

REVIEW ARTICLE

Fighting With The Nightmare; An Overview On Persistent Radicular Infections.

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Abstract

The basics of endodontic therapy are much the same as those of wound debridement. It is aimed at the elimination of bacteria from the infected root canal and at the prevention of re-infection. This is accomplished by a thorough chemo-mechanical cleaning of root canal followed by a complete filling of canal space. The purpose of this article is to review and discuss the occurrence causes and consequences of, and strategies to deal with endodontic post treatment residual root canal infection

Keywords; endodontic therapy, retreatment, radicularinfections

INTRODUCTION

The objective of the practice of clinical dentistry is to institute preventive measures, to relieve suffering and to cure disease

These purposes are not achieved by the haphazard utilization of a few therapeutic formulas or of certain mechanical procedures, but they are based on a thorough knowledge of clinical pathology.¹

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The purpose of this article is to review and discuss the occurrence causes and consequences of, and strategies to deal with endodontic post treatment residual root canal infection.

CASE SELECTION

Retreatment and apical surgery are usually performed to treat existing disease, presenting with definitive radiographic changes and possibly clinical signs and symptoms. However, even in the absence of disease, retreatment may be indicated to prevent the potential emergence of disease in the future.

At times, retreatment can be more time-consuming and costly than surgery, particularly when an extensive restoration must be replaced. To summarize, orthograde retreatment is generally selected because of its greater benefit and lesser risk in comparison with apical surgery. A proper and thorough discussion should be done before planning a definitive treatment.

These considerations focus on:

- The patient,
- The tooth in question,
- The clinician,
- The previous treatment attempts.
- Host resistance
- Post restoration

1. Patient considerations

CONSIDERATIONS	NO	YES
Motivation to save tooth in question	Extraction	Retreatment or surgery
Motivation to pursue the best longterm outcome	Surgery	Retreatment
Critical time concerns	Retreatment	Surgery
Critical financial concerns	Retreatment	Surgery

TABLE.1

2. Tooth considerations

After the patient indicates a preference for retreatment, the tooth and surrounding tissues are scrutinized with the aim of identifying clinical conditions that might adversely affect the prognosis.³

- a. **‘Site of infection’:** As explained above, infection by root canal microorganisms is best eliminated by retreatment, whereas infection by extra-radicular microorganisms is best eliminated by apical surgery. In contrast, infection associated with a vertical root crack

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or fracture cannot be predictably eliminated by either procedure.⁴

- Hard-setting cement;
- Broken instrument.

b. Perforation :In the past, the presence of a perforation was considered an indication for surgical intervention aimed at external repair, because of a doubtful prognosis of internal repair. Currently, however, it is recognized that a perforation of the pulp chamber or root impairs the prognosis only when it has become a pathway of infection.

3. Clinician considerations

- a. Capability** is a combination of training, skills and experience. Specialist endodontists usually are more capable of treating post-treatment disease than the non-specialist dentists.
- b. Armamentarium**: Use of special instruments can optimize the benefit– risk balance of both retreatment and apical surgery. Without a referral option, if only the instruments required to perform one of the procedures are available to the attending clinician, that procedure is recommended.
- c. Time availability**: In specific circumstances (remote areas, community clinics), an excessive practice load may prevent the clinician from undertaking an elaborate retreatment of one complex case surgery must be prime concern.⁵
- 4. Previous treatment attempts**: If a previous orthograde retreatment or apical surgery procedure did not result in healing, the quality of that procedure should be evaluated. If the initial case selection is considered to have been appropriate but the quality improvable, the same procedure is recommended again or not the alternative should be considered.⁶
- 5. Compromised host resistance**:Theoretically, weakened host resistance can modify the balance and prompt infection. This factor, however, has not been thoroughly investigated.
- 6. Post restoration** :In addition to the above, there is a risk of root canal contamination during the post space preparation, temporary restoration, and final post cementation.

