

Root Canal Retreatment: A Review of The Prevalence and Factors Related to The Need for Root Canal Retreatment and Its Success Rates

Perawatan Ulang Saluran Akar: Tinjauan Prevalensi dan Faktor Terkait Kebutuhan Perawatan Ulang Saluran Akar dan Tingkat Keberhasilannya

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ABSTRACT

Root canal retreatment (RCR) is a critical aspect of endodontic practice, often necessitated by various factors that compromise the success of initial root canal treatments. This literature review synthesizes current research on the prevalence of RCR, associated factors leading to treatment failure, and success rates. Key factors influencing the need for retreatment include procedural errors, anatomical complexities, microbial persistence, and patient-related variables. Procedural factors, such as incomplete cleaning and shaping, inadequate obturation, and the use of outdated techniques, significantly contribute to treatment failures. Microbial persistence, particularly involving resistant strains like *Enterococcus faecalis*, exacerbates the challenges faced in endodontic therapy. Additionally, demographic factors, practitioner experience, and technological advancements play pivotal roles in determining treatment outcomes. Success rates for RCR vary widely, typically ranging from 70% to over 90%, influenced by the underlying causes of retreatment and the methodologies employed. Understanding these factors is essential for clinicians seeking to enhance treatment efficacy and improve patient outcomes in endodontic care. This review underscores the importance of continuous education and the adoption of innovative techniques and materials to mitigate the need for RCR and optimize success rates.

Keywords: Root canal retreatment, Endodontic treatment failure, Endodontic success rate

ABSTRAK:

Perawatan ulang saluran akar (RCR) adalah aspek penting dari praktik endodontik, sering kali diperlukan oleh berbagai faktor yang mengkompromikan keberhasilan perawatan saluran akar awal. Tinjauan literatur ini mensintesis penelitian terkini tentang prevalensi RCR, faktor-faktor terkait yang menyebabkan kegagalan pengobatan, dan tingkat keberhasilan. Faktor kunci yang mempengaruhi kebutuhan untuk perawatan ulang termasuk kesalahan prosedural, kompleksitas anatomi, kegigihan mikroba, dan variabel terkait pasien. Faktor prosedural, seperti pembersihan dan pembentukan yang tidak lengkap, obturasi yang tidak memadai, dan penggunaan teknik yang sudah ketinggalan zaman, secara signifikan berkontribusi pada kegagalan perawatan. Kegigihan mikroba, terutama yang melibatkan strain resisten seperti *Enterococcus faecalis*, memperburuk tantangan yang dihadapi dalam terapi endodontik. Selain itu, faktor demografis, pengalaman praktisi, dan kemajuan teknologi memainkan peran penting dalam menentukan hasil pengobatan. Tingkat keberhasilan untuk RCR sangat bervariasi, biasanya berkisar dari 70% hingga lebih dari 90%, dipengaruhi oleh penyebab yang mendasari perawatan ulang dan metodologi yang digunakan. Memahami faktor-faktor ini sangat penting bagi dokter yang ingin meningkatkan kemanjuran pengobatan dan meningkatkan hasil pasien dalam perawatan endodontik. Tinjauan ini menggarisbawahi pentingnya pendidikan berkelanjutan, adopsi teknik dan materi inovatif untuk mengurangi kebutuhan RCR dan keberhasilan perawatan.

Kata kunci: Perawatan ulang saluran akar, Kegagalan endodontik, keberhasilan endodontik

INTRODUCTION

Preventing or treating apical periodontitis is the main aim of root canal treatment, with the overall goal being to maintain the treated tooth in normal function.¹ In this complex process, the tooth's infected or damaged dental pulp is carefully removed, and the root canal system is then meticulously cleaned and shaped. The last step is to close the canal and stop reinfection by filling it with a biocompatible substance. In addition to relieving pain, root canal therapy (RCT) aims to protect the natural tooth, maintaining its structural integrity and function inside the dental arch.²

