

Pattern Of Endodontic Treatment Failure In South Eastern Region Of Uttar Pradesh- A Retrospective Study

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ABSTRACT

Aim: This study aimed to evaluate and identify the cases of endodontic treatment failure and also Dental Sciences BHU. **Materials and Methods:** A total recorded data of 100 patients of both sexes were selected using convenience sampling from Faculty of Dental Sciences IMS BHU over a six-month period (August 2024 to January 2025). Failure of endodontic treatment was diagnosed based on clinical symptoms such as pain, tenderness on pressure and radiographic evidence of periapical radiolucency. Data were analysed using chi-square tests and descriptive statistics to determine frequencies and proportions. **Results:** Poor quality adjunctive treatment was identified as the leading cause of failure, affecting 58% of male and 42% female patients. No statistical significance was found between sex vs reason of failure, sex vs quadrant involved, age group vs reason of failure and age group vs quadrant involved. Molars were the most frequently affected teeth. The primary reasons for failure included under obturation (31%), periapical pathology (27%), over obturation (12%), perforations (3%), instrumentation errors (4%), and untreated canal (6%). **Conclusion:** Molars are the most commonly affected teeth in endodontic treatment failure. These failures are more common among male patients. Under obturation is the leading cause of endodontic failure highlight the factors involved in the failure among patients reported for retreatment in faculty of Dental sciences IMS BHU.

Keywords: Endodontic treatment, Obturation, Periapical pathology, Perforation.

INTRODUCTION

The term root canal comes from cleaning of canals inside a tooth root canals treatment also called endodontic therapy is a dental procedure that involves removing infected or inflamed pulp from the inside of a tooth cleaning and shaping the root canal and then sealing them to save a tooth that might otherwise need extraction. It is typically performed when bacteria invade the pulp chamber causing pain or infection and is usually performed with local anaesthetics, making the process relatively painless for the patient. Root canal is a treatment used to repair and save a severely damaged or infected tooth instead of removing it. Factors affecting the success of root canal treatment include preoperative tooth condition that is presence of infection, severity of peripheral lesion, tooth anatomy, operator skill, proper cleaning and shaping of canal, accurate working length determination, complete removal of debris, quality of the root filling material seal, coronal restoration quality and patient factors such as overall health and compliance with post operative instructions. Key aspects such as

avoiding missed canals, preventing perforation and ensuring adequate irrigation are crucial for successful outcomes.

Root canal fails when the original treatment does not remove all the infection and the tooth becomes infected again. It can take weeks, months or even years for a failed root canal to show clinical symptoms including recurrence of clinical symptoms and presence of peripheral radiolucency.

Factors that can lead to root canal failure includes periapical pathology, under obturation, over obturation, crown fracture, instrument fracture, untreated canal, overextended crown, perforation, unusual tooth anatomy, fracture crown, fractured instrument and untreated canal.

Root Canal sealing provides a proper seal against bacterial ingress and there is evidence of correlation between the -quality of endodontically treated tooth outcome and the quality of root canal sealing. Therefore, an untreated root canal system can cause

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increased bacterial growth and necrotic tissue can lead to treatment failure. Proper obturation is required once root canal preparation is completed. However over or under obturation leads to the failure of root canal treatment. Failure often occurs if treatment is not adequately performed.

In general, after every root canal treatment a follow-up should be performed after either one year of completion of treatment completion or a minimum of 6 months both clinically and radiographically. The following are certain clinical and radiological signs that indicates either success or failure of endodontic treatment.