To summarize, the considerations governing prevention of potential post-treatment disease include:

- The adequacy of the root filling;
- The adequacy of the coronal seal;
- The need for a new restoration.⁷

PRINCIPLES AND RATIONALE FOR IRRIGATION AND INSTRUMENTATION:

a. Irrigation materials :Irrigation is used for the removal of tissue remnants and dentin debris during mechanical instrumentation of the root canal.

Commonly used irrigants used are: Sodium hypochloride, Chlorhexidine, Citric acid and EDTA. Some other irrigants were also used like MTAD and hydrogen peroxide were also used with promising results. Other natural agents like green tea and triphala can be used as natural agents.

Both edta and citric acid regimens are effective in removing the smear layer, but acidic solutions tend to more aggressively demineralize the dentin surface.⁸

b. Instrumentation :Instrumentation plays an important role in the process of eliminating endodontic infections. The handheld endodontic file in its various forms has served as an excellent tool for root canal debridement, but the work with the endodontic file is tedious and time consuming. Stainless steel has been the principal material for fabrication of endodontic files. In 1989, nickel-titanium was proposed as a new alloy for endodontic files.⁹ due to their flexibility, short working time and cutting efficiency they became popular soon in a short time.¹⁰

CAUSES OF RESIDUAL ENDODONTIC INFECTIONS

MICROBIAL CAUSES

1. Intra radicular infections
2. Extra radicular infections

NON-MICROBIAL CAUSES

1. Cystic apical periodontitis
2. Cholesterol crystals
3. Foreign bodies
4. Gutta percha
5. Other plants Materials

MICROBIAL CAUSES

1. Intraradicular infection:

a. Microbial flora of root canal-treated teeth :The endodontic microbiology of treated teeth is less understood than that of untreated infected necrotic dental pulps. The bacteria found in these cases are predominantly Gram-positive cocci, rods and filaments. Species belonging to the genera **Actinomyces**, **Enterococcus** and **Propionibacterium** (previously **Arachnia**) frequently isolated and characterized from such root canals.⁸ **Enterococcus faecalis** is the most consistently reported organism.⁹ The organism is resistant to most of the intracanal medicaments, and can tolerate a pH up to **11.5**, which may be one reason why

this organism survives antimicrobial treatment with calcium hydroxide dressings.¹⁰

- b. Bacterial colonization** :The great majority of microorganisms in apical periodontitis are located in the main root canal. Usually, the infection does not proceed through the apical foramen and bacteria cannot be detected outside the root⁴, although sometimes bacteria may also be found in the periapical tissues. The location of bacteria in lateral canals in various parts of the root canal system has not been studied in great detail.

Histological observations (Fig 1) indicate that invasion from the root canal occurs seemingly at random.

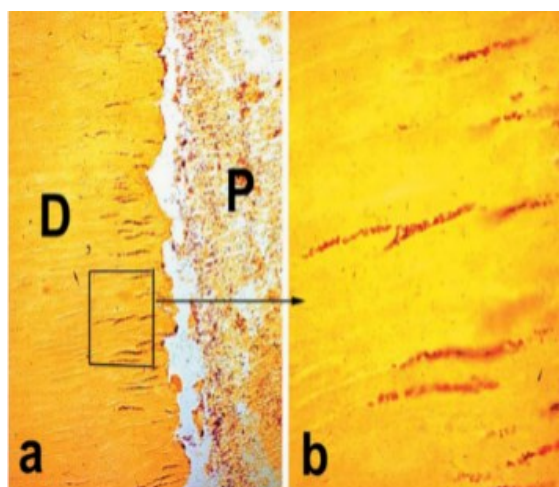


Fig 1. a. Section of root canal wall stained with Brown and Brenn. Dark colored objects represent microorganisms. b. The necrotic pulp (P) is infected and microbes have entered the dentinal tubules (D). Section is a magnification of framed area in a.

