

# Failure of endodontic treatment: The usual suspects

Sadia Tabassum<sup>1</sup>, Farhan Raza Khan<sup>1</sup>

**Correspondence:** Dr Sadia Tabassum  
Email: sadyatabassum@gmail.com

<sup>1</sup>Operative Dentistry, Aga Khan University Hospital, Karachi, Pakistan

## ABSTRACT

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. Despite the high success rate of endodontic treatment, failures do occur in a large number of cases and most of the times can be attributed to the already stated causes. With an ever increasing number of endodontic treatments being done each day, it has become imperative to avoid or minimize the most fundamental of reasons leading to endodontic failure. This paper reviews the most common causes of endodontic failure along with radiographic examples.

**Key words:** Endodontics, periapical periodontitis, root canal therapy

## INTRODUCTION

Endodontic treatment is fairly predictable in nature with reported success rates up to 86–98%.<sup>[1]</sup> However, there has not been a consensus in the literature upon a consistent definition of “success” criteria of endodontic treatment. Likewise “failure” has variable definitions. It has been defined in some studies as a recurrence of clinical symptoms along with the presence of a periapical radiolucency.<sup>[2]</sup> An endodontically treated tooth should be evaluated clinically as well as radiographically for its root canal treatment to be deemed successful. Patient should be scheduled for follow ups to ascertain that the treatment is a success and the tooth in question is functional. Myriad of factors have been implicated in the failure of endodontic treatment. The usual factors which can be attributed to endodontic failure are:

- Persistence of bacteria (intra-canal and extra-canal)
- Inadequate filling of the canal (canals that are poorly cleaned and obturated)
- Overextensions of root filling materials
- Improper coronal seal (leakage)
- Untreated canals (both major and accessory)
- Iatrogenic procedural errors such as poor access cavity design
- Complications of instrumentation (ledges, perforations, or separated instruments).

The aim of endodontic treatment is thorough debridement and cleaning of the root canal system

of any infected pulp tissue so the canal space can be shaped and prepared to be filled with an inert material thus preventing or minimizing any chances of reinfection. However, failure ensues when the endodontic treatment falls short of the standard clinical principles.<sup>[3]</sup>

## PERSISTENCE OF BACTERIA

One of the foremost causes of endodontic failure is persistent microbiological infection.<sup>[4]</sup> The role of bacteria in periradicular infection has been well established in literature and endodontic treatment will be afflicted with a higher chance of failure if microorganisms persist in the canals at the time of root canal obturation.<sup>[5]</sup> Bacteria harbored in root canal areas such as isthmuses, dentinal tubules and ramifications may evade disinfectants.<sup>[6]</sup> A study performed by Lin *et al.* on 236 cases of endodontic treatment failures found a correlation between the presence of bacterial infection in the canals and

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periradicular rarefaction in endodontic failures.<sup>[7]</sup> Bacteria present in the periradicular area will be inaccessible to disinfection procedures. Canals with negative cultures for bacteria are said to have higher success rates as opposed to those canals which test positive.<sup>[8]</sup> Treatment is more likely to fail in these teeth with pretreatment periradicular rarefactions than those without these radiographic changes.<sup>[9]</sup> Other than improper debridement of the canal, a leaky apical seal is also a contributory factor in endodontic failure due to microbiological persistence.<sup>[4]</sup> Seepage of fluids is likely to occur if apical seal is not properly established. This can perpetuate periradicular inflammation anytime. The chances of a favorable outcome are invariably higher when an affective cleaning of the canal has been undertaken. Thus the importance of thorough debridement cannot be over emphasized [Figure 1a and b].

## INADEQUATE OR OVEREXTENDED ROOT FILLING

Apart from proper disinfection and debridement of canals, another factor which is of colossal importance is the quality of obturation. The quality of root canal obturation was the most important factor in the success of the endodontic treatment in a study carried out on 1001 endodontically treated teeth.<sup>[10]</sup> In another study which assessed teeth with endodontic failures, 65% of the cases exhibited poor quality obturation whereas 42% of the teeth had some canals which were left untreated.<sup>[11]</sup> Success rates are naturally lower for obturations which are under or overextended and are highest for those which end flush or within 2 mm of the apex.<sup>[12]</sup> According to a study,<sup>[13]</sup> overextended

obturation is 4 times more likely to fail than under obturated canals. In the presence of an existing periradicular lesion, an overextended root canal filling will have a worse prognosis than a tooth without excess filling material.<sup>[9]</sup> Moreover in a study,<sup>[14]</sup> an association was found between increased incidence of periapical periodontitis and inadequate or overextended root fillings. However paradoxical results were reported in a study by Lin *et al.*, in which the apical extent of the root fillings did not seem to have any significant correlation with treatment failures<sup>[7]</sup> [Figure 2a and b].