Clinical Signs	Radiological sign
Persistence of following signs like	Resolution of previously existing Lesion or lack of development of new one compare to the preoperative radiograph indicates “Healing”
Swelling	Reduction in lesion size or signs of rarefaction compared to preoperative radiograph indicates “healing”
Sinus tract	Developing a new design compared to the preoperative radiograph indicates “failed treatment”
Pain on percussion	No changes in the lesion size compared to preoperative radiograph “uncertain”
Pain on palpation in the apical region	

Based on the above clinical and radiographic findings endodontically treated cases can be classified as successes or failure.¹

This retrospective study aimed to evaluate and identify cases of root canal treatment failures and to highlight the factors involved in the failure of endodontic treatment. The main objective of this study was to evaluate the cause of failure of endodontic treatment among patients reported for retreatment in the Department of Conservative and Endodontic in Dental Hospital Banaras Hindu University Uttar Pradesh.

MATERIALS AND METHODS-

Data of one hundred patients of both sexes were collected from the dental hospital in BHU Varanasi Uttar Pradesh. Convenience sampling method was used for the study. Data were collected for a duration of 6 months and a diagnostic chart was prepared. The diagnostic chart contains a few details including patient age, sex, tooth affected, quadrant involved and

the reason for endodontic failure. The data were collected based on the clinical and radiographic findings of patients who needed endodontic retreatment of their affected teeth.

The inclusion criteria were persistent signs of swelling, tenderness on percussion, pain on palpation in the apical region, fracture of the crown etc.

Exclusion criteria- Patients with periodontal disease, vertical fractured root, split crown or unknown source of treatment. Periapical radiographs of all subjects were obtained and analysed by endodontists. After analysis the subjects were referred for retreatment. Basic criteria used for determining the cause of failure were as follows 1) Filling $\geq 2\text{mm}$ from the apex of the root was considered underfilled 2) Filling beyond the root apex was considered overfilled 3) Periapical pathology 4) Ledges, perforations, separated instruments, crown fractures, over extended crowns etc were also recorded.

The cause of endodontic treatment failure was recorded and the subjects were sent for retreatment.

OBSERVATION-

Distribution of patients of failure of root canal treatment according to gender and age.

GENDER	NUMBER	PERCENTAGE	CUMULATIVE PERCENTAGE
MALE	58	58.0	58
FEMALE	42	42.0	100
TOTAL	100	100	

AGE RANGE	NUMBER	PERCENTAGE	CUMULATIVE PERCENTAGE
18- 25	20	20.0	20.0
26 – 35	25	25.0	45.0
36 and above	55	55.0	100

Occurrence frequency of reason of failure

REASON OF FAILURE	NUMBER	PERCENT	CUMULATIVE PERCENTAGE
PERIAPICAL PATHOLOGY	27	27.0	27.0
UNDER OBTURATION	31	31.0	58.0
OVER OBTURATION	12	12.0	70.0
CROWN FRACTURE	5	5.0	75.0
INSTRUMENT FRACTURE	4	4.0	79.0
UNTREATED CANAL	6	6.0	85.0
OVEREXTENDED CROWN	2	2.0	87.0
PERFORATION	3	3.0	90.0

UNDER OBTURATION AND PERIAPICAL	3	3.0	93.0
UNUSUAL TOOTH ANATOMY	1	1.0	94.0
FRACTURED CROWN AND FRACTURED INSTRUMENT	1	1.0	95.0
UNTREATED CANAL & PERIAPICAL	2	2.0	97.0
INTRUMENT FRACTURE & PERIAPICAL	1	1.0	98.0
FRACTURED CROWN & PERIAPICAL	2	2.0	100.0

Frequency of quadrant involved

QUADRANT	NUMBER	PERCENTAGE	CUMULATIVE PERCENTAGE
UPPER RIGHT (UR)	18	18.0	18.0
UPPER LEFT (UL)	30	30.0	48.0
LOWER LEFT (LL)	29	29.0	77.0
LOWER RIGHT (LR)	23	23.0	100.0

Gender vs Reason of failure crosstab

GENDER		REASON OF FAILURE																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Chi - squ	Df	P
	COUNT	16	20	9	5	2	1	1	0	1	1	0	1	0	1			
MALE	% WITH IN	27.6	34.5	15.5	8.6	3.4	1.7	1.7	0.0	1.7	1.7	0.0	1.7	0.0	1.7			