The success of root canal treatment has been the object for number of studies that indicated that root canal treatment is a dependable process that yields positive results in 86%–98% of instances.^{3–5} However, the anatomical features of the root canal structure and the presence of unique noxious factors within the inflamed tissue can cause failures even when a proper standard procedures is followed.⁶ Large cross-sectional studies have revealed that the prevalence of post-treatment disease, which can include persistent, recurrent, or emerging apical periodontal disease, may affect up to 42% of all root-filled teeth, indicating a significant need for additional intervention.³

The idea that endodontic failure is directly caused by procedural mistakes such broken tools, perforations, overfilling, underfilling, ledges, and so forth frequently misleads the clinician. Unless there is a concurrent infection, procedural mistakes usually do not compromise the result of endodontic therapy. In actuality, a procedural mishap frequently hinders or prevents the execution of suitable intracanal operations. Therefore, while treating infected teeth, there is a chance that a procedural mishap might result in the root canal procedure failing.⁷

Retreatment may be necessary for a significant percentage of treated teeth. There are several reasons why root canal retreatment (RCR) may be necessary. Inadequate cleaning or sealing during the first treatment can facilitate bacteria regrowth and result in a persistent infection.^{8,9} Furthermore, Treatment success is significantly hampered by the anatomical complexity of the root canal system, which is typified by complicated branching,

auxiliary canal presence, and variations in canal morphology.

Another important element that leads to treatment failure is microbial persistence. Conventional disinfection techniques may not be able to eradicate resistant bacteria, including *Enterococcus faecalis*, which can result in problems and reinfection. Furthermore, the necessity for RCR and the risk of reinfection might be increased by subpar post-treatment care, such as poor oral hygiene and irregular follow-up.^{10,11}

Estimates of the prevalence of RCR range widely, from 5% to 15%, and are impacted by clinical and demographic factors such availability to high-quality dental treatment, socioeconomic level, and geographic location. In order to determine the technical, biological, and patient-related aspects that lead to the necessity of root canal retreatments, this research will comprehensively investigate the prevalence of these operations, as well as their success rates. The purpose of this study is to educate dentists on how to improve first root canal procedures and reduce retreatments in the future by providing evidence-based insights. It also aims to draw attention to gaps in existing studies, which advances endodontic techniques and patient care in general.

METHODS

Using the PubMed database, a thorough search of the literature was carried out with a focus on publications released between 2000 and 2023. The search approach comprised of terms like "success rates," "root canal retreatment," "root canal retreatmen," "factors influencing retreatment," and "endodontic treatment failure." Peer-reviewed papers, systematic reviews, and meta-analyses that provide empirical information on the prevalence of RCR, contributory variables, and treatment results were all included in the inclusion criteria.

Research papers were carefully chosen based on their quality of data presentation, methodological soundness, and relevancy. Important components such as prevalence rates, variables linked to RCR, and success rates described in the literature were the focus of the data extraction process. In addition, an assessment was conducted on the methodology utilized in the research to determine how reliable the results were. To guarantee a

thorough examination of the topic, the reference lists of the included papers were also checked for new research.

LITERATURE REVIEW

Research reveals that the failure rate of root canal treatments varies from 5% to 20% worldwide,⁵ due to numerous factors, such as geographic location, socioeconomic position, and access to high-quality dental care, affect the occurrence of root canal retreatment (RCR). With success rates between 70% and 90%, root canal retreatment is a practical alternative for handling endodontic treatment failures.¹²

The typical incidence of retreatment is almost 10%, according to Ng et al. (2011).⁵ However, the percentage of retreatment after treatment also varies within this range of 30% in some populations.¹⁰ Nonetheless, further research indicates that this percentage may vary considerably, spanning from 5% to 15%, mostly contingent upon the demographic under investigation and the caliber of the first care administered.⁴