## IMPROPER CORONAL SEAL

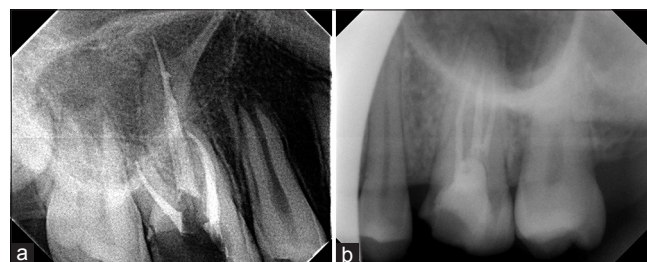
A well-sealing coronal restoration is essential after the completion of obturation as it would prevent the ingress of any microorganisms, which are present in the ambient environment.<sup>[15]</sup> Swanson and Madison<sup>[16]</sup> emphasized in their study that coronal leakage should be considered as a potential factor resulting in endodontic failure. The importance of a good quality coronal restoration was also emphasized by Ray and Trope in their study<sup>[17]</sup> and later, their work was replicated by another retrospective study performed on 1001 endodontically treated teeth.<sup>[10]</sup> The results of this latter study showed that success rates of the teeth with poor quality coronal restorations fell in contrast to teeth with good quality obturation and coronal restorations. However the main determining factor in the success of the root canal was proved to be the quality of the root canal filling in this study rather than the quality of the coronal restoration. Nevertheless, an impervious seal at the coronal area is vital for a successful prognosis of an endodontically treated tooth [Figure 3]. Ng *et al.*, in their meta-analysis stated that pooled success rate for teeth which have satisfactory restorations is higher than those teeth which have poor quality restorations.<sup>[8]</sup>

## COMPLICATIONS OF INSTRUMENTATION

Rotary instruments tend to fracture in the canals when either laws of access cavity preparation are not



**Figure 1:** (a) Endodontic treatment in this patient failed due to a leaky apical seal which resulted in a persistent periapical radiolucency. (b) Retrograde endodontic treatment was done to seal the apices so a favorable environment can occur for the healing of the infection



**Figure 2:** (a) The success rate is reduced: With overextended obturation. (b) And under extended obturation

adhered to or guidelines regarding the use of rotary instruments are not followed. As a consequence of fracture, the access to the apical portion of the root canal is decreased and this could have a deleterious effect on canal disinfection and later on, on obturation. Most of the studies done on the effect of fractured instruments have demonstrated the minimal influence on the success rate of the treatment.<sup>[9,18,19]</sup> The stage of instrumentation at which the instrument breaks can have an effect on the prognosis. The disinfection and obturation of the part of canal distal to the fractured instrument becomes difficult possibly leading to the presence of persistent infection in that area.<sup>[19]</sup> However, the fractured instrument itself has less to do with failure because most of the times, the success is only affected when a concomitant infection is present.<sup>[3]</sup> A clinical investigation on relationship of broken rotary instruments to endodontic case prognosis confirmed that in the absence of any preoperative infection and periradicular changes, a separated instrument is most likely not to affect the prognosis.<sup>[20]</sup> Hence it would be very rare that the fractured instrument is directly involved in endodontic failure [Figure 4a and b].

## UNTREATED CANALS

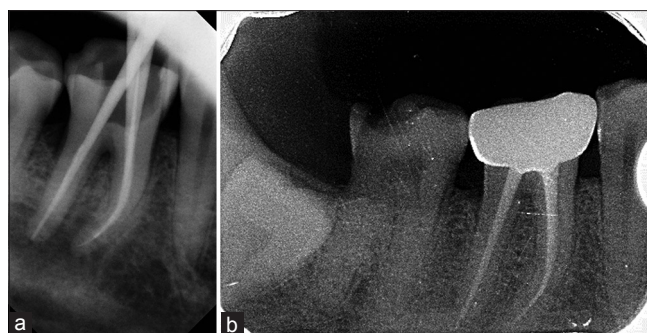
It is not an uncommon practice to miss a canal while carrying out endodontic treatment especially in molar teeth where one root, one canal formula is frequently over ruled by the fact that number of canals are more than the number of roots. Moreover, a less than adequate access opening makes it difficult for the primary dentist to locate the supplemental canals. The inability to treat all the canals is one of the causes leading to endodontic failure. Bacteria residing in these canals lead to the persistence of symptoms. The results of one study carried out on 5616 molars which were retreated showed that failure to locate the MB2 canal had resulted in a significant decrease in the long-term prognosis of those teeth.<sup>[21]</sup> In another prospective study carried out by Hoen and Pink,<sup>[11]</sup> the incidence of missed canals were reported to be 42% of all the 1100 endodontically failing teeth [Figure 5a and b].

## CONCLUSIONS

To sum it up, these “usual suspects” should be kept in mind while carrying out the endodontic treatment. Giving attention to details not only improves the finesse of the endodontic quality but also maximizes



**Figure 3:** Improper coronal seal along with under extended obturation has played havoc resulting in periapical periodontitis



**Figure 4:** (a) File separated in apical third of the mesial canal of a mandibular molar. (b) The tooth is asymptomatic after a follow-up after 2 years



**Figure 5:** (a) Patient remained symptomatic after the treatment of maxillary first molar. (b) On follow-up visit, mesiobuccal 2 was located and obturated

the success. Regular follow ups aid in assessing the outcome and should be done at least on a yearly basis to monitor any changes. However clinical thoroughness during the treatment phase can potentially benefit the clinician and the patient in the long run.

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### Conflicts of interest

There are no conflicts of interest.

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