with acceptable density were 64.4%. Overall 54.3% in all evaluated teeth were found to have a root filling of an acceptable quality.

**Conclusion:** In the radiographic evaluation of the canals treated by the students, the students performed better treatments in the anterior region compared to the molars. The quality of molar teeth was low and the total quality of the treatments was not at the desired level. Preclinical applications should be increased and more current techniques and equipment should be used in clinics to improve the total treatment quality, especially the treatment quality of molars.

**Keywords:** Dental radiography; root canal treatment; dental students.

## INTRODUCTION

Survival of natural teeth is a contemporary concern for all societies (1). For this reason, endodontic treatment have been gaining popularity in our day for both increased esthetic expectations of patients which can be provided by saving natural teeth and high cost of implant supported prosthesis (2).

The essentials of endodontic treatment are complete removal of all organic-inorganic tissue remnants from root canal system, shaping and disinfection of all canals, 3-dimensional obturation of this prepared space with an inert material (3). The outcomes of endodontic treatment are generally evaluated with conventional radiographs (4,5) while clinical and histological evaluations may provide further aid in cases of failure (6,7).

The quality of root canal obturation is important for the long-term success of the treatment (4,5). Previous studies stated that the apical position of filling material to

radiographic apex affect the success rate (8,9). Root canal filling coronal to radiographic apex more than 2 mm and over-fillings have been reported to reduce success rate (6). Furthermore, spaces and voids in root canal fillings, particularly in apical segments are directly proportional to the occurrence of periapical pathosis (10,11).

Latest retrospective studies regarding the success of endodontic treatment including different populations reported the rate of acceptable root canal fillings ranging between 26.5% and 55.3% (12–15). The success rates differ depending on the filling techniques and skill of the operators. High success rates are generally detected in treatments performed by specialists while the quality of fillings performed by general dental practitioners have been reported as low (20.8–31.2%) (16,17).

The aim of the present study is to evaluate the quality of root canal fillings performed by undergraduate, class 5 students of Gaziantep University, Faculty of Dentistry,

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Department of Endodontics by using radiographic records. The main purposes are to determine the factors reducing the quality of the treatment during the education course and to suggest necessary revisions leading to better dental education levels.

**MATERIAL and METHODS**

The study was approved by the Gaziantep University Clinical Trials Ethics Committee and the standards in the Helsinki Declaration were adhered to (Ethical committee resolution no: 2019/07, date 09.01.2019).

In this study, we evaluated the quality of root canal treatments by using the records of patients who had received endodontic treatment performed by the fifth-year undergraduate students at Department of Endodontics, Faculty of Dentistry, Gaziantep University between the years 2016 and 2017. Records of incomplete root canal treatments, significant angular differences between preoperative and postoperative radiographs, not including preoperative and postoperative radiographs and low radiographic quality were excluded. Radiography of visible post-operative images free-off any dimensional distortion and artifact were included. A total sample of 584 records of patients was investigated and 523 records of 523 patient providing these criteria were evaluated. Periapical radiography recordings were evaluated for more detailed examination.

In accordance with the asepsis rules, working length was determined by the periapical radiographs, teeth were instrumented with step back technique and root fillings were carried out with lateral compaction technique. All periapical radiographs were obtained with Acteon Sopro PSPX (France) intraoral phosphor screen scanner. Evaluation was performed independently by two endodontists in a dark room at x3 magnification, and a third endodontist was consulted when two endodontists disagreed and final agreement was reached. Evaluation criteria were based on the criteria of Barrieshi-Nusair et al. (13) (Table 1) which consider the distance of root canal filling to radiographic apex (length) and density of filling material. During the evaluation of multi-rooted teeth, each root canal was evaluated separately evaluations were based on the root canal with worst quality. Acceptable/adequate quality was defined as having acceptable length and density as shown in Table 1.