A significant frequency of retreatment cases was discovered in research done by Jaju et al., (2020) in Chennai, India, especially in the upper anterior teeth and lower posterior teeth. The study also found that retreatment was more common in men and in the 18–30 age range.¹³ Another research from Kuala Lumpur, Malaysia had 40 randomly chosen individuals, of whom half received retreatment and the other half received primary root canal therapy.¹⁴ Remarkably, comprehensive research conducted in Germany over a period of three years, examining 556,067 root canal procedures, discovered that the total overall survival rate for all goal events combined including retreatment, apicoectomy, and extraction was 84.3%. This indicates that within three years of starting therapy, the incidence of retreatments is about 15.7%.¹³

Many factors affect the results of root canal retreatments, and one important predictor of posttreatment discomfort is the pretreatment pain levels.¹⁴ Retreatment is frequently necessary due to coronal leakage, untreated canal space, and poor quality of the first root canal treatment.¹⁵ Pre-operative patient characteristics, the effectiveness of intraoperative therapy, and post-operative restorative variables are all influencing periapical healing following retreatment.¹⁶

Observational studies have demonstrated that variables linked to the durability of apical periodontitis in longitudinal investigations are comparable to those linked to favorable results in clinical research, such as pre-operative diagnosis, root filling quality, and coronal restoration.¹⁷

The efficacy or failure of endodontic treatments is largely determined by procedural parameters, and poor execution of these procedures might result in the need for retreatment. A key step in root canal treatments (RCT) that influences treatment results is access cavity preparation. The finding of all canal orifices, straight-line access to the apical foramen, and preservation of tooth structure are all made possible by appropriate access.²⁰ Although it has been shown that cavities treated with minimally invasive methods retain tooth structure, there is insufficient data to conclude that these methods are better than traditional methods.¹⁸ The RCT prognosis may be compromised by procedural mistakes brought on by inadequate access.¹⁹ In order to change the microbial ecology and encourage periapical healing, the operator's RCT protocol's effectiveness including access preparation is essential.¹⁶ As a result, practitioners should concentrate on designing access cavities that strike a compromise between maintaining as much of the tooth structure as possible and providing enough light and equipment for the root canal system.

It is essential to thoroughly clean the root canal system in order to eliminate germs, debris, and necrotic tissue. One of the main causes of the requirement for root canal retreatment is incomplete root canal cleaning and shaping. Insufficient disinfection of the root canal system can lead to nonhealing, since bacteria may continue to exist in places that are not reachable by irrigation and instruments even after first treatment.²⁰ Incomplete or poor cleaning, shaping, irrigation, and a lack of dental isolation are among the factors that contribute to treatment failure.²⁵ The selection and administration of irrigants have a major impact on cleaning efficacy as well. Because of its antibacterial qualities, sodium hypochlorite is a frequent irrigant, but if it is not administered properly, its effectiveness may be reduced.²¹ Combining irrigants with suitable agitation methods, including ultrasonic or manual

approaches, can improve disinfection and make the removal of debris and biofilm easier.²²

Considerable research has been done on retreatment results and root canal instrumentation procedures. According to Wildey et al. (1992),²³ less needless dentin removals can be achieved by using better tools and methods. Mesio Buccal, mesiolingual, and distal buccal canals are more likely to leak during instrumentation, as shown by canal curvature and location.^{16,24} Imura et al. (2000)²⁵ compared retreatment procedures and discovered that there were no appreciable variations in debris extrusion between manual and rotary devices when filling material was left inside the root canal. Hedström files, however, took less time to complete than Quantec rotary instruments. The study also found that when retreatment operations are performed, rotary devices have a greater chance of breaking.

A further important procedural component influencing treatment results is the obturation procedure. The long-term efficacy of root canal therapy is directly impacted by the quality of obturation (RCT). Canals that are not properly filled might leave gaps that could open up doors for reinfection. According to Vizgirda P. et al. (2004),²⁶ one of the most frequent reasons endodontic treatments fails is insufficient sealing. Treatment results are also influenced by the type of filling material utilized; thermoplasticized gutta-percha as well as bioceramic sealers were found to be more biocompatible and have greater sealing properties than conventional materials. Appropriate compaction methods are necessary to provide a thick fill devoid of voids.^{26,27}