	GENDER																	
	COUNT	11	11	3	0	2	5	1	3	2	0	1	1	1	1	18.45	13	0.14
FEMALE	% WITH IN GENDER	26.2%	26.2	7.1	0.0	4.8	11.9	2.4	7.1	4.8	0.0	2.4	2.4	2.4	2.4			
TOTAL	COUNT	27	31	12	5	4	6	2	3	3	1	1	2	1	2			

AGE RANGE (YEARS)		REASON OF FAILURE																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	Chi-squ	Df	P
	COUNT	6	3	3	2	0	1	1	1	1	0	0	1	0	1			
18- 25	% WITH IN AGE RANGE	30.0	15.0	15.0	10.0	0.0	5.0	5.0	5.0	5.0	0.0	0.0	5.0	0.0	5.0			
	COUNT	6	6	3	0	1	4	0	1	1	1	0	1	0	1	25.26	26	0.504
26- 35	% WITH IN AGE RANGE	24.0	24.0	12.0	0.0	4.0	16	0.0	4.0	4.0	4.0	0.0	4.0	0.0	4.0			
	COUNT	15	22	6	3	3	1	1	1	1	0	1	0	1	0			
36 – above	% WITH IN AGE RANGE	27.3	40.0	10.9	5.5	5.5	1.8	1.8	1.8	1.8	0.0	1.8	0.0	1.8	0			

	TOTAL	27	31	12	5	4	6	2	3	3	1	1	2	1	1			
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GENDER Vs QUADRANT INVOLVE

GENDER		QUADRANT INVOLVED				Chi-squ	Df	P
		UR	UL	LL	LR			
MALE	COUNT	13	19	14	12			
	% WITHIN GENDER	22.4	32.8	24.1	20.7			
						3.29	3	0.349
FEMALE	COUNT	5	11	15	11			
	% WITHIN GENDER	11.9	26.2	35.7	26.2			

AGE RANGE Vs QUADRANT INVOLVED

AGE RANGE		QUADRANT INVOLVED				Chi-squ	Df	P
		UR	UL	LL	LR			
18- 25 YEARS	COUNT	5	6	5	4			
	% WITHIN AGE RANGE	25.0	30.0	25.0	20.0			
						2.48	6	0.871
26-35 YEARS	COUNT	4	6	7	8			
	% WITHIN AGE RANGE	16.0	24.0	28.0	32.0			
36 and above	COUNT	9	18	17	11			
	% WITHIN AGE RANGE	16.4	32.7	30.9	20.0			

TOOTH GROUP Vs REASON OF FAILIURE

TOOTH GROUP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Chi-squ	P value
CI	6	3	1	0	0	0	0	1	0	1	0	0	0	0	3.2	0.524
LI	0	2	1	1	0	0	0	0	0	0	0	0	0	1	11.2	0.02

C	0	1	0	0	0	0	0	0	0	0	0	0	0	0	18.05	0.001
P	7	11	4	1	1	2	0	0	1	0	0	0	0	0	2.45	0.653
M	14	14	6	3	3	4	2	2	2	0	1	1	1	1	61.2	0.0001
															320	0.0001

RESULT-

A total of hundred root canal treated teeth records were assessed of which 58% percent belongs to male and 42% were females. The selected patients were divided into three age groups, group 1) 18-25 years, group 2) 26 -35 years and group 3) ≥ 36 years.

