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Potential Endodontic Failures and Possible Treatment Options: A Review

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Abstract

Introduction: *The presence of post-treatment apical periodontitis, which may be permanent, emergent, or recurring, is typically what distinguishes endodontic treatment failure. Biological and technical aspects might be categorized as endodontic failure causes, anatomical issues such isthmus, apical ramification, and other morphological anomalies can contribute to treatment failures.*

Purpose of the study: *The purpose of this study was to examine the potential causes of endodontic failure and to determine possible approaches in the process of treating endodontically compromised tooth.*

Methodology: *This study had been conducted by a literature review of scholarly articles, peer-reviewed articles, journals, and case studies. Eight database and five government websites were used in this study. The study used twelve articles for the collection of relevant information, which was then reviewed and reduced to nine articles and were included in the research material.*

Results: *The results from this study illustrated the potential endodontic failures would result in compromised tooth vitality. However, effective endodontic procedures were identified and discussed.*

Discussion: *It is challenging to adequately clean, shape, and obturate C-shaped canals due to their complexity. There are various reasons for endodontic failure. In most cases inappropriate mechanical debridement, persistence of bacteria in the canals and apex, poor obturation quality, over and under extension of the root canal filling, and coronal leakage are some of the commonly attributable causes of failure. One more possible factor is biofilms that develop on root surfaces outside apical foramens have been found to be associated with refractory periapical periodontitis, which eventually cause an endodontic failure.*

Conclusion: *The first-line treatment option after failure of initial root canal treatment is nonsurgical retreatment. Endodontic surgery, intentional replantation, and auto transplantation should be considered before extraction and replacement by a single-tooth implant.*

Keywords: *'Endodontics' AND 'Endodontic failure' AND 'Endodontic emergencies' AND 'Endo-Perio lesions' AND 'Root canal therapy' AND 'Endodontic Pain Management' AND Endodontic surgery intentional replantation.*

Introduction

There are various reasons for endodontic failure. In most cases inappropriate mechanical debridement, persistence of bacteria in the canals and apex, poor obturation quality, over and under extension of the root canal filling, and coronal leakage are some of the commonly attributable causes of failure. Root fracture, perforation, and open apices were potential factors too. The primary issue is that the apico-coronal seal is frequently insufficient, allowing tissue fluids rich in glycoproteins to percolate into the root canal and serve as a food source for any remaining microorganisms, which can multiply until they reach a critical mass and cause or sustain a peri radicular lesion.

On the other hand, there are some circumstances in which the sealed root canals can become contaminated by the oral cavity, including filtrations through temporary or permanent restoration materials, fracture or loss of the restoration, fracture of the tooth structure, recurrent caries that expose the root filling material, and a delay in applying the definitive restoration material.

In these conditions, the bacteria can penetrate and recolonize the canal system if the root filling doesn't stop the saliva percolation. Additionally, the presence of microbes that have been isolated as biofilms or planktonic cells. Pathogens have a better environment to live in and have access to a wider variety of metabolic processes in biofilm. These organized functional communities provide bacterial defense against competing microbes, antimicrobial agents, and host defenses in addiction, so increasing the pathogenicity of the bacteria.

Root fracture, perforation, and open apices were potential factors too. High tooth survival rates are seen with nonsurgical retreatment, apical surgery, replantation, and auto transplantation. In most cases, nonsurgical retreatment prioritizes over surgical endodontic treatment. Microsurgical endodontic treatment is superior to conventional surgical endodontic treatment and survival rate is generally high.

Methodology

The primary working hypothesis derived out this research was that the recognizing potential endodontics failures would result in productive treatment planning to address the real issue and developing possible treatment options to maximize patient benefit.

The methodology used to derive this hypothesis was a literature review of scholarly articles, peer reviewed articles, journals, and case studies. The research study began with the identification of the endodontic failures and treatment. This systematic review was conducted in a phased manner and

included the establishment of overall strategy, determination of the inclusion and exclusion criteria, and literature and case study classification and analysis.