**Table 1. Length, density and quality of root canal treatments**

<b>Length</b>	
Adequate	Within 2 mm from radiographic apex
Extruded	Beyond the radiographic apex
Short	Coronal to radiographic apex more than 2 mm
<b>Density</b>	
Adequate	No radiographic space or voids
Inadequate	Spaces and/or voids can be observed radiographically
<b>Quality</b>	
Adequate	Enough length and density
Inadequate	Shorter in length and low density

**Statistical Analysis**

Statistical Package for the Social Sciences for Windows version 24.0 (IBM SPSS Corp.; Armonk, NY, USA) software package was used for statistical analyses. Chi-square test was used to determine the statistically significant differences between the length, density and quality of the root canal fillings in each group according to the location (maxillary and mandibular) and position (anterior and posterior). A P value of < 0.05 was considered as statistically significant.

**RESULTS**

In the maxilla and mandible, the highest number of treated teeth were respectively premolars (31.4%) and molars (40%), while the lowest number of treated teeth were canines (9.6-9.6%).

In Table 2 data is presented in terms of adequacy/inadequacy of quality including density, over filling and short filling. There was no statistical difference between the maxilla and mandible in terms of the quality of the treatments (p > 0.05). No significant difference was found between the same teeth groups. (p > 0.05).

When the all groups were compared, the quality of root canal fillings from the anterior to the posterior was decreasing. The highest quality in maxilla and mandible was observed in incisors (64-68.6%), and he lowest quality in molars (44.8-43.5%). There was a statistically significant difference between the incisors and molars in both the maxilla and the mandible (p < 0.05).

In terms of quality of the all treatments 54.3% of the teeth were found adequate, while 45.7% were inadequate.

**Table 2. Quality, length and density of fillings according to the type and position of teeth**

Type of teeth	N	Quality		Length			Density	
		Adequate	Inadequate	Adequate	Extruded	Short	Adequate	Inadequate
<b>Maxilla</b>	293							
Incisor	86 (29.3%)	55 (64%)a	31 (36%)	78 (90.7%)	5 (5.8%)	3 (3.5%)	67 (77.9%)	19 (22.1%)
<b>Canine</b>	28 (9.6%)	16 (57.1%)	12 (42.9%)	21 (75%)	1 (3.6%)	6 (21.4%)	18 (64.3%)	10 (35.7%)
Premolar	92 (31.4%)	48 (52.2%)	44 (47.8%)	67 (72.8%)	5 (5.4%)	20 (21.8%)	59 (64.1%)	33 (35.9%)
Molar	87 (29.7%)	39 (44.8%)b	48 (55.2%)	48 (55.2%)b	7 (8%)	32 (36.8%)	44 (50.6%)	43 (49.4%)
<b>Mandibula</b>	230							
Incisor	70 (30.4%)	48 (68.6%)a	22 (31.4%)	59 (84.3%)	5 (7.1%)	6 (8.6%)	57 (81.4%)	13 (18.6%)
Canine	22 (9.6%)	13 (59.1%)	9 (40.9%)	17 (77.3%)	2 (9.1%)	3 (13.6%)	16 (72.7%)	6 (27.3%)
Premolar	46 (20%)	25 (54.3%)	21 (45.7%)	37 (80.5%)	2 (4.3%)	7 (15.2%)	28 (60.9%)	18 (39.1%)
Molar	92 (40%)	40 (43.5%)b	52 (56.5%)	51 (55.4%)	7 (7.6%)	34 (37%)	48 (52.2%)	44 (47.8%)
<b>TOTAL</b>	523 (100%)	284(54.3%)	239 (45.7%)	378 (72.3%)	34 (6.5%)	111 (21.2%)	337 (64.4%)	186 (35.6%)

Data with different lowercase letters (a, b) indicate statistically significant differences (p < 0.05).

## DISCUSSION

In the present study, the quality of root canal fillings performed by undergraduate – class 5 students between years 2016-2017 at Gaziantep University Dentistry Faculty, Department of Endodontics was evaluated by using periapical radiographs. All periapical radiographs taken during the routine procedures of the treatment were randomly selected and are not special to the present study. Because panoramic radiographs are not detailed and thus may lead to misevaluations (18), periapical radiographs were preferred.

