

# Evaluation of the causes of primary root canal failure in permanent teeth.

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## ABSTRACT:

**Objective:** To determine the reasons why the primary root canal treatment of permanent teeth may fail among patients who have a previous record of root canal treatment.

**Methodology:** The cross-sectional study design employed non-probability convenience sampling at the Department of Operative Dentistry, Liaquat University of Medical and Health Sciences, Jamshoro, over six months. Statistics were analyzed using SPSS version 26.

**Results:** The patients had a mean age of  $36.44 \pm 10.85$  years, with 44 (41.51%) males and 62 (58.49%) females. Under-obturation, lack of coronal restoration and over-obturation were the most frequent causes of failure of primary root canal treatment (55.66%, 26.42% and 17.92%, respectively).

**Conclusion:** The study concluded that the failure in root canal treatment was most often caused by under-irrigation of the canals. When carrying out endodontic management and nonsurgical retreatment, it is essential to carefully examine the symptoms of infection and the cause of failure. By paying close attention to the mentioned factors, one cannot only improve the quality of endodontic care but also increase the chances of treatment success.

**Key words:** Failure in permanent teeth, Over obturation, Under obturation, Root Canal Treatment.

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## Introduction:

Root canal treatment (RCT) is a crucial aspect of comprehensive dental care. The final aim of the non-surgical root canal therapy is to cause healing of periapical tissue by removing infected or necrotic tissue in the root canal system.<sup>1</sup> The endodontic treatment method can be used as the best treatment regimen for dealing with infected pulp or periapical tissues, thereby maintaining the tooth instead of extraction.<sup>2</sup> Acquaintance with the foundations of treatment is often a factor that affects the quality of endodontic work in general practice. This compromise in quality could also be attributed to the lack of educational programs and a lack of confidence in the use of root canal procedures.<sup>3</sup>

When root canal treatment falls below acceptable standards, it is likely to fail. Most teeth fail to respond well to treatment due to procedural errors that make controlling and preventing intracanal infections time-consuming and challenging.<sup>4</sup> The most common reasons why endodontic procedures fail are marked by continued microbial infection in the root canal system or the peri-radicular region.<sup>5</sup> The effect of infection is also another area where the success of the endodontic therapy is highly reliant on the successful elimination of the infection before filling the root canal. The objective of therapy is to eliminate or significantly decrease the quantity of microbes in the root canal complex and to prevent re-calcification by keeping the ends of the root canal complex closed tightly.<sup>6-8</sup> Breakage and reduction of the microbial load involve the use of mechanical instrumentation, irrigation with various solutions containing tissue-dissolving agents, the use of microbicidal solutions, and the insertion of antimicrobial medicaments into the root canal.<sup>9-10</sup>

Radiographic features of the root canal, along with clinical signs and symptoms, can be utilized in diagnosing failure of endodontic treatment. Treatment failure is caused by several factors, including necrotic pulp, periradicular infection, periodontal disease, root breakage, instrument breakage, perforation due to instrument use, underfilling of root canals, undetected canals, and unfilled canals.<sup>11</sup> By completing the endodontic treatment, the teeth are restored to their original form and function. Conventional wisdom holds that a coronal restoration seals the treated root canal system and tooth against coronal leakage and reinfection. This is considered to be increased with the placement of restoration soon after the endodontic treatment is completed. Unrestored teeth and those with root canals are at a greater risk of reinfection.<sup>12</sup> It is stated that endodontic procedures are successful in most cases (86 to 98 per cent), and the prognosis is even more favorable in patients whose general health is not a cause for concern.<sup>13-15</sup>

In this study, an evaluation of the factors that cause root canal treatment failure in permanent teeth of patients with a history of root canal therapy was attempted, so that in fu-

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ture utilization, such failures could be handled through the encouragement of new techniques.

#### Objective:

To determine the reasons why the primary root canal treatment of permanent teeth may fail among patients who have a previous record of root canal treatment.