Results

The primary issue is that the apico-coronal seal is frequently insufficient, allowing tissue fluids rich in glycoproteins to percolate into the root canal and serve as a food source for any remaining microorganisms, which can multiply until they reach a critical mass and cause or sustain a peri radicular lesion. On the other hand, there are some circumstances in which the sealed root canals can become contaminated by the oral cavity, including filtrations through temporary or permanent restoration materials, fracture or loss of the restoration, fracture of the tooth structure, recurrent caries that expose the root filling material, and a delay in applying the definitive restoration material.

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Pathogens have a better environment to live in and have access to a wider variety of metabolic processes in biofilm. These organized functional communities provide bacterial defense against competing microbes, antimicrobial agents, and host defenses in addiction, so increasing the pathogenicity of the bacteria.

Several other bacteria have also been detected with high prevalences of 48%–60%, including Tannarella forsythia (48%), Dialister pneumosintes (48%–58.3%), Pseudoramibacter alactolyticus (52%), and Filiphactor alocis (48%). Other bacteria that are less frequently identified from the root canals of teeth with failed endodontic therapy include: Streptococcus anguinosus, Streptococcus sanguinis, Vagococcus fluvialis, Campylobacter gracilis, Enterobacter amnigenus, Klebsiella pneumoniae, Atopobium rimae.

Numerous predisposing factors, such as immune function, endocrine disorders, poorly fitting dentures, poor oral hygiene, use of broad-spectrum antibiotics, corticosteroids, immunosuppressive agents, and medications that may cause neutropenia and xerostomia, influence the development of Candida from a benign oral commensal to an opportunist pathogen.

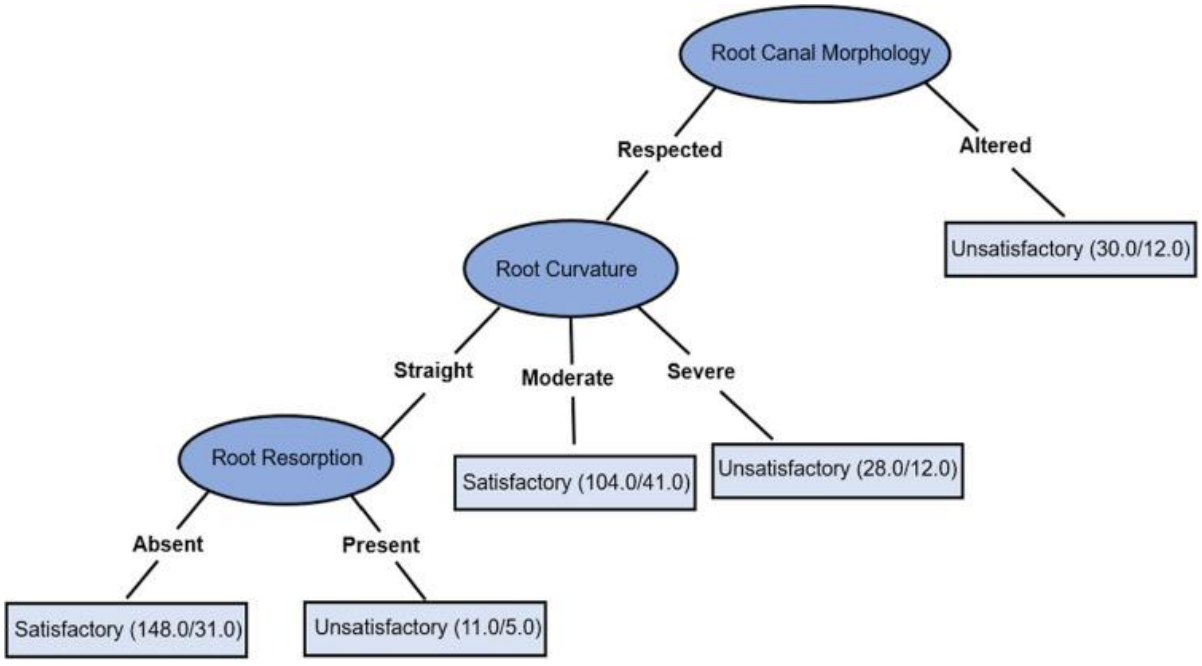
The health of the pulp tissue has a direct impact on how well an endodontic procedure goes. When present, the infection is contained to the pulp chamber and cervical third after the radical therapy for inflamed vital pulp (bio pulpectomy). The peri radicular tissues and root canal system are not infected.

