

Radiographic Assessment of The Root Canal Obturation Performed by Interns in Patients Visiting a Dental Teaching Hospital of Kathmandu

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ABSTRACT

Introduction: Root canal treatment aims to retain natural teeth by eliminating infection and achieving three-dimensional obturation. Evaluating the radiographic quality of obturation performed by dental interns helps assess clinical competence and identify areas for educational improvement.

Objective: This study aims to evaluate the radiographic quality of root canal obturation performed by interns in patients visiting a dental teaching hospital in Kathmandu.

Methodology: An analytical cross-sectional study was conducted in the Department of Conservative Dentistry and Endodontics, Nepal Medical College Hospital, from August 2024 to July 2025. A total of 240 radiograph was evaluated for obturation length, density, and taper. Data were analysed with a Chi-square test to find an association between parameters and tooth type, arch, and location.

Result: Among 240 evaluated teeth, 38.8% showed perfectly acceptable obturation quality, while 4.6% were totally unacceptable. Mandibular teeth (82.6%) exhibited better obturation quality than maxillary teeth (67.2%). Anteriors demonstrated better obturation length (96.3%) compared to posteriors (84.2%). Acceptable density was (92.7%) in anteriors and (94.3%) in posteriors, while acceptable taper was (92.7%) in anteriors and (90.5%) posteriors.

Conclusion: The radiographic quality of root canal obturation was satisfactory, although improvements are still needed.

Keywords: Dental interns; endodontic treatment; obturation; radiographic assessment.

INTRODUCTION

Root canal treatment is a dental procedure done for the retention of natural teeth with carious involvement extending to pulp, trauma with pulp involvement or for prosthetic enhancement.¹ Reinfection of the root canal can be prevented by eliminating bacteria and their toxins from necrotic and gangrenous canals through biomechanical instrumentation, disinfection and air-tight obturation.² The final objective of root canal obturation is to fill the root canal space irregularities completely.³ Teeth with adequately filled root canals show lower incidence

of persistent apical periodontitis, making the quality of root canal fillings a critical factor in ensuring the long-term success and longevity of root canal treated teeth.⁴

Citation

Joshi B et al. Radiographic Assessment of The Root Canal Obturation Performed by Interns in Patients Visiting a Dental Teaching Hospital of Kathmandu. J Nepal Dent Assoc. 2025 Jul-Dec;25(41):20-8.

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The outcome of endodontic therapy is multifactorial which is assessed by the radiographic quality of root canal obturation, or in combination with clinical and histological assessments.⁵ Training undergraduate students for endodontic treatment procedure is one of the most complicated and challenging tasks for faculty, as it requires integrating knowledge and skills to build clinical competence.⁶ Despite supervision, studies report that the quality of undergraduate endodontic treatment is often poor.^{1,2,7,8}

A study conducted in Bangladesh have shown that 41.7% cases of root canal treatments were of excellent quality, whereas 20.6% were completely unacceptable.⁹ Another study from Pakistan found 34.9% of root canal filling were of acceptable quality.¹⁰ In the context of Nepal, 66.3% of apical periodontitis cases were associated with inadequately filled root canals.¹¹

Since root canal therapy is taught at the undergraduate level and graduates are expected to perform it independently, evaluating the performance and success rate of treatments done by interns is essential. Such assessment helps to provide appropriate guidance and builds students' confidence while performing root canal therapy. Thus, this study aims to evaluate the radiographic quality of root canal obturation performed by interns on patients visiting a dental teaching hospital in Kathmandu.

METHODS

An analytical, cross-sectional study was conducted in the Department of Conservative Dentistry and Endodontics, Nepal Medical College Hospital from August 2024 to July 2025.

Sample size was calculated as,

$$\begin{aligned}\text{Sample } n &= \frac{Z^2pq}{d^2} \\ &= \frac{(1.96 \times 1.96 \times 0.193 \times 0.807)}{(0.05 \times 0.05)} \\ &= 239.33 \text{ (approx. 240)}\end{aligned}$$

Where, Z=1.96 at 95% confidence interval,

P = 19.3% (proportion of teeth with RCT of acceptable technical quality taken from a study by AlRahabi et al.¹²),

$$q = 1 - p,$$

$$d = 0.05 \text{ (margin of error).}$$

Data were collected from the root canal treatment procedures performed by trained interns in the Department of Conservative Dentistry and Endodontics. Ethical approval was obtained from the Institutional Review Committee of Nepal Medical College (Ref no:02-081/082) and informed consent was obtained from all the participants.

