Introduction

A case of failure of a previous endodontic treatment is a clinical situation that we face in the office very often and the treatment plan, as well as the communication with the patient, is a challenging task. Failure of an endodontic treatment may involve extrusion of filling materials into the periradicular tissue, iatrogenic errors that either block the root canals or alter their natural anatomy. Alternatively, a radiographically satisfactory endodontic treatment may fail and, combined with the presence of intraradicular posts and permanent restorations, access for retreatment may not be feasible or practical. This article describes the decision-making criteria for providing nonsurgical retreatment or apical surgery as the treatment of choice for the management of endodontic treatment failure.

Failure of endodontic treatment

Reasons for failure of an endodontic treatment that are reported in literature essentially involve the presence of intraradicular infection, while others have to do with factors that cause an extraradicular infection. This means microorganisms found outside the root canals. The complexity of the root canal anatomy is one of the causes of failure of an endodontic treatment. Anatomical studies published as early as 1925 described this complexity and showed that, apart from the main root canals, there are lateral canals, anastomoses, apical ramifications and other areas that need to be cleaned during the endodontic treatment. Those areas cannot be accessed with the means of instrumentation and disinfection that we have available today. Isthmuses and apical deltas and ramifications are among these areas. The term “root canal system” is used to describe this complex anatomy (Figs. 1a & b). More recent findings using 3-D microcomputed tomography imaging have proved the inability to shape and disinfect the entire root canal surface. Coronal microleakage and microorganisms that are resistant to antimicrobial medications and disinfection techniques, such as Enterococcus faecalis, can also maintain the intraradicular infection. The importance of an adequate permanent restoration for the long-term success of an endodontic treatment has been proved in many studies.

In addition, the presence of a true cyst, formation of a microbial biofilm, and microorganisms such as Actinomyces and Propionibacterium propionicum that cause periradicular infections resistant to endodontic treatment procedures are among the factors that can cause an extracanal pathology. Even if a paper point is accidentally extruded into the periradicular tissue when treating particularly a necrotic case, it can cause an acute inflammatory response and extracanal infection. Histological images of