Many of the previous studies considered the length of root canal filling materials 0-2 mm to radiographic apex as adequate (5,6). On the contrary, Helminen et al. (19) accepted root canal filling at a distance of 0-3 mm to radiographic apex as adequate. We preferred to consider the apical plugs 0-2 mm to radiographic apex as high quality obturation, thus the criteria stated by Barrieshi-Nusair et al. (13) were used.

Root canal treatment performed by general dental practitioners worldwide may sometimes not fulfill the scientific criteria (20–22). Researchers correlated this situation to some little gaps in endodontic education which directs the daily practice of the clinicians (23). Thus, it can be stated that updating of endodontic education involvements in the direction of current data may be beneficial.

In the present study, 72.3% of vertical dimension (adequate length) of the root canal fillings was normal. Although a direct comparison is not possible due to different samples sizes and type of teeth included, this result may be considered as accordant with previous studies which found rates of 69% (24), 69.6% (15) and 70% (25) vertical success. Short and extruded fillings were found 21.2% and 6.5% respectively. Shorter fillings were detected in maxillary molars (36.8%) and mandibular molars (37%). Extruded fillings were detected in maxillary molars (8%) and mandibular canines (9.1%). The rate of completely condensed fillings without any voids is 64.4% which is lower than Eleftheriadis et al. (14) (82.6%) and Barrieshi-Nusair et al. (13) (72.6%) but higher than Er et al. (15) (%53.2%). Spaces and voids were most frequent in the maxillary molars (49.4%) and mandibular molars (47.8%). Both vertical insufficiency and density failures were found in molar teeth. This may be related to harder negotiability of multi-rooted posterior teeth compared to incisors. This may further lead to insufficient application of finger spreaders or inaccurate placing of accessory gutta-percha cones.

Studies dealing with the quality of root canal fillings radiographically considered mainly apical limit and density of filling materials. The present study found canal filling with both adequate vertical position and density to be 54.3%. These results are in accordance with Eleftheriadis et al. (14) (55%), higher than Hayes et al. (23) (13%) and Barrieshi-Nusair et al. (13) (47.4%), lower than Benenati et

al. (26) (91.05 %) and Lynch (25) (63%). Highest quality canal fillings were performed in maxillary and mandibular incisors (68.69 -64% respectively) while the worst results were found in mandibular molars (43.5%) and maxillary molars (44.8%).

Radiographic evaluation in the present study revealed that the quality of root canal treatments performed by undergraduate students seems low. Both theoretical and practical education methods should be advanced. Preclinical and clinical courses may be extended. Undergraduate students should be encouraged to use novel equipment and systems. By this way, interns will deal with more cases.

## CONCLUSION

Within the limitations of the present study, undergraduate students were found to be more successful in performing single rooted treatments compared to molars. Quality of root canal fillings should be improved. The present study considered radiographic outcomes for the evaluation of root canal filling which may not be always in consistent with clinical success or non-success.