The root canals were prepared using stainless steel K-files (VIDEYA, Huizhou) with the step-back technique. All the root canals were obturated using the lateral compaction technique using gutta percha points (VIDEYA, Huizhou) and epoxy resin-based AH-26 sealer (DENTSPLY). The radiographic procedure was performed using a dental X-Ray Unit (New life wall mount Radiology, Italy) at 70kVp, 8mA, 230V, operating frequency 50KHz and exposure time 0.032S on the Photo Stimulable Phosphor. Periapical radiographs of teeth were obtained using the bisecting angle technique. The radiographs were assessed by two endodontists who had undergone prior discussion to ensure uniform understanding of radiographic assessment of parameters to evaluate root canal obturation.

The radiographs without the entire length of the root and 2 mm of the periapical region visible clearly and incomplete endodontic treatment were excluded from the study. Patients less than 18 years of age and physically or mentally challenged patients were excluded.

For the radiographic assessment of the technical quality of root canal fillings, the scoring criteria for the parameters (length, density and obturation) to evaluate root canal obturation and quality categories of root canal treatment were evaluated as in Table 1.¹² For the length, density and taper, scores were interpreted as 0 (unacceptable), 1 (acceptable) and 2 (perfect).

Table 1: Parameters used to evaluate root canal obturation

Parameter	Definition	Score
Length of root canal obturation	Root filling ending >2 mm short of the radiographic apex (under-filling)	0
	Root filling ending beyond the radiographic apex (over-filling)	0
	Root filling ending at the radiographic apex (tip-to-tip) or 1-2 mm shorter than the radiographic apex	1
	Root filling ending 0.5-1mm short of the radiographic apex (adequate)	2
Density of root canal obturation	Inhomogeneous root canal obturation with several visible voids	0
	Root canal obturation with only one visible void	1
	No void present in the root canal obturation	2
Taper of root canal obturation	Not consistently tapered from the apex to the coronal part (over-or-under-shaped)	0
	Not enough taper	1
	Consistently tapered from the apex to the coronal part (adequate)	2

The quality of root canal treatment was further calculated as: cases with 0-2 points (totally unacceptable), cases with 3 points with a length score of 0 (unacceptable), cases with 3-4 points with a length score of 1 (slightly unacceptable), cases with 3 points with a length score of 1 or 2 (neutral), cases with 4 points with a length score of 1 or 2 (slightly acceptable), cases with 5 points (acceptable) and cases with 6 points (perfectly acceptable).

Data was entered into Microsoft Excel and then exported to Statistical Package for the Social Sciences (SPSS) Version 20 for statistical analysis. Descriptive statistics were presented in the form of frequency and percentage. Chi-square test was used to find the association of length, density and taper of root canal filling with arch and location of the

teeth and gender. Level of significance was set at p-value <0.05.

RESULTS

A total of 240 endodontically treated teeth were included in the study, of which most of them were maxillary and mandibular premolars (62(52.1%) and 63(52%) respectively). There was a total of 119(49.5%)maxillary teeth, 121(50.4%)mandibular teeth, of which 82(34.1%) were anterior (incisors and canines) and 158(65.8%) were posteriors (premolars and molars) (Figure 1).

Of all, a greater proportion of the lower canines had perfect length (90.0%) and density (80.0%) of root canal obturation. All the lower canines had a perfect taper of root canal obturation (Table 2).