2. Extra-radicular infection

Actinomycosis :Actinomycosis is a chronic, granulomatous, infectious disease in humans and animals caused by the genera *Actinomyces* and *Propionibacterium*. They were classified as a fungus for long term due to their morphological appearance. The intertwining filamentous colonies are often called ‘sulphur granules’ because of their appearance as yellow specks in exudates. On careful crushing, the tiny clumps of branching microorganisms with radiating filaments in pus, give a ‘starburst appearance’ which prompted Harz to coin the name *Actinomyces* or ‘ray fungus’. The most common species isolated from humans is *A. Israeli*, which is followed by *Propionibacterium propionicum*, *Actinomyces naeslundii*, *Actinomyces viscosus* and *Actinomyces odontolyticus* in descending order.

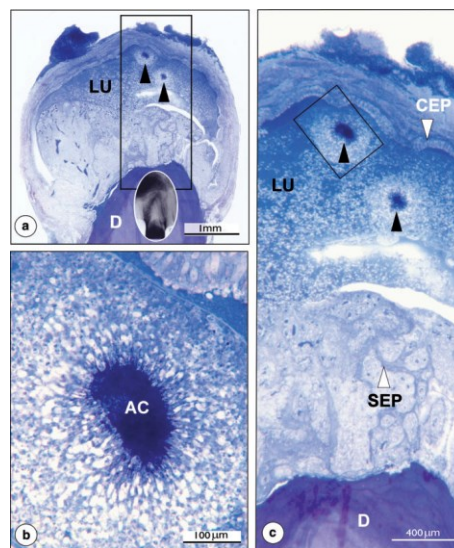


Figure 2 an actinomyces-infected periapical pocket cyst affecting a human maxillary first premolar (radiographic inset). The cyst is lined with ciliated columnar (CEP) and stratified squamous (SEP) epithelia. The rectangular block in (a) is magnified in (c). The typical ‘ray-fungus’ type of actinomycotic colony (AC in b) is a magnification of the one demarcated in (c). Note the two black arrow-headed, distinct actinomycotic colonies within the lumen (LU). Original magnifications: (a) ·20, (b) ·60, (c) ·210. From N.R. Nair et al.¹⁰

NON-MICROBIAL CAUSES

- 1. Cystic apical periodontitis** :The question as to whether or not periapical cysts heal after non-surgical root canal treatment has been longstanding. Oral surgeons are of opinion that cysts do not heal and should be removed by surgery. Many endodontists, on the other hand, hold the view that majority of cysts heal after endodontic treatment.¹⁰
- 2. Cholesterol crystals** :Although the presence of cholesterol crystals in apical periodontitis lesions has long been observed to be a common histopathological feature, its etiological significance to failed root canal treatments has not yet been fully appreciated.. Excess blood level of cholesterol, Deposition of cholesterol crystals in tissues and organs can cause ailments such as otitis and arethero sclerosis.
- 3. Foreign bodies.** :They include amalgam, endodontic sealants and calcium salts derived from periapically extruded Calcium Hydroxide ($\text{Ca}(\text{OH})_2$), amalgam and endodontic sealer components. Scar tissue healing there is evidence that unresolved periapical radiolucencies may occasionally be due to healing of the lesion by scar tissue that may be misdiagnosed as a radiographic sign of failed endodontic treatment.¹⁰

4. **Gutta-percha** :The most frequently used root canal filling material is gutta-percha in the form of cones. The widely held view that it is biocompatible and well tolerated by human tissues is inconsistent with the clinical observation that extruded gutta-percha is associated with delayed healing of the periapex.
5. **Other plant materials** :Vegetable food particles, particularly leguminous seeds (pulses), and materials of plant origin get lodged cause serious issues. Oral pulse granuloma is a distinct histopathological entity. The lesions are also referred to as the giant cell hyaline angiopathy, vegetable granuloma and food-induced granuloma. Pulse granuloma has been reported in lungs, stomach walls and peritoneal cavities