In contrast to treatments for necrotic pulp and retreatment, endodontic therapies with vital pulp have a higher success rate. For dental practitioners, deciding whether to reconstruct or restore nonvital teeth is a challenging issue. Planning, choosing a restorative system, and specifically preparing the cavity should all be properly considered.

To promote healing and maintain the health of the peri-radicular tissue, the major goal of endodontic therapy is to establish a biologically suitable environment within the root canal system. One of the main causes of pulp problems is bacteria, and they can enter the endodontic space by a variety of routes, including carious lesions, traumatic pulp exposures, and fractures. The types of bacteria discovered include facultative anaerobes, aerobes, and the hardiest species that can endure in nutrient-free settings; E. faecalis is a member of this latter group.

After endodontic treatment, E. faecalis is thought to be one of the main causes of reoccurring apical periodontal lesions, with persistent lesions continuing even after re-treatment. The review presented in this paper was performed in accordance with the PRISMA protocol and covers articles from the related scientific literature that were sourced from PubMed, Scopus, and Google Scholar using the following terms as keywords: “endodontic treatment”, “endodontic bacteria”, “microbial endodontic”, and “endodontic failure”.

Only the articles considered most relevant for the purposes of this paper were read in full and taken into consideration for the following review. The findings indicate that the three species most frequently associated with persistent radicular and extra-radicular infections are E. faecalis, Actinomycetes, and P. propionicum.