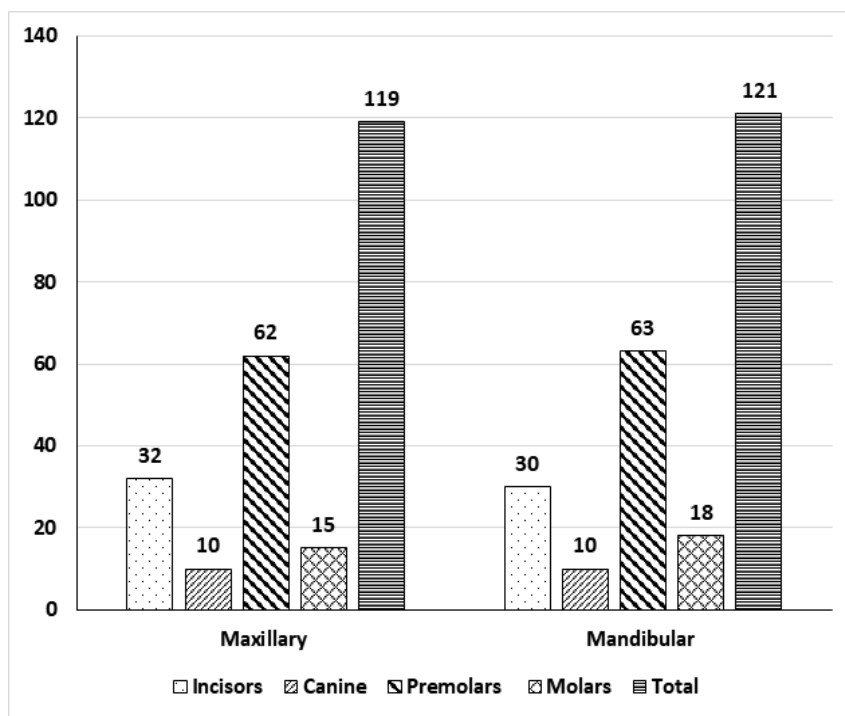


Figure 1: Distribution of endodontically treated teeth according to tooth type

Table 2: Distribution of endodontically treated teeth according to length, density and taper score

Teeth type	Length score n (%)			Density score n (%)			Taper score n (%)		
	0	1	2	0	1	2	0	1	2
UI	1 (3.1)	8 (25.0)	23 (71.9)	1 (3.1)	13 (40.6)	18 (56.3)	3 (9.4)	9 (28.1)	20 (62.5)
LI	1 (3.3)	9 (30.0)	20 (66.7)	1 (3.3)	6 (20.0)	23 (76.7)	-	7 (23.3)	23 (76.7)
UC	1 (10.0)	5 (50.0)	4 (40.0)	3 (30.0)	4 (40.0)	3 (30.0)	3 (30.00)	2 (20.0)	5 (50.0)
LC	-	1 (10.0)	9 (90.0)	1 (10.0)	1 (10.0)	8 (80.0)	-	-	10(100.0)
UPM	11 (17.7)	18 (29.0)	33 (53.3)	5 (8.1)	21 (33.8)	36 (58.1)	10 (16.1)	20 (32.3)	32 (51.6)
LPM	9 (14.3)	7 (11.1)	47 (74.6)	3 (4.8)	10 (15.9)	49 (79.3)	2 (3.2)	7 (11.1)	53 (85.7)
UM	3 (20.0)	7 (46.7)	5 (33.3)	1 (6.7)	4 (26.7)	10 (66.7)	2 (13.3)	3 (20.0)	10 (66.7)
LM	2 (11.1)	4 (22.2)	12 (66.7)	-	4 (22.2)	14 (77.8)	1 (5.6)	3 (16.7)	14 (77.8)
All Teeth	28 (11.7)	59 (24.6)	153 (63.8)	15 (6.3)	63 (26.3)	162 (67.5)	21 (8.8)	51 (21.3)	168 (70.0)

UI: upper incisors, LI: lower incisors, UC: upper canine, LC: lower canine, UPM: upper premolar, LPM: lower premolar, UM: upper molar, LM: lower molar, Scores 0: Unacceptable, 1: Acceptable, 2: Perfect

Of the total, 11 (4.6%) had RCT of totally unacceptable quality and 93 (38.8%) had RCT of perfectly acceptable quality. Among all the teeth, lower canines (7, 70.0%) were found to have the highest rate of perfectly acceptable quality of

endodontic treatment followed by lower premolars (35, 55.6%). The highest rate of totally unacceptable radiographic quality was found to be for upper canines (4, 40.0%) followed by upper premolars (4, 6.5%) (Table 3).