DIAGNOSIS

1. Visualization of bone and periapical tissues

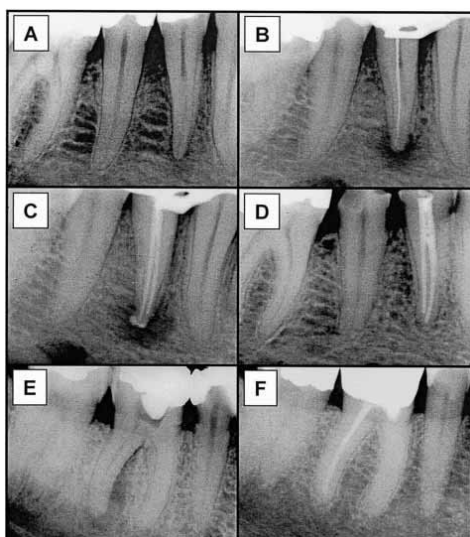


Fig. 3. Appearance of apical periodontitis and features of healing. In (A) through (D), the mandibular first premolar shows features of lamina dura disruption and bone structural changes in (A); 2 weeks later, there is a clear radiolucency confirming an established lesion (B); the root filling 1 week later shows a surplus (C); at the 3-year recall, healing is complete except for some discontinuities in the lamina dura and minor structural disorganization of the apical bone. The distal root of the mandibular first molar in (E) shows chronic apical periodontitis with signs of exacerbation; 24 years after endodontic treatment, there is complete restitution of the periapical bone. Courtesy **Nair et. al**

Radiographic techniques :Bisecting angle and parallel techniques, Multiple exposures, Panoramic radiography, Densitometric methods and subtraction, Tomography and computer tomography, Tuned-aperture computed tomography (TACT), Bone scanning (bone scanning).

2. Histopathological investigations like cultures, staining, catalase testing and oxidase testing can be employed for the proper identification of organism and proper treatment.

SYSTEMIC EFFECTS OF RESIDUAL RADICULAR INFECTIONS

Whether a long-standing canal infection and apical periodontitis will influence general health has been discussed for over a century, but no definite conclusion has emerged. Recently, long-standing inflammation has been related to the risk of cardiovascular diseases. In a study where plasma **C-reactive protein (CRP)**, a marker for systemic inflammation, was measured in 1068 male adults, half developed **coronary heart disease (CHD)** over the course of a 14-year study. It was found that those with very low levels of **CRP**, $<0.5 \text{ mg L}^{-1}$, rarely had CHD; however, when **CRP** was higher than 1.0 mg L^{-1} , the risk of **CHD** was increased.¹¹

STRATEGIES TO DEAL WITH POST TREATMENT RESIDUAL RADICULAR INFECTION

Treatment-benefits and risks

Post-treatment disease, like other disease processes, can be resolved only if the etiological factor is eliminated or critically curtailed. To achieve this goal without having to extract the affected tooth, either orthograde retreatment or apical surgery can be performed. In accordance with the current guidelines regarding treatment decision making processes, the respective benefits and risks of both treatment alternatives have to be weighed.¹²

Benefits

In general terms, 'a treatment procedure is beneficial to a patient if it is in some way conducive to his welfare, health, or both'. When considering treatment alternatives, therefore, factors should be taken into account that can potentially affect those two aspects of benefiting the patient. The better ability of retreatment to curtail root canal infection should theoretically translate into the most important benefit of all:- an improved treatment outcome.¹⁴ Surgery, on the other hand, has a limited capacity to curtail root canal infection, and therefore, it offers a lesser benefit. For extraradicular infection, surgery is an attempt to exclude the microorganisms by totally removing the infected site, whereas retreatment is an attempt to isolate the extraradicular microorganisms by cutting them off from possible, albeit unlikely, support from root canal microorganisms. Surgery therefore offers a better chance to curtail extraradicular infection, and this is its main benefit.¹²

Risks

Both retreatment and apical surgery require considerable manipulation, and should be considered invasive procedures associated with inherent risks. For re-treatment, the inherent risk depends on the type of restoration that is present, and the type of root canal filling or other obstacles that have to be eliminated. At most, the patient is at risk of losing the

tooth because of fracture or a significant complication, such as an irreparable perforation.