Group1) comprised 20% of the patients, Group 2) 25% of the patients and Group 3) 55% of the patients. Out of hundred cases 27% had periapical pathology 31% had under-obturation, 12% had over-obturation, 5% had crown fracture, 4% had instrument fracture, 6% had an untreated canal due to abnormal anatomy, 2% had an overextended crown, 3% had perforation, 3% had obturation with periapical pathology, 1% had unusual anatomy, 1% had fractured crown and fractured instrument, 2% had an untreated canal with periapical pathology, 1% had instrument fracture and periapical pathology, and 2% had fractured crown and periapical pathology. (table 3)

Eighteen teeth (18%) were in the upper right quadrant, 30 (30%) in the upper left quadrant, 29 (29%) in lower left quadrant and 23 (23%) in the lower right quadrant. (table 4)

The most commonly affected tooth in males is the upper right quadrant the 1st molar (75%), the upper left quadrant is the 2nd molar (75%) and the lower quadrant is 1st molar (41.7% in the lower right quadrant and 42.9% in the lower left quadrant). In contrast females showed involvement of the first molar in the upper quadrant as well as the lower quadrant. (UR- 25%, UL- 57%, LR-58%, LL- 60%).

The common cause of RCT failure in both male and females was under observation that is males 20% female 11% a total of 31% is this is followed by Barrier Packer pathology that is 27% then over observation that is 12% the Chi Square value for gender versus reason of RCT failure is 18.451 and the

P value was equal to 0.141 which is statistically not significant. The most commonly involved quadrants in male and female are the upper left and lower left quadrants respectively. The upper left quadrant involved 32.8% of males and 26.2% of females and the lower left quadrant involved 24.1% of males and 35.7% of females. The chi-square value for sex vs quadrant involved in RCT failure was 3.29 and the P value was 0.349 which was not statistically significant. In the case of age range vs reason of failure, the common reason for our city failure is 40% and it occurs mostly in age group three that is 36 years and above. The chi square value is 25.26 and the P value is equal to 0.504 which is not statistically significant. (TABLE – 5).

In the case of age range vs quadrant involved in this age group three were more commonly affected than in the other groups. The upper left quadrant (32.7%) and lower left quadrant (30.9%) were most commonly involved with the chi-square value of 2.480 and P value of 0.871 which was not statistically significant. (table 6)

DISCUSSION

The present study analysed the different causes and patterns of root canal treatment (RCT) failure in a sample of 100 patients. Demographic analysis revealed a male predominance (58%) over females (42%), with the highest incidence of RCT failure observed in the age group of 36 years and above (55%). Notably, the association between sex and reason for RCT failure was not statistically significant ($p = 0.141$), suggesting that technical or anatomical factors may play a more influential role than sex in treatment failure.

This could be attributed to cumulative dental issues with advancing age, including calcification of the canals, anatomical variations, and delayed dental care, which may complicate endodontic procedures and

compromise treatment outcomes. The primary cause of RCT failure was under-obturation (31%), followed by periapical pathology (27%) and over-obturation (12%). These findings highlight the importance of proper working length determination and obturation quality as critical factors influencing the success of endodontic treatment.

The quadrant-wise distribution revealed that the upper left quadrant (30%) and lower left quadrant (29%) were the most frequently affected sites, with the first molar being the most commonly involved tooth across both sexes. In males, the upper right 1st molar and upper left 2nd molar were most frequently affected, whereas in females, the first molar was the most commonly involved tooth in all quadrants. This suggests that molars are more prone to endodontic complications due to their complex anatomy and higher occlusal load. Although the Chi-square values for associations between sex, age, and quadrant involvement with reasons for RCT failure were not statistically significant ($p > 0.05$), the trends observed provide valuable clinical insights. The high failure rate in patients above 36 years of age and in posterior teeth underscores the need for meticulous treatment planning, advanced imaging, and possible referral to endodontic specialists in complex cases.

Endodontic treatment is often perceived as successful when the treated tooth is asymptomatic. However, the absence of pain does not necessarily equate to the successful healing or resolution of the underlying pathology. As Seltzer (1988) emphasized, the term "adequate clinical function" is more appropriate, as the primary goal of endodontic therapy is to maintain the tooth in a functional condition over the long term.

Various criteria have been proposed for determining success or failure, including clinical signs, radiographic evidence, and histological outcomes. Clinically, persistence of symptoms such as pain and swelling, even in the absence of radiographic abnormalities, can indicate failure. Radiographically, the development or progression of periapical rarefaction following treatment is a key indicator of treatment failure (Bender et al., 1964; Seltzer et al., 1963).