Table 3: Distribution of teeth according to radiographic quality of endodontic treatment

Teeth	Quality of endodontic treatment n (%)						
	Totally unacceptable	Unacceptable	Slightly unacceptable	Neutral	Slightly acceptable	Acceptable	Perfectly acceptable
UI (N=32)	3 (9.4)	-	1 (3.1)	1 (3.1)	10 (31.3)	5 (15.6)	12 (37.5)
LI (N=30)	-	1 (3.3)	5 (16.7)	-	5 (16.7)	6 (20.0)	13 (43.3)
UC (N=10)	4 (40.0)	1 (10.0)	1 (10.0)	-	2 (20.0)	1 (10.0)	1 (10.0)
LC (N=10)	-	-	-	-	2 (20.0)	1 (10.0)	7 (70.0)
UPM (N=62)	4 (6.5)	2 (3.2)	7 (11.3)	6 (9.7)	14 (22.6)	15 (24.2)	14 (22.6)
LPM (N=63)	-	-	4 (6.3)	-	12 (19.0)	12 (19.0)	35 (55.6)
UM (N=15)	-	1 (6.7)	-	1 (6.7)	7 (46.7)	4 (26.7)	2 (13.3)
LM (N=18)	-	-	-	3 (16.7)	2 (11.1)	4 (22.2)	9 (50.0)
All Teeth (N=240)	11 (4.6)	5 (2.1)	18 (7.5)	11 (4.6)	54 (22.5)	48 (20.0)	93 (38.8)

A higher proportion of mandibular teeth (97.5%) had acceptable taper of obturation as compared to maxillary teeth (84.9%). The quality of root canal obturation was also found to be acceptable in a greater proportion of mandibular teeth (82.6%)

than maxillary teeth (67.2%) and there was a statistically significant proportional difference in taper of obturation (p-value = 0.001) and quality of obturation (p-value = 0.005) between maxillary and mandibular teeth (Table 4).

Table 4: Comparison of length, density, taper and quality of obturation between maxillary and mandibular teeth

Variables	Quality	Maxillary teeth n (%)	Mandibular teeth n (%)	p-value
Length	Acceptable	103 (86.6)	109 (90.1)	0.395
	Unacceptable	16 (13.4)	12 (9.9)	
Density	Acceptable	109 (91.6)	116 (95.9)	0.172
	Unacceptable	10 (8.4)	5 (4.1)	
Taper	Acceptable	101 (84.9)	118 (97.5)	0.001*
	Unacceptable	18 (15.1)	3 (2.5)	
Quality	Acceptable	80 (67.2)	100 (82.6)	0.005*
	Unacceptable	39 (32.8)	21 (17.4)	

Chi square test, p-value<0.05 statistically significant*

Table 5: Comparison of length, density, taper and quality of obturation and teeth between anterior and posterior teeth

Variables	Quality	Teeth site		p-value
		Anterior n (%)	Posterior n (%)	
Length	Acceptable	79 (96.3)	133 (84.2)	0.005*
	Unacceptable	3 (3.7)	25 (15.8)	
Density	Acceptable	76 (92.7)	149 (94.3)	0.623
	Unacceptable	6 (7.3)	9 (5.7)	
Taper	Acceptable	76 (92.7)	143 (90.5)	0.571
	Unacceptable	6 (7.3)	15 (9.5)	
Quality	Acceptable	66 (80.5)	114 (72.2)	0.135
	Unacceptable	16 (19.5)	44 (27.8)	

Chi square test, p-value<0.05 statistically significant*

Higher proportion of anterior teeth (96.3%) had acceptable length of obturation as compared to posterior teeth (84.2%) and there was a statistically significant proportional difference in length of obturation between anterior and posterior teeth (p-value=0.005) (Table 5).