Several anatomical factors that can complicate initial treatment or result in chronic infections frequently require root canal retreatment. The complexity of root canal anatomy, such as curvatures, calcifications, and variations in canal morphology, greatly affects working length accessibility and the overall success of endodontic procedures.^{28,29} The results of retreatment is significantly influenced by whether the original root canal morphology was respected or altered during former treatment; cases with respect for the anatomy had a higher success rate (86.8%) than those with altered morphology (47%).³⁰

Retreatment may be required if the complete root canal system including additional

canals is not included in the disinfection procedure can result in chronic illness.³¹ Remarkably, even in teeth of straight root canals, apical root resorption can impede excellent technical results, emphasizing the need of taking into account a variety of anatomical factors.²⁸ Estimating treatment difficulties and enhancing results in both initial treatments and retreatments need careful evaluation of tooth anatomy prior to instrumentation. Comprehending these anatomical aspects is essential for precise evaluation, efficient case selection, and the successful handling of unsuccessful treatment of root canals.³²

Microbial Persistence

The necessity for root canal retreatment is significantly influenced by microbial persistence, mostly because of the intricate and varied microbial populations at play. Even after first endodontic therapy, research indicates that bacteria and their metabolites are frequently found in teeth that need retreatment. In particular, recurrent endodontic infections are often linked to *Enterococcus faecalis*, which exhibits significant resistance to standard therapies. A number of variables, like as the quality of the original root canal treatment and the existence of extra-radicular infections, affect its persistence.³³

Key Microbial Species

1. Faecal *Enterococcus*: According to PCR methods, *Enterococcus faecalis* is the most often identified pathogen in endodontic failures, exhibiting prevalence rates as high as 75.6%.³⁴ This species is especially dangerous because it may create biofilms that shield it from antibiotics and increase its resistance to standard therapies. It is challenging to obtain positive results in retreatment instances since *E. faecalis* is mostly seen in chronic infections and shows strong antibiotic resistance.³⁵
2. Associations of Polymicrobial: Treatment is made more difficult by the fact that infections frequently include many species, such as *Porphyromonas* and *Prevotella*.^{36,37}
3. *Candida albicans*: This fungal species is frequently detected with *E. faecalis* and adds to the polymicrobial character of infections in retreatment patients. Its existence is important when biofilm

development takes place, as this makes therapy more difficult.³⁴

4. Nucleatum of *Fusobacterium*: It has been discovered as a keystone taxon in infections that occur after treatment and is essential to the dynamics of the microbial community in root canals.³⁸

Treatment of *E. faecalis* and *C. albicans* is complicated by their ability to form biofilms, which protect them from antimicrobial agents, making successful disinfection difficult. Additionally, both species exhibit antimicrobial resistance, allowing them to survive standard disinfection protocols and highlighting the need for the development of more effective antimicrobial strategies.^{39,40}

TECHNOLOGICAL FACTORS

The results of retreatment are significantly influenced by the caliber of the prior root canal filling. Healing failure in first endodontic therapy has been associated with poor root filling quality. Retreatment may be required if the root canal system is not completely sealed as a result of poor obturation methods or materials utilized in the initial treatment.⁴⁶

Improvements in imaging technology, especially cone-beam computed tomography (CBCT), have made it easier to identify anatomical variations in mandibular molars that were previously undetected, such as middle mesial canals (MMC). Locating extra root canal orifices that might have gone unnoticed during the initial treatment has been made possible by the use of magnification tools like dental operating microscopes and ultrasonic tips.⁴¹

However, another study has demonstrated that the use of rotary instrumentation techniques greatly increases the success rates of retreatment treatments, with 75% success rate reported.⁴² It is essential to remove old root filling materials effectively since this enables clinicians to correct any technical flaws that might have led to the initial treatment's failure. When combined, these strategies improve the chances of retreatment success and long-term results.^{42,43}