#### Methodology:

The cross-sectional study was conducted at the Department of Operative Dentistry at the Institute of Dentistry, Liaquat University of Medical and Health Sciences, Jamshoro. Non-probability consecutive sampling was employed over six months, from January 1, 2024, to June 30, 2024. Data was collected after approval of research proposal by CPSP (CPSP/REU/DSG-2020-166-3335) on dated April 29, 2023. The study received written informed consent from all study participants. The frequency of overfilling in the group, which was used to answer the question of root canal treatment failure, was used to determine the sample size using the WHO sample size calculator =22.7%<sup>3</sup> Margin of error =08%, Confidence level=95% Sample size=106. Inclusion criteria was confined on patients with primary root canal treatment, patients presenting with sign and symptoms of pain indicating root canal failure, either gender, having ages between 15-55 years and patients referred for retreatment were included and previously retreated, in-completed root canal treatment, patient with periodontally compromised teeth and unrestorable teeth were excluded from the study.

Patients presenting with symptoms of pain were vetted through a thorough history and clinical examination, and the symptoms of pain were evaluated using the Visual Analogue Scale (VAS). All the patients were undergoing post-treatment periapical radiography (conventional and/or digital). Through a thorough examination of these radiographs, it was possible to identify a treatment failure and potential contributing factors, such as the quality of obturation that may have led to the failure of the root canal treatment. The extent of under-obturation was considered to be when the filling material was 2 mm or less short of the radiographic apex, and over-obturation was determined when the filling material had extended past the radiographic apex. The major root canal treatment was also checked using clinical examination. A pre-designed proforma was used to record all relevant study variables, such as age and gender.

The data analysis was conducted using SPSS version 26. Quantitative measurements, such as age and symptom duration, were presented as the mean and standard deviation (SD). Qualitative variables (gender and reasons for root canal failure) were shown as percentages and frequencies. Stratification was used to determine the effect modifiers, which included age and gender. The Chi-Square test was used, and the p-value was set at 0.05, which is considered statistically significant.

#### Results:

The demographic information & clinical parameters of study participants are shown in table 1. Most of the patients belong to age group 36-45 years (31.13%). Average age of the patients was 36.44±10.85 years. Regarding gender distribution females were in majority 62 (58.49%). Similarly mean duration of symptoms was 6.72±1.74 days. While mean VAS pain score was 5.81±1.11.

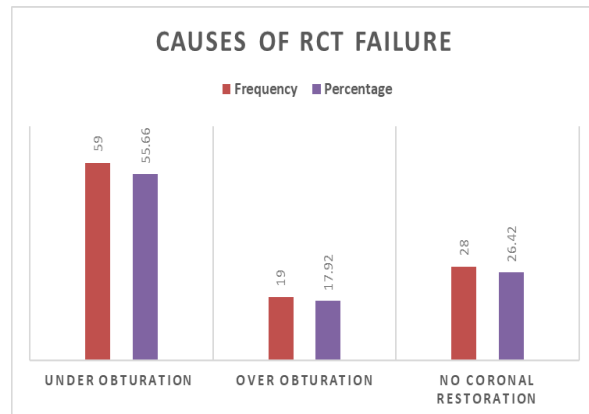
Figure 1 shows what causes failure of primary root canal treatment in permanent teeth in patients who already had a history of root canal treatment. Under-obturation was the commonest reason for failure (55.66%), whereas the lack of coronal restoration was the second reason (26.42%),

and the third was over-obturation (17.92%). Stratification of age was analyzed and observed that rate of under obturation was not statistically significant among age groups (p=0.124) however over and no coronal restoration was statistically significant among the age groups (p=0.037 and p=0.050) respectively as shown in table 2.