DISCUSSION

This study evaluated the radiographic quality of root canal obturation performed by undergraduate dental interns in the Department of Conservative Dentistry and Endodontics. A total of 240 radiographs of endodontically treated teeth were assessed based on parameters such as length, density, and taper of obturation. The results from this study revealed that 38.8% had perfectly acceptable quality of obturation. This result is similar to studies done showing 34.8% in Taiwan¹³, 32.6% in Saudi Arabia¹⁴, 32.5% in Iran¹⁵, 29.2% in Jordan¹⁶, while 4.6% were totally unacceptable which is in contrast to study done by Dadresanfar et al. 29.3%.¹⁵

In this study, mandibular teeth (82.6%) showed acceptable obturation quality compared to maxillary teeth (67.2%), and this difference was statistically significant (p<0.05). This may be due to the fact that mandibular teeth are often easier to access and

visualize during treatment, allowing more accurate instrumentation and obturation. In contrast, maxillary teeth frequently present anatomical and radiographic challenges such as complex root and canal morphologies and superimposition of anatomical structures.¹ Contradictory results were reported by Eskandarloo et al. (2017) which shows better obturation in maxillary anterior 47.1%, and Barrieshi -Nusair et al. (2004) reported that mandibular molars have higher percentage of shorter obturation.^{17,18}

This study also revealed that mandibular canines had the highest rate of perfectly acceptable obturation (70.0%) whereas, upper canines showed the highest rate of totally unacceptable treatments (40%). The better outcome in mandibular canines in this study could be due to the difference in shorter root canal anatomy and shorter root canal length, thereby improving manageability or resulting in improved operability. The poor outcomes in upper canines, reflect difficulties in maintaining working length and achieving uniform taper in long and curved canals, similar challenges were reported in this study.¹⁹

The assessment of the obturation parameters showed that the quality of root canal was acceptable

in greater proportion in mandibular teeth (82.6%) than maxillary teeth (67.2%). However, significant differences in taper between maxillary and mandibular teeth ($p < 0.001$) indicate that shaping and tapering of root canal are technical aspects that still require more supervision and improvement among the dental interns. There are studies which also highlight the importance of strengthening training in endodontic procedures.^{12,20}

When comparing anterior and posterior teeth, the study found that anterior teeth had significantly better obturation length (96.3%) than posterior teeth (84.2%). This finding is consistent with earlier research suggesting that anterior teeth are generally easier to treat because they usually have a single root and a single root canal, while posterior teeth are more prone to procedural error owing to limited access and complex root canal system.²¹⁻²⁴ Although the differences in density, taper, and overall quality between anterior and posterior teeth were not statistically significant, the trend toward better outcomes in anterior teeth supports the importance of adequate training and experience in posterior endodontics. But, only relying on two-dimensional representation of a three-dimensional structure is not sufficient.

Superimposition of roots may also hide the technical error.²⁵ Overall, the findings emphasise the need to strengthen both pre-clinical and clinical endodontic training, particularly focusing on managing complex morphologies and interpreting radiographic outcomes. Incorporating advanced educational tools such as virtual reality simulators, cone-beam CT interpretation and rotary instrumentation systems, which could enhance students' performance and obturation quality.²⁶

Even though many cases achieved satisfactory results, 4.6% of root canal treatments were rated as unacceptable, which highlights the need for continuous supervision, structured feedback and

standardised assessment criteria through regular dental education. Periodic comprehensive strict clinical and radiographic assessment of student work should be done for quality control, and patient safety and professional competency.²⁷ This study has some limitations. This study was conducted only in single hospital, which may limit the generalizability of the findings to other hospital settings. As this study evaluated the radiographs of root canal treated by interns from this institution which may not represent the performance or practice of interns in other institutions. Another limitation was inter-examiner reliability was also not assessed.

Despite these limitations, the study has important strengths. This study being conducted in one hospital ensures consistency in equipment, protocols, supervision, radiographic standards, and reduces confounding factors. Assessing the radiographs from a specific group of interns provides detailed insights into their performance and areas requiring improvement. Overall, the findings offer practical value for enhancing training programs and guiding future research.

CONCLUSION

Within the limitations of this study, it is concluded that the overall radiographic quality of root canal obturation performed by undergraduates was clinically acceptable but suboptimal, with acceptable parameters for length, density, and taper although further improvements are required. Mandibular and anterior teeth showed significantly better obturation quality than maxillary and posterior teeth, likely due to easier access and simpler anatomy. The presence of unacceptable cases highlights the need for stronger supervision, enhanced teaching methods, and greater emphasis on preclinical endodontic training.



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