Several specific patient variables can determine the requirement for root canal retreatment. Age appears to be a significant factor influencing retreatment requirements. A

study of 500 patient records revealed that age was a statistically significant predictor of retreatment success.⁴⁴ Furthermore, in a study of 262 patients, those aged 18 to 30 had the highest rate of retreatment (38.5%), while those over 60 had the lowest (6.9%). This shows that younger patients are more likely to require retreatment.⁴⁵

Interestingly, gender does not appear to be a big factor in retreatment needs. While one study indicated a higher prevalence of retreatment in males (64.9% vs 35.1% females), another found a more balanced gender distribution, with 56% female participants. This suggests that gender may not be a reliable predictor of retreatment requirement.^{44,45}

Recent research has demonstrated the link between patient health and endodontic treatment outcomes. Diabetes was shown to be the most prevalent systemic condition among patients getting retreatment.⁴⁶ Age, gender, and overall health state were all linked with tooth retention following endodontic therapy. Retreatment was associated with lower oral health-related quality of life (OHQoL), with patients who needed treatment for numerous teeth being twice as likely to experience poor OHQoL.⁴⁷ However, nonsurgical retreatment using modern procedures demonstrated a 90.4% success rate after two years, with considerable improvements in patients' quality of life and chewing abilities. These data highlight the necessity of addressing systemic and tooth-related factors in endodontic treatment planning and outcomes.⁴⁸

Follow-up care and monitoring are critical in determining the effectiveness of root canal treatment. Endodontic treatment has a success rate of 69-72% after 24 months. The original lesion size, usage of a rubber dam, root filling technique, and apical level of the root filling all have an impact on treatment outcomes.⁴⁹ Teeth with unmodified root canal morphology have a higher success rate (86.8%) than those with altered morphology (47%). Only 2.8% of asymptomatic teeth with radiographically inadequate root fillings developed problems after a median of 6 years of surveillance.⁵⁰

The necessity for root canal retreatment is influenced by practitioner experience, clinical decision-making variability, and the quality of previous procedures. Practitioners frequently make different retreatment options

based on personal values and their perception of periapical lesions, as outlined by the "Praxis Concept theory," which places such lesions on a health continuum.⁵¹ Retreatment is frequently required due to inadequate cleaning and filling during the initial procedure, resulting in persistent infections and compromised healing, with factors such as the operator's protocol and the tooth's structural integrity playing critical roles.^{16,52}

Practitioner expertise has a major impact on retreatment decisions and outcomes. Even in cases of periapical pathosis, general dentists choose less intrusive techniques such as observation or no treatment, whereas endodontic specialists prefer retreatment.⁵³ The quality of existing root fillings, type of coronal restoration, and presence of periapical radiolucency all influence decisions, with general practitioners frequently preferring implant insertion in difficult patients over specialists.⁵⁴ While current treatments have reduced some difficulties, residents still have greater complication rates than specialists, particularly in ledge formation and flare-ups.^{55,56}

CONCLUSIONS

Root canal retreatment (RCR) remains an essential component of endodontic practice, addressing complications that arise from initial treatment failures. Procedural errors, microbial persistence, anatomical complexities, and patient-specific factors such as systemic health or oral hygiene habits all contribute to the need for retreatment. Despite these challenges, advancements in materials, diagnostic technologies, and treatment techniques continue to improve the efficacy of RCR.

Success rates for retreatment, which range from 70% to over 90%, are influenced by the complexity of the case, the underlying cause of the initial failure, and the skill of the practitioner. The adoption of advanced diagnostic tools like cone-beam computed tomography (CBCT), innovative instrumentation systems, and improved obturation materials have significantly enhanced the precision and success of retreatment procedures. Furthermore, practitioner training and adherence to evidence-based protocols play a crucial role in mitigating treatment failures and optimizing outcomes.

This review underscores the importance of a comprehensive approach that integrates precise diagnostics, meticulous treatment planning, and robust follow-up care to minimize the incidence of RCR. By embracing continuous education and technological advancements, clinicians can refine their skills, improve patient outcomes, and advance the field of endodontics, ultimately fostering greater success and satisfaction in dental care.

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