Authors and year	Study type	Study results
Narayanan L, Vaishnavi C. 2010 (4)	Review	The bacteria involved in the endodontic faillure are: - Fusobacterium nucleatum, Prevotella spp., Campylobacter rectus, Streptococci, Lactobacilli, Staphylococci, E. faecalis, Olsenella uli, Parvimonas micras, Pseudoramibacter alactolyticus, Propionibacterium spp., Actinomices spp., Bifidobacterium spp, Eubacterium spp., Candida albicans
Ricucci D, Siqueira J. 2010 (5)	Ex vivo	- Intrarradicular biofilm: 77% of the canals. In untreated teeth intrarradicular biofilm was found in the 80% of the cases, while in treated teeth in the 74% of the cases. - Extrarradicular biofilm: 6% of the canals - In radiographical small lesions (<5mm), intrarradicular biofilm was found in 62% of the cases, while in radiographical bigger lesions in 82% of the cases (no statistically significant differences) - Intrarradicular biofilm was associated with epithelialized lesions (cysts > granulomas) with statistically significant differences.
Pinheiro E, Gomes B. y col. 2003 (7)	In vivo	The isolated bacteria and their prevalence in endodontic failure are: Enterococcus spp. (36.7%), **Enterococcus faecalis (45.8%),** Streptococcusspp. (30%), Peptostreptococcus spp. (23.3%), Actinomices (13.3%), Prevotella spp. (10%), Stafilococcus (10%), Gemella (10%), Fusobacterium (6.7%), Veionella (6.7%), Lactobacillus (6.7%), Propionibacterium (3.3%), Haemofilus (3.3%)
Siqueira J, Rocas I 2004 (8)	In vivo	The isolated bacteria, with PCR, and their prevalence in endodontic failure are: **E. faecalis (77%),** Pseudoramibacter alactolyticus (52%), Propionibacterium propionicum (52%), Dialister pneumosintes (48%), Filifactor alocis (48%), Candida albicans (9%)
Sedgley C, Nagel A y col. 2006 (9)	In vivo	The E. faecalis presence detected with PCR was 79,5% while with culture was 10.2%. The E. faecalis presence in primary infections is 67.5%, while in secundary infections is 89.6% (statistically significant differences).
Endo M, Ferraz C y col. 2013 (10)	In vivo	The mo. present in filled teeth with apical periodontitis are: Stafilococcus spp. (13.63%), Actinomices spp. (12.72%), Gemella spp. (10.9%), Gemella morbillorum (12%), Haemofilus spp (9.09%), Enterococcus spp. (7.27%), Enterococcus faecalis (13.33%), **Parvimonas micra (24%),** Prevotella nigrescens (14.67%)
Pereira R, Rodrigues V y col. 2017 (11)	In vivo	The mo. isolated in teeth with endodontic failure are: **F. nucleatum (71.6%),** D. pneumosintes (58.3%), T. forsythia (48.3%), A. actinomycetemcomitans (25%), T. denticola (16.6%), P. intermedia (15%), P. gingivalis (15%), E. faecalis (11.6%), P. endodontalis (10%), Prevotella nigrescens (1.6%)
Henriques L, Brito L y col. 2016 (12)	In vivo	The mo. isolated in treatment resistant infections are: **Corynebacterium difteria (8.03%),** Porfiromonas gingivalis (5.42%), Streptococcus sobrinus (5.33%), Stenotrofomonas maltofilia (4.72%), Eubacterium safenum (3.85%), Helicobacter pylori (3.16%), Dialister pneumosintes (3.12%), Clostridium difficile (2.74%), Enterobacter agglomerans (2.64%), Salmonella entérica (2.51%), Mobiluncus mulieris (2.44%), Klebsiella oxytoca (2.32%), Enterococcus faecalis (0.52%), Bacteroides ureolyticus (0.04%), Haemophilus influenzae (0.04%), Prevotella oris (0.01%)
Rocas I, Siqueira J 2012 (13)	In vivo	The bacteria isolated in teeth with posttreatment apical periodontitis are: **Propionibacterium acnes (52%),** Fusobacterium nucleatum (24%), Streptococcus spp (17%), Propionibacterium acidifaciens (14%), Pseudoramibacter alactolyticus (14%), E. faecalis (12%), Tannarella forsythia (12%)

Discussion

The diagnosis must reflect severity in terms of the probability of tooth loss, disease progression, or the emergence of acute systemic problems to build an infection control strategy. The framework provided by disease staging can also be used to decide whether tools and tactics, such as single or numerous appointments, decompression, root-end surgery with or without guided tissue regeneration, and purposeful replantation or extraction, are necessary. To respond to variations in a patient's health requirements and give clinical data pertinent to prognosis analysis, a future diagnostic categorization that includes staging is required.

The occurrence of moderate or severe preoperative discomfort is a crucial clinical characteristic to support the use of an intracanal medication. Patients with acute apical abscesses or symptomatic apical periodontitis should be especially aware of this. Overall, it has been found that the severity of preoperative pain can predict whether a flare-up or postoperative pain will occur. According to a prospective study, 1 week after receiving root canal therapy, 19% of patients will complain of excruciating pain. Before therapy is finished, several predictive indicators, including baseline pain severity, baseline pain made worse by stress, baseline pain interfering with daily activities, and cases of symptomatic apical periodontitis, must be considered.

It is commonly acknowledged that there is a direct correlation between apical periodontitis and root canal infection. Oral biofilms could colonize lateral anatomy, including the apical ramifications, and the main root canal.

The lateral compaction technique, which is often used by the endodontists who contributed to this study to obturate root canals made with hand files, was designated as the control in the current trial. The use of a single cone to fill the root canals (typical for canals instrumented with NiTi rotary or reciprocating systems) boosts the endodontic therapy's simplicity, thus we also decided to utilize a different root filling technique for SFSC.

