



THE USUAL SUSPECTS OF FAILURE OF ENDODONTIC TREATMENT: REVIEW ARTICLE

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Abstract:

Background: Endodontic treatment failure can occur due to various factors such as persistent bacterial infection, inadequate obturation, improper coronal seal, complications of instrumentation, and untreated canals. Understanding the common causes of failure is crucial for improving treatment outcomes and preventing adverse consequences for patients and practitioners. **Objective:** This study aims to investigate the common causes of failure in endodontic treatments, focusing on identifying recurring issues, analyzing the impact of improper techniques or materials on treatment outcomes, and exploring the role of microbial infections in contributing to treatment failure. **Conclusion:** The study highlights the importance of thorough debridement to eliminate persistent bacteria, proper obturation to ensure a well-sealed canal, and a good coronal seal to prevent reinfection. Complications of instrumentation and untreated canals are also significant factors contributing to treatment failure. By adhering to preventative measures such as proper diagnosis, meticulous cleaning and shaping, effective disinfection, and quality obturation, dental professionals can enhance the success rate of endodontic treatments and minimize the risk of failure. Regular follow-up appointments and communication with patients are essential to identify and address any issues promptly, ultimately improving the long-term prognosis of endodontically treated teeth.

Keywords: Endodontics, periapical periodontitis, root canal therapy.

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Introduction:

The primary goal of root canal treatment (RCT) is to remove inflamed and infected pulpal tissue, creating an environment that supports healing and halts the progression of periapical pathology, ultimately promoting periapical healing and ensuring the long-term functionality of endodontically treated teeth [1]. The assessment of RCT outcomes is crucial in the field of endodontics, requiring dental clinicians to possess the necessary skills and judgment to determine the success of the treatment. Success in endodontics is typically evaluated based on the response of a root-filled tooth to various functional stresses over time [2]. While endodontic treatment generally demonstrates predictability with reported success rates ranging from 86% to 98%, there is a lack of consensus in the literature regarding the specific criteria defining success and failure in endodontic therapy [3]. Some studies define failure as the recurrence of clinical symptoms accompanied by the presence of a periapical radiolucency. To ensure the success of root canal treatment, both clinical and radiographic evaluations of the treated tooth are essential, and patients should undergo regular follow-ups to confirm treatment efficacy and functional tooth status.

Common causes of endodontic treatment failure include inadequate mechanical cleaning, bacterial persistence within the canals and apex, poor quality of obturation, improper extension of the root canal filling, and coronal leakage [4]. Despite the generally high success rates associated with endodontic therapy, failures do occur in a considerable number of cases, often attributable to the aforementioned factors. Given the increasing frequency of endodontic procedures performed daily, it is crucial to prevent or minimize these fundamental causes of endodontic failure [5].

Objectives:

The main objectives of this review are:

1. To investigate the common causes of failure in endodontic treatments, with a focus on identifying recurring issues.
2. To analyze the impact of improper techniques or materials used in endodontic procedures on treatment outcomes.
3. To explore the role of microbial infections in contributing to treatment failure.

Parameters related to endodontic treatment failure:**• Persistence of bacteria:**

Persistent microbiological infection is a significant factor contributing to endodontic failure [6]. The literature strongly supports the role of bacteria in

periradicular infection, emphasizing that the presence of microorganisms in the canals during root canal obturation can increase the likelihood of treatment failure. Bacteria located in areas such as isthmuses, dentinal tubules, and ramifications may be difficult to eliminate with disinfectants. A study by Lin et al. involving 236 cases of failed endodontic treatments revealed a link between bacterial infection in the canals and periradicular rarefaction in these cases [7]. Bacteria in the periradicular region may be shielded from disinfection procedures, with canals showing negative bacterial cultures generally associated with higher success rates compared to those with positive cultures. Endodontic treatments are more prone to failure in teeth with pre-existing periradicular rarefactions than in those without such radiographic changes [8]. Apart from inadequate canal debridement, a poorly sealed apex can also contribute to endodontic failure by allowing microbiological persistence. Inadequate apical seal can lead to fluid leakage, potentially perpetuating periradicular inflammation. Ensuring effective cleaning of the canal significantly improves the chances of a successful outcome, highlighting the critical importance of thorough debridement [9].