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## REFERENCES

1. Daly RM, Elsner RJF, Allen PF, et al. Associations between self-reported dental status and diet. *J Oral Rehabil* 2003;30:964-70.
2. Legan JJ, Brown CE. Instrumentation enhances today's endodontic care. *J Indiana Dent Assoc* 1998;77:30-4, 37-8, 40-1.
3. Schilder H. Cleaning and shaping the root canal. *Dent Clin North Am* 1974;18:269–96.
4. Kerekes K, Tronstad L. Long-term results of endodontic treatment performed with a standardized technique. *J Endod* 1979;5:83–90.
5. Saunders WP, Saunders EM, Sadiq J, et al. Technical standard of root canal treatment in an adult Scottish sub-population. *Br Dent J* 1997;182:382–6.
6. Peak JD, Hayes SJ, Bryant ST, et al. Endodontics: The outcome of root canal treatment. A retrospective study within the armed forces (Royal Air Force). *BDJ* 2001;190:140–4.
7. Lin LM, Pascon EA, Skribner J, et al. Clinical, radiographic, and histologic study of endodontic treatment failures. *Oral Surgery Oral Med Oral Pathol* 1991;71:603–11.
8. Sjögren U, Hägglund B, Sundqvist G WK. Factors affecting the long-term results of endodontic treatment. *Mater Sci Technol* 2016;32:675–83.
9. Smith CS, Setchell DJ, Harty FJ. Factors influencing the success of conventional root canal therapy—a five-year retrospective study. *Int Endod J* 1993;26:321–33.
10. Cheung GS. Survival of first-time nonsurgical root canal treatment performed in a dental teaching hospital. *Oral Surgery Oral Med Oral Pathol Oral Radiol Endod* 2002; 93: 596-604.

11. Chugal N, Clive J, Spångberg L. Endodontic infection: Some biologic and treatment factors associated with outcome. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2003;96:81–90.
12. Kirkevang L-L, Orstavik D, Horsted-Bindslev P, et al. Periapical status and quality of root fillings and coronal restorations in a Danish population. *Int Endod J* 2000;33:509–15.
13. Barrieshi-Nusair K, Al-Omari M, Al-Hiyasat A. Radiographic technical quality of root canal treatment performed by dental students at the Dental Teaching Center in Jordan. *J Dent* 2004;32:301–7.
14. Eleftheriadis GI, Lambrianidis TP. Technical quality of root canal treatment and detection of iatrogenic errors in an undergraduate dental clinic. *Int Endod J* 2005;38:725–34.
15. Er Ö, Sagsen B, Maden M, et al. Radiographic technical quality of root fillings performed by dental students in Turkey. *Int Endod J* 2006;39:867–72.
16. Boucher Y, Matossian L, Rilliard F, et al. Radiographic evaluation of the prevalence and technical quality of root canal treatment in a French subpopulation. *Int Endod J* 2002;35:229–38.
17. Basmadjian-Charles C, Bourgeois D, Coudeville L, et al. National survey of endodontics in general dental practice in France. *Eur J Prosthodont Restor Dent* 2004;12:144–53.
18. Flint DJ, Paunovich E, Moore WS, et al. A diagnostic comparison of panoramic and intraoral radiographs. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 1998;85:731–5.
19. Helminen SE, Vehkalahti M, Kerosuo E, et al. Quality evaluation of process of root canal treatments performed on young adults in Finnish public oral health service. *J Dent* 2000;28:227–32.
20. Weiger R, Hitzler S, Hermle G, et al. Periapical status, quality of root canal fillings and estimated endodontic treatment needs in an urban German population. *Dent Traumatol* 1997;13:69–74.
21. Jamani KD, Fayyad MA. A radiographic study of the prevalence of endodontically treated teeth and procedural errors of root canal filling. *Trop Dent J* 2005;28:29–33.
22. Pettigrew LK, Jauhar S, Lynch CD, et al. An audit of the quality of root canal treatments performed by undergraduate dental students on single-rooted teeth in Glasgow dental hospital and school. *Eur J Prosthodont Restor Dent* 2007;15:72–6.
23. Hayes SJ, Gibson M, Hammond M, et al. An audit of root canal treatment performed by undergraduate students. *Int Endod J* 2001;34:501–5.
24. Moussa-Badran S, Roy B, Bessart du Parc AS, et al. Technical quality of root fillings performed by dental students at the dental teaching centre in Reims, France. *Int Endod J* 2008;41:679–84.
25. Lynch CD, Burke FM. Quality of root canal fillings performed by undergraduate dental students on single-rooted teeth. *Eur J Dent Educ* 2006;10:67–72.
26. Benenati F, Khajotia S. A radiographic recall evaluation of 894 endodontic cases treated in a dental school setting. *J Endod* 2002;28:391–5.