A feature of enormous significance in addition to the correct cleaning and debridement of canals is the caliber of obturation. In a study involving 1001 endodontically treated teeth, the effectiveness of root canal obturation was found to be the most critical component.

This can cause periradicular irritation to persist at any time. When the canal has undergone an effective cleaning, the odds of a successful result are generally enhanced. It is therefore impossible to overstate the significance of complete debridement. The prognosis may vary depending on the instrumentation stage at which the instrument fails. It becomes challenging to clean and seal the portion of the canal

distal to the broken tool, which could result in a persistent infection there. However, the broken instrument itself has less to do with failure since success is typically only impacted by the presence of a concomitant infection.

Disinfection techniques won't be able to reach bacteria that are present in the periradicular region. Compared to canals that test positive, those with negative bacterial cultures are believed to have higher success rates. Compared to teeth without these radiographic alterations, those with preoperative periradicular rarefactions have a higher risk of treatment failure. In addition to inadequate canal cleaning, a leaky apical seal is a contributing cause of endodontic failure brought on by microbial persistence. If the apical seal is not effectively maintained, fluid seepage is likely to happen.

This can cause periradicular irritation to persist at any time. When the canal has undergone an effective cleaning, the odds of a successful result are generally enhanced. It is therefore impossible to overstate the significance of complete debridement. According to the findings of the latter study, teeth with subpar coronal restorations had lower success rates than teeth with superior obturation and coronal restorations.

However, this study demonstrated that the quality of the root canal filling, not the quality of the coronal restoration, was the primary determinant in the effectiveness of the root canal procedure. However, a satisfactory prognosis of an endodontically treated tooth depends on an impermeable seal in the coronal area. For all materials, a rise in compressive strength was seen.

It has been demonstrated that adding compounds to MTA reduces its strength. According to the current study, MTA demonstrated a higher compressive strength than other MTA associations, which may be attributed to the cements' higher CaO content. CaO may be added to the formulation of MTA in addition to the substance's primary building blocks, such as calcium silicates.

Due to its transformation into calcium hydroxide, CaO plays a significant part in the biological response. It was noted that PC's composition has more CaO than MTA Angelus. CaO reacts with water and is crucial to the hydration process that occurs when cement sets. To retain the natural teeth, endodontic surgery is an effective therapeutic option.

The retrograde instrumentation of the root canal system is one of the main difficulties in surgical endodontics, despite the importance of each step in the process. The persistence of intraradicular bacteria and their by-products is the most frequent cause of nonsurgical and surgical endodontic failure.

The objective of retrograde instrumentation is to remove the obturation material, infected tissues, and irritants from the root canal system and create a space that can be properly sealed. Anything less undercuts the biological foundation of effective endodontic therapy. Numerous retrograde instrumentation techniques have been introduced and tested throughout history.

Conclusion

The effectiveness of endodontic treatment in patients is significantly influenced by their age. According to the findings, the age group of 50 to 41 years had the highest rate of endodontic failures (41.11 percent), while the age group of 21 to 30 years had the lowest rate of endodontic failures (24.44 percent). The calcified channels in the older age groups were the obvious cause of failure in the age range of 41 to 50. Poor oral health and insufficient patient-specialist communication could be the second factor.

Mandibular anterior teeth have a higher incidence of accessory root canal alterations than maxillary counterparts. The most common accessory root/root canal aberrations are those resulting from dens invaginates and palato-gingival groove anomalies in maxillary incisor teeth.

Particularly maxillary canines, primary anterior teeth can have visible and internal anatomical abnormalities in the root. Dental professionals should be aware of these anatomical variances due to the extensive morphological divergence of the root and root canal systems in human anterior teeth to reduce the risk of failure due to insufficient debridement of inaccessible or undetected areas of the root canal system.

Recent advancements in endodontic and periodontal procedures, modern diagnostic tools, and endodontic biomaterials could lead to high levels of success in treating.

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