• Inadequate or overextended root filling:

Apart from ensuring proper disinfection and debridement of canals, the quality of obturation plays a crucial role in the success of endodontic treatment. Research has highlighted the significance of root canal obturation quality, with studies showing that it is a key factor in treatment success [10]. In cases where endodontic failures occurred, a substantial percentage exhibited poor obturation quality, and some teeth had untreated canals [11]. Success rates are notably higher for obturations that are appropriately placed, either flush with the apex or within 2 mm of it, compared to those that are under or overextended [12]. Studies have indicated that overextended obturations are significantly more likely to fail compared to underfilled canals [13]. Furthermore, the presence of an overextended root canal filling in teeth with periradicular lesions is associated with a poorer prognosis, as evidenced by increased incidences of periapical periodontitis [14]. However, conflicting results regarding the correlation between the apical extent of root fillings and treatment failures have been reported in some studies [15].

• Improper coronal seal:

After the completion of obturation, it is crucial to have a well-sealing coronal restoration to prevent the ingress of microorganisms from the

environment, as highlighted by Swanson and Madison [16]. Coronal leakage has been identified as a potential factor in endodontic failure. Ray and Trope also emphasized the importance of a high-quality coronal restoration in their study [17], which was further supported by a retrospective study on 1001 endodontically treated teeth. The results of this study showed a decrease in success rates for teeth with poor-quality coronal restorations compared to those with good-quality obturation and coronal restorations. However, the quality of the root canal filling was found to be the main determinant of root canal success in this study, rather than the quality of the coronal restoration. Nonetheless, an impervious seal at the coronal area is essential for a successful prognosis of an endodontically treated tooth. Ng et al., in their meta-analysis, reported a higher pooled success rate for teeth with satisfactory restorations compared to those with poor-quality restorations [18].

• **Complication of instrumentation:**

When rotary instruments fracture in the canals due to non-compliance with access cavity preparation protocols or improper use of rotary instruments, it can reduce access to the apical part of the root canal. This reduction in access may hinder effective canal disinfection and subsequent obturation. Studies on fractured instruments have generally shown minimal impact on treatment success rates [19]. The point during instrumentation at which the instrument breaks can influence the prognosis. Disinfecting and obturating the canal section distal to the fractured instrument becomes challenging, potentially leading to persistent infection in that area [20]. However, the presence of a fractured instrument alone does not necessarily lead to treatment failure; success is more likely affected when concurrent infection is present. A clinical study investigating the relationship between broken rotary instruments and endodontic outcomes confirmed that in the absence of preoperative infection and periradicular changes, a separated instrument is unlikely to impact prognosis significantly. Therefore, direct involvement of the fractured instrument in endodontic failure is rare [21].

• **Untreated canals:**

It is not uncommon to overlook canals during endodontic treatment, particularly in molars where the assumption of one root, one canal is often overridden by the presence of multiple canals. Additionally, inadequate access openings can hinder the primary dentist's ability to locate supplemental canals. Failing to treat all canals is a

common cause of endodontic failure, as bacteria in untreated canals can sustain symptoms. A study on 5616 retreated molars revealed that the inability to locate the MB2 canal significantly decreased the long-term prognosis of those teeth [22]. In another prospective study by Hoen and Pink, missed canals were reported in 42% of 1100 endodontically failing teeth [23].

Consequences of failure of endodontic treatment:

The failure of endodontic treatment can have significant consequences for both the patient and the dental practitioner. One of the most immediate consequences is the persistence or recurrence of symptoms such as pain, swelling, or infection [24]. This can lead to discomfort for the patient and may require additional treatment to address the underlying issue. In some cases, the failure of endodontic treatment can result in the loss of the tooth, which can have aesthetic and functional implications for the patient. Additionally, failed endodontic treatment can damage the reputation of the dental practitioner, leading to a loss of trust from patients and potential legal consequences. It is important for dental professionals to thoroughly assess and treat endodontic cases to minimize the risk of treatment failure and its associated consequences. Regular follow-up appointments and proper communication with the patient can help to identify and address any issues before they escalate [25].