Some other risks are :

1. **Post retained restoration** -Post removal is associated with a risk of root fracture, proportional to the retention of the post within the root. Post retention depends on its size, type and the material with which it is cemented— it is the greatest when the post is large.
2. **Root canal obstacles:** Attempts to eliminate insoluble materials, such as zinc-phosphate cement or broken instruments, are associated with a risk of root perforation. The more apical the location of the obstacle, the greater the risk.
3. **Proximity to the inferior alveolar nerve and the maxillary sinus**— Operation on mandibular premolars and molars is associated with a risk of paresthesia or dysesthesia, mainly resulting from manipulation and inadvertent nerve damage. Depending on their proximity to the sinus, operation on maxillary premolars and molars, the risk of misplacing the resected root apex into the sinus, which may necessitate further surgical intervention.
4. **Pain:** Another potential risk associated with treatment is the postoperative sequelae of pain and swelling. According to **Kvist&Reit**, the symptoms subsided faster after retreatment, with only 4% of the patients still having some swelling after 1 week, compared to 66% of patients that had apical surgery.¹³

Alternative options like **laser irradiation** can also be took into consideration if the cost effectiveness is not a concern.

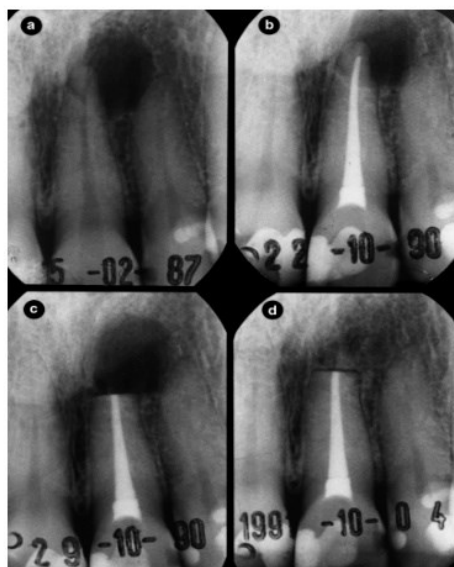


Figure 4. depicting the healing of periapical tissue after surgery (a) before treatment (b) after endodontic therapy (c) 3 months after root resection (d) 4 years recall pic courtesy: **Nair et. al**

SUCCESS	
a)	The contours, width and structure of the periodontal margin are normal;
b)	The periodontal contours are widened mainly around the excess filling.
FAILURE	
a)	A decrease in peri-radicular rarefaction;
b)	Unchanged peri-radicular rarefaction;
c)	An appearance of new rarefaction or an increase in the initial.
UNCERTAIN	
a)	There are ambiguous or technically unsatisfactory control radiographs which could not for some reason be repeated.
b)	The tooth is extracted prior to the 3-year follow up owing to the unsuccessful treatment of another root of the tooth.

TABLE 2 . RADIOGRAPHICAL CRITERIA FOR THE RESULTS OF ENDODONTIC TREATMENT

CONCLUSION

A residual root canal infection, which may be radiographically undetectable, is likely to persist or emerge in most root filled teeth as a consequence of residual endodontic post-treatment root infection.¹⁴ If the objective of root canal treatment is defined as elimination of these infections at a histological level, current treatment procedures must be improved.¹⁵ At the same time, it is essential that further knowledge is acquired of the local and systemic biological consequences of residual post-treatment root infection and post-treatment apical periodontitis.¹⁶

It is always mandatory to follow the proper protocols while doing any elective procedures. Having through knowledge, skills and armamentarium can help one to avoid potential complication which can eventually ruin the time, money and name and fame one acquired through years of hard work. This can always help in reducing the chances of post endodontic treatment infections away from your practice which ultimately delivers the smile to the patient and satisfaction to the clinician.¹⁷

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