**Table No 1: Demographic and clinical parameters of study subjects.**

| Variable                    | Frequency (%) | Mean ± SD   |
|-----------------------------|---------------|-------------|
| Age (years)                 |               | 36.44±10.85 |
| 15-25                       | 20 (18.87)    |             |
| 26-35                       | 22 (20.75)    |             |
| 36-45                       | 33 (31.13)    |             |
| 46-55                       | 31 (29.25)    |             |
| Gender                      |               |             |
| Male                        | 44 (41.51)    |             |
| Female                      | 62 (58.49)    |             |
| Duration of Symptoms (days) |               | 6.72±1.74   |
| VAS (Pain Score)            |               | 5.81±1.11   |

**Graph No 1: Demonstrates causes of root canal treatment failure in study subjects.**



**Table No 2: Causes of primary root canal treatment failure Stratified by age.**

| Age →                  | 15-25<br>n=20 | 26-30<br>n=22 | 36-45<br>n=33 | 46-55<br>n=31 | P-Value |
|------------------------|---------------|---------------|---------------|---------------|---------|
| Cause ↓                |               |               |               |               |         |
| Under obturation       | 11<br>(55%)   | 17<br>(77.3%) | 15<br>(45.5%) | 16<br>(51.6%) | 0.124   |
| Over obturation        | 3<br>(15%)    | 3<br>(13.6%)  | 11<br>(33.3%) | 2<br>(6.5%)   | 0.037   |
| No Coronal restoration | 6<br>(30%)    | 2<br>(9.1%)   | 7<br>(21.2%)  | 13<br>(41.9%) | 0.050   |

**Table No 3: Causes of primary root canal treatment failure stratified by gender**

| Cause                  | Male          | Female        | p-value |
|------------------------|---------------|---------------|---------|
| Under obturation       | 28<br>(63.6%) | 31<br>(50%)   | 0.164   |
| Over obturation        | 4<br>(9.1%)   | 15<br>(24.2%) | 0.046   |
| No Coronal restoration | 12<br>(27.3%) | 16<br>(25.8%) | 0.086   |

According to gender stratification, rate of under obturation and no coronal restoration was not statistically significant between gender and rate of over obturation was significantly high in female than male ( $p=0.046$ ) as observed in table 3. As per duration of symptoms all cause were not statistically significant as shown in table 3.

#### Discussion:

The aim of the root canal treatment is to provide a pleasant environment in the periapical tissues by eliminating infected or necrotic pulp tissue remnants so that a tooth may stay formed in the oral cavity.<sup>16</sup> Although root canal treatment has a high success rate of approximately 89%, a significant number of cases result in unsuccessful treatment outcomes. The return of the symptoms accompanied by the radiolucency of the periapical region may occur when the standard principles of root canal treatment are not followed. This situation has been termed a root canal treatment failure.<sup>17</sup>

The failure may be a result of an ongoing infection or a new infection in the root canal. Iatrogenic mistakes may adversely impact the treatment outcomes during mechanical preparation of root canals, including instrument breakage, perforations, ledge formation, and under- or over-instrumentation during the cleaning and shaping procedures.<sup>18</sup> In this study, a sample of 106 patients who had previously undergone primary root canal treatment and exhibited indications and symptoms of pain on review, indicating root canal failure, was included. The mean age of the patients was  $36.44 \pm 10.85$ , with ages ranging from 15 to 55 years. A survey conducted by Tariq et al found an average age of  $36.7 \pm 8.5$  years with an almost equal proportion of males to females.<sup>19</sup>

In our current study, the most common cause of failure of root canal treatment was under obturation that incidence was found to be 55.7%.

There were comparable findings from other studies, Aljabri MK et al [20] performed a study and revealed that 71% of the causes of endodontic failures was under-filling as a cause of failure of root canals and revealed that 18 to 40 years patients (78.6%) were observed with failed RCT, also revealed that 60.3% of patients with failed RCT in female. In some other studies male had more dominance in the rate of failed RCT than female. The other issue that can predispose to endodontic treatment failures is over-obturation of root canals. Over-obturation has been identified in this study as a factor contributing to failure in 17.92% of cases. These results are in harmony with those presented by Aljabri et al.<sup>20</sup> as the incidence reported was 16.8%, with 42.7 cases of coronal leakage and 16 missed canals.

Dar SY et al<sup>21</sup> also reported the mean age of patients was  $34 \pm 12$  years and reported that the 45.5% cause of the failure of root canal treatment was under obturation. The rate of over obturation was low (5%). Aslam S et al<sup>22</sup> found that in private and public sector the commonest cause of failure of RCT was under obturation that was found in 8.8% and 16.3% respectively and observed that the high rate of (63.8%) poor coronal seal.