Preventative measures:

To prevent failure of endodontic treatment, it is important for dental professionals to adhere to certain preventative measures. Firstly, proper diagnosis and treatment planning are crucial in ensuring the success of endodontic treatment. This includes conducting a thorough examination of the tooth and surrounding tissues, as well as obtaining high-quality radiographs to accurately assess the root canal anatomy. Additionally, meticulous cleaning and shaping of the root canal system are essential to remove all infected tissue and bacteria [26]. Using the latest techniques and instruments, such as rotary files and ultrasonic tips, can help achieve optimal cleaning and shaping of the root canal system. Proper disinfection of the root canal system with irrigants such as sodium hypochlorite and ethylenediaminetetraacetic acid (EDTA) is also important in eliminating bacteria and preventing reinfection. Lastly, obtaining a well-sealed and properly filled root canal system is crucial in preventing leakage and subsequent failure of endodontic treatment. Using high-quality materials, such as gutta-percha and resin-based

sealers, and employing techniques such as warm vertical compaction can help ensure a tight seal and long-term success of the root canal treatment. By following these preventative measures, dental professionals can increase the likelihood of a successful outcome for their patients undergoing endodontic treatment [27].

Conclusion:

In conclusion, the failure of endodontic treatment can have significant consequences for both patients and dental practitioners. Common causes of failure include persistent bacterial infection, inadequate or overextended root filling, improper coronal seal, complications of instrumentation, and untreated canals. To prevent treatment failure, dental professionals must focus on proper diagnosis, meticulous cleaning and shaping of the root canal system, effective disinfection, and ensuring a well-sealed and properly filled root canal. Regular follow-ups and communication with patients are essential to identify and address any issues before they escalate. By adhering to preventative measures and best practices, dental professionals can increase the likelihood of successful outcomes for patients undergoing endodontic treatment.

References:

- Zahran S, Patel S, Koller G, Mannocci F. The impact of an enhanced infection control protocol on molar root canal treatment outcome—a randomized clinical trial. *Int Endod J.* 2021;54:1993–2005. [PubMed] [Google Scholar]
- Fleming CH, Litaker MS, Alley LW, Eleazer PD. Comparison of classic endodontic techniques versus contemporary techniques on endodontic treatment success. *J Endod.* 2010;36:414–418. [PubMed] [Google Scholar]
- Riis A, Taschieri S, Del Fabbro M, Kvist T. Tooth survival after surgical or nonsurgical endodontic retreatment: long-term follow-up of a randomized clinical trial. *J Endod.* 2018;44:1480–1486. [PubMed] [Google Scholar]
- Kebke S, Fransson H, Brundin M, Mota de Almeida FJ. Tooth survival following root canal treatment by general dental practitioners in a Swedish county—a 10-year follow-up study of a historical cohort. *Int Endod J.* 2021;54:5–14. [PubMed] [Google Scholar]
- European Society of Endodontology Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *Int Endod J.* 2006;39:921–930. [PubMed] [Google Scholar]
- Endo MS, Ferraz CC, Zaia AA, Almeida JF, Gomes BP. Quantitative and qualitative analysis of microorganisms in root-filled teeth with persistent infection: Monitoring of the endodontic retreatment. *Eur J Dent.* 2013;7:302–9. [PMC free article] [PubMed] [Google Scholar]
- Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: Systematic review of the literature - Part 2. Influence of clinical factors. *Int Endod J.* 2008;41:6–31. [PubMed] [Google Scholar]
- Tronstad L, Asbjørnsen K, Døving L, Pedersen I, Eriksen HM. Influence of coronal restorations on the periapical health of endodontically treated teeth. *Endod Dent Traumatol.* 2000;16:218–21. [PubMed] [Google Scholar]
- Hoehn MM, Pink FE. Contemporary endodontic retreatments: An analysis based on clinical treatment findings. *J Endod.* 2002;28:834–6. [PubMed] [Google Scholar]
- Kojima K, Inamoto K, Nagamatsu K, Hara A, Nakata K, Morita I, et al. Success rate of endodontic treatment of teeth with vital and nonvital pulps. A meta-analysis. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.* 2004;97:95–9. [PubMed] [Google Scholar]
- Swartz DB, Skidmore AE, Griffin JA., Jr. Twenty years of endodontic success and failure. *J Endod.* 1983;9:198–202. [PubMed] [Google Scholar]
- Segura-Egea JJ, Jiménez-Pinzón A, Poyato-Ferrera M, Velasco-Ortega E, Ríos-Santos JV. Periapical status and quality of root fillings and coronal restorations in an adult Spanish population. *Int Endod J.* 2004;37:525–30. [PubMed] [Google Scholar]
- Lin LM, Skribner JE, Gaengler P. Factors associated with endodontic treatment failures. *J Endod.* 1992;18:625–7. [PubMed] [Google Scholar]
- Swanson K, Madison S. An evaluation of coronal microleakage in endodontically treated teeth. Part I. Time periods. *J Endod.* 1987;13:56–9. [PubMed] [Google Scholar]
- Ray HA, Trope M. Periapical status of endodontically treated teeth in relation to the technical quality of the root filling and the coronal restoration. *Int Endod J.* 1995;28:12–8. [PubMed] [Google Scholar]
- Simon S, Machtou P, Tomson P, Adams N, Lumley P. Influence of fractured instruments on the success rate of endodontic treatment. *Dent Update.* 2008;35:172–4. 176, 178-9. [PubMed] [Google Scholar]