Histologically, even in cases that appear successful both clinically and radiographically, unresolved inflammation or lesions may still be present. This

disconnection between histological and clinical outcomes further complicates the assessment of endodontic success (Seltzer et al., 1963). The timing of the failure varies considerably. While most failures tend to occur within the first two years after treatment, some may not manifest until a decade or later. Therefore, a follow-up of at least two years is recommended for accurate assessment, especially in cases without initial periapical pathology.

Endodontic failure can arise due to preoperative, operative, and postoperative factors. Preoperative issues include incorrect diagnosis, undetected endo-periodontal lesions, or systemic conditions affecting healing. Operative factors such as anatomical variations, poor debridement, use of inadequate aseptic techniques, and technical errors such as over- or under-extension of fillings are the most commonly implicated causes of failure. Postoperative causes include persistent infection, improper restorative procedures, and failure following surgical intervention.

Numerous studies support these findings. Grossman (1972) reported that failure was largely due to technical inadequacies and poor treatment planning. Ingle (1985) grouped the causes of failure into three main categories: apical perforations, operative errors, and poor case selection. Ray and Trope (1995) demonstrated that both the quality of root canal fillings and subsequent restorations significantly influence long-term success.

Almakrami *et al.* (2018) suggested that endodontic failure depends on the skill of the person who performed an RCT. Almeshari *et al.* (2018) suggested that posterior teeth had higher failure rates than anterior teeth due to underfilling and Ni-Ti rotary instruments are better in RCT treatment and less iatrogenic.

Mustafa *et al.* (2019) found that the first molars were the most commonly affected teeth in cases of failure of endodontic treatment. Poor adjunctive treatment and inadequate filling of the root canals were the most common causes of endodontic failure, and were more commonly seen in male than in women. Most of the failure cases were found in the age group of 26–45 years

Carmen *et al.*, 2020 suggested that the maximum period between RCTs and the placement of coronal restorations was 2 weeks, the instrumentation technique used in RCT, whether manual or rotary, may also influence its outcome, It is generally considered as “adequate” if the gutta percha filling extends 0–2 mm from the radiographic apex, teeth with a favorable coronal restoration have a 1.82 times higher probability of success than an unfavorable restoration. Greater periapical lesion size was negatively associated with healing.

Mohsen *et al.* (2020) found that endodontic treatment failures mostly occur in under filled root canals, followed by coronal leakage. Premolars had a higher failure rate than anterior and molar teeth. Laukkanen *et al.*, 2021 found that RCTs were more likely to succeed in non-molars, teeth with optimal root fillings and teeth without apical periodontitis. Improvement in the quality of RCTs by GDPs is needed.

Rao *et al.*, 2023 found that the maximum primary root canal treatment failure was noted in molars, quality of obturation is a prognostic factor determining endodontic treatment outcome, and endodontic treatment failures mostly occurred in under-filled root canals and poorly sealed post-endodontic coronal restoration, along with periapical radiolucency.

Ahmad *et al.*, 2024 suggested that mandibular first molars had the highest endodontic treatment failure rate. Poor coronal seal and underfilled root canal caused most root canal failures. Jang *et al.*, 2024 found that the presence of untreated additional canals was a predictor of endodontic failure within 5 years of initial root canal treatment.

CONCLUSION

In conclusion, this study emphasizes that technical factors such as obturation quality and anatomical challenges are predominant contributors to RCT failure. Ultimately, a multidisciplinary approach that includes thorough diagnosis, meticulous operative techniques, and well-executed restorative procedures is critical for minimizing endodontic failure. Continued research and adherence to evidence-based protocols remain essential for improving the outcomes of root canal therapy. Future studies with larger sample sizes and prospective designs are

warranted to validate these findings and to develop targeted interventions to reduce endodontic failures.

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