Rao S et al<sup>14</sup> reported that in 17.8% cases cause of RCT failed was under-filled. Similarly in another study, the factor which was found to be most responsible for endodontic treatment failure was under obturation of canals and the reported frequency was 33.3% and 37.5%.<sup>23</sup>

Another failure cause of RCT was no coronal restoration that was observed in 26.42% in our study which is in sharp contrast to a recent study<sup>23</sup> the rate of over obturation was low that was reported about 1.5%. This is comparable with

the study of Rao S et al<sup>14</sup> in which 16.8% of the failed cause of RCT was inadequate coronal restoration. Rao S et al<sup>14</sup> reported the mean was  $36.29 \pm 12.28$  years. Mean age of patients in all of these studies are almost similar with our study and majority of the patients were found between middle age of 25 and 45 years.

Regarding gender difference, it was noted that in this study female gender (58.49%) was found predominantly affected than male. Rao S et al<sup>14</sup> witnessed that 58.4% of cases presenting with failed RCT in females than male.

Akbar I et al<sup>24</sup> The radiographic analysis conducted to diagnose the causes of endodontic failures has indicated that in 46.9% of root canals, failure was attributed to underfilling.

The Systematic reviews built on the idea that keeping obturation up to 2 mm short of the radiographic apex is essential for the effectiveness of endodontic therapy and, subsequently, for the avoidance of apical periodontitis. As a result, the filling material should only be used in the root canal and should never extend past the apex. The primary cause of the onset of apical periodontitis is not the obturation material itself, but rather the bacteria that is transported by the obturation material and causes inflammatory and immune-modulatory reactions in the periapical tissues.

The study was hampered by the patients' location in a confined area, the department collected, and the small sample size. It was not possible to conduct long-term follow-up on the trial participants in order to determine the RCT outcome. Additionally, the outcomes of periodontitis management were not also recorded.

#### Conclusion:

The most common causes of the initial root canal treatment failure were determined to be the root canals' obturation and the incapacity to install a coronal restoration. Taking into account the causes of RCT and the signs of infection, the presence of RCT should also be taken into account when doing nonsurgical retreatment and endodontic therapy. In addition to enhancing the overall quality of endodontic therapy, the highest level of attention to detail would also raise the procedure's chances of success.

#### References:

1. Ahmed SA, Anwar S, ul Haq I. Evaluation of Quality of Root Canal Obturation, Coronal Restoration and Periapical Health in Failed Endodontically Treated Teeth. *Journal of Bahria University Medical and Dental College*. 2021 Apr 5;11(2):54-9. doi: [10.51985/WHTJ7349](https://doi.org/10.51985/WHTJ7349).
2. Olcay K, Ataoglu H, Belli S. Evaluation of Related Factors in the Failure of Endodontically Treated Teeth: A Cross-sectional Study. *J Endod*. 2018 Jan;44(1):38-45. doi: [10.1016/j.joen.2017.08.029](https://doi.org/10.1016/j.joen.2017.08.029). PMID: [29246376](https://pubmed.ncbi.nlm.nih.gov/29246376/).
3. Evaluation of endodontic treatment performed by the undergraduate international students of Lithuanian University of Health Sciences: A pilot study. Master's thesis, Lithuanian University of Health Sciences (Lithuania), 2018. available at <https://lsmu.lt/cris/entities/etd/92df866d-0544-4d94-ad61-b9d455bbe0c6>.
4. Yancheshmeh SS. Examining the Factors Affecting Endodontic Therapy Failure. *I Mol Bio Res*. 2020;10(1):1-5. doi: [10.5539/jmbr.v10n1p1](https://doi.org/10.5539/jmbr.v10n1p1)
5. Rahman I, Rahman K, Mansoor F, Nazir U, Ali F, Afridi U. Evaluation of the causes of root canal failure treated by different operator groups. *Journal of khyber college of dentistry*. 2020;10(01):51-4. doi: [10.33279/jkcd.v10i01.290](https://doi.org/10.33279/jkcd.v10i01.290)
6. Mustafa M, Almuhaiza M, Alamri HM, Abdulwahed A,

- Alghomlas ZI, Alothman TA, Alhajri FF. Evaluation of the causes of failure of root canal treatment among patients in the City of Al-Kharj, Saudi Arabia. *Niger J Clin Pract.* 2021 Apr;24(4):621-628. doi: [10.4103/njcp.njcp.290.20](https://doi.org/10.4103/njcp.njcp.290.20). PMID: [33851687](https://pubmed.ncbi.nlm.nih.gov/33851687/).
7. Ballikaya E, Koc N, Avcu N, Cehreli ZC. The quality of root canal treatment and periapical status of permanent teeth in Turkish children and teens: a retrospective CBCT study. *Oral Radiol.* 2022 Jul;38(3):405-415. doi: [10.1007/s11282-021-00570-2](https://doi.org/10.1007/s11282-021-00570-2). Epub 2021 Oct 29. PMID: [34714509](https://pubmed.ncbi.nlm.nih.gov/34714509/).
  8. Herbst CS, Schwendicke F, Krois J, Herbst SR. Association between patient-, tooth- and treatment-level factors and root canal treatment failure: A retrospective longitudinal and machine learning study. *J Dent.* 2022 Feb;117:103937. doi: [10.1016/j.jdent.2021.103937](https://doi.org/10.1016/j.jdent.2021.103937). Epub 2021 Dec 20. PMID: [34942278](https://pubmed.ncbi.nlm.nih.gov/34942278/).
  9. Muhammad A, Sohail S, Khalid B, Adeeb U, Idrees M, Memon M. Evaluating the Causes of Root Canal Treatment Failure in Southern Punjab, Pakistan. *Pakistan Postgraduate Medical Journal.* 2024 Dec 4;35(03):91-5. doi:[10.51642/ppmj.v35i03.686](https://doi.org/10.51642/ppmj.v35i03.686)
  10. Aslam SA, Ahmed MR, Bukhari JH, Hussain MA. Most Common Reason of Root Canal Failure in Government and Private Sectors in South Punjab. *P J M H S.*2021; 15 (4) pp 854-56. available at <https://pjmhsonline.com/2021/april/854.pdf>.
  11. Adnan K, Tahir A, Azam HM, Hussain A, Bilal H, Fatima QU. Comparative Analysis of Different Techniques Used for Root Canal Obturation and their Effects on Long Term Tooth Longevity. *Pakistan Journal of Medical & Health Sciences.* 2023 Dec 31;17(12):205-208. doi:[10.53350/pjmhs020231712205](https://doi.org/10.53350/pjmhs020231712205)
  12. Jang, YE., Kim, Y., Kim, SY. et al. Predicting early endodontic treatment failure following primary root canal treatment. *BMC Oral Health.* 2024;24, 327. doi:[10.1186/s12903-024-03974-8](https://doi.org/10.1186/s12903-024-03974-8)
  13. Aljabri, Mohsen K.; Kensara, Jamal A.1; Mandorah, Ayman O.2; Sunbul, Monammed A.3. Causes of root canal treatment failure: A prospective study in Makkah City, Saudi Arabia. *Saudi Journal of Oral Sciences.* 2020; 7(1):p 40-45. doi: [10.4103/sjos.SJOralSci.35.19](https://doi.org/10.4103/sjos.SJOralSci.35.19)
  14. Rao S, Nilker V, Telikapalli M, Gala K. Incidence of Endodontic Failure Cases in the Department of Conservative Dentistry and Endodontics, DY Patil School of Dentistry, Navi Mumbai. *Cureus.* 2023 May 10;15 (5):e38841. doi: [10.7759/cureus.38841](https://doi.org/10.7759/cureus.38841). PMID: [37303357](https://pubmed.ncbi.nlm.nih.gov/37303357/); PMCID: [PMC10254946](https://pubmed.ncbi.nlm.nih.gov/PMC10254946/).
  15. Hoskinson SE, Ng YL, Hoskinson AE, Moles DR, Gulabivala K. A retrospective comparison of outcome of root canal treatment using two different protocols. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2002 Jun;93(6):705-15. doi: [10.1067/moe.2001.122822](https://doi.org/10.1067/moe.2001.122822). PMID: [12142878](https://pubmed.ncbi.nlm.nih.gov/12142878/).
  16. Alamoudi RA, Alharbi AH, Farie GA, Fahim O. The value of assessing case difficulty and its effect on endodontic iatrogenic errors: a retrospective cross-sectional study. *Libyan J Med.* 2020 Dec;15(1):1688916. doi: [10.1080/19932820.2019.1688916](https://doi.org/10.1080/19932820.2019.1688916). PMID: [31694490](https://pubmed.ncbi.nlm.nih.gov/31694490/); PMCID: [PMC6844443](https://pubmed.ncbi.nlm.nih.gov/PMC6844443/).
  17. Yamaguchi, M., Noiri, Y., Itoh, Y. et al. Factors that cause endodontic failures in general practices in Japan. *BMC Oral Health.*2018; 18, 70. doi:[10.1186/s12903-018-0530-6](https://doi.org/10.1186/s12903-018-0530-6)
  18. Tabassum S, Khan FR. Failure of endodontic treatment: The usual suspects. *Eur J Dent.* 2016 Jan-Mar;10(1):144-147. doi: [10.4103/1305-7456.175682](https://doi.org/10.4103/1305-7456.175682). PMID: [27011754](https://pubmed.ncbi.nlm.nih.gov/27011754/); PMCID: [PMC4784145](https://pubmed.ncbi.nlm.nih.gov/PMC4784145/).
  19. Hina Tariq, Rizwan Qureshi. Assessment of periapical periodontitis in root canal treatment failure patients related to the length of root canal filling. *Pakistan Oral & Dental Journal.*2023; 43(1), 10-14. available at <https://podj.com.pk/index.php/podj/article/view/720>.
  20. Clove Dental. When Good Roots Go Bad: Unmasking Failed Root Canals and Their Lifelines [Internet]. Clove Dental. 2024. Available from: <https://clovedental.in/blog/filling-root-canal/root-canal-causes-diagnosis-treatment-options>.
  21. Dar SY, Qadeer S, Munir MB. An Evaluation of the Causes of Failure of Initial Endodontic Therapy Based On Radiographic Findings. *Pak J Med Health Sci.* 2017 Jul 1;11(3):1026-8. available at [https://pjmhsonline.com/2017/july\\_sep/pdf/1026.pdf](https://pjmhsonline.com/2017/july_sep/pdf/1026.pdf).
  22. P Harish Babu, Sameer P P, Jamila Hameed. Early Failures in Root Canal Treatment: A Systematic Review and Meta-Analysis. *Annals of Medicine and Medical Sciences (AMMS).*2025; 04. pp:288 -96 Available at: <https://ammspub.com/index.php/amms/article/view/144>
  23. Mehta, D., Coleman, A. & Lessani, M. Success and failure of endodontic treatment: predictability, complications, challenges and maintenance. *Br Dent J.* 2025; 238, 527-535. doi:[10.1038/s41415-025-8453-5](https://doi.org/10.1038/s41415-025-8453-5)
  24. Akbar I. Radiographic study of the problems and failures of endodontic treatment. *Int J Health Sci (Qassim).* 2015 Apr;9(2):111-8. PMID: [26309429](https://pubmed.ncbi.nlm.nih.gov/26309429/); PMCID: [PMC4538887](https://pubmed.ncbi.nlm.nih.gov/PMC4538887/).

#### "Author's Contribution"

|                      |                                           |
|----------------------|-------------------------------------------|
| Rizwana Bughio       | Data collection & analysis                |
| Feroze Ali Kalhoro   | Supervision & Review of Draft             |
| Naresh Kumar         | Methodology                               |
| Aysha Sami           | Discussion writing                        |
| Muhammad Amin Sahito | Literature review & editing of manuscript |
| Suffiyan Saleem      | Manuscript writing & editing              |