17. Ng YL, Mann V, Rahbaran S, Lewsey J, Gulabivala K. Outcome of primary root canal treatment: Systematic review of the literature - Part 2. Influence of clinical factors. *Int Endod J.* 2008;41:6–31. [PubMed] [Google Scholar]
18. Simon S, Machtou P, Tomson P, Adams N, Lumley P. Influence of fractured instruments on the success rate of endodontic treatment. *Dent Update.* 2008;35:172–4. 176, 178-9. [PubMed] [Google Scholar]
19. Peters LB, Wesselink PR, Bujis JF, van Winkelhoff AJ. Viable bacteria in root dentinal tubules of teeth with apical periodontitis. *J Endod.* 2001;27:76–81. [PubMed] [Google Scholar] [Ref list]
20. Tanomaru JM, Leonardo MR, Tanomaru Filho M, Bonetti Filho I, Silva LA. Effect of different irrigating solutions and calcium hydroxide on bacterial LPS. *Int Endod J.* 2003;36:733–9. [PubMed] [Google Scholar] [Ref list]
21. Del Fabbro M, Taschieri S, Lodi G, Banfi G, Weinstein RL. Magnification devices for endodontic therapy. *Cochrane Database Syst Rev.* 2009;(3):CD005969. [PubMed] [Google Scholar] [Ref list]
22. Wolcott J, Ishley D, Kennedy W, Johnson S, Minnich S, Meyers J. A 5 yr clinical investigation of second mesiobuccal canals in endodontically treated and retreated maxillary molars. *J Endod.* 2005;31:262–4. [PubMed] [Google Scholar]
23. Hoen MM, Pink FE. Contemporary endodontic retreatments: An analysis based on clinical treatment findings. *J Endod.* 2002;28:834–6. [PubMed] [Google Scholar]
24. Miccoli, Gabriele et al. “Possible Complications of Endodontic Treatments.” *The journal of contemporary dental practice* vol. 21,5 473-474. 1 May. 2020
25. Rass, Marwan Abou. “Interim endodontic therapy for alveolar socket bone regeneration of infected hopeless teeth prior to implant therapy.” *The Journal of oral implantology* vol. 36,1 (2010): 37-59. doi:10.1563/AAID-JOI-D-09-00040
26. Abbott, P V. “Recognition and prevention of failures in clinical dentistry. Endodontics.” *Annals of the Royal Australasian College of Dental Surgeons* vol. 11 (1991): 150-66.
27. Cheung, G S. “Endodontic failures--changing the approach.” *International dental journal* vol. 46,3 (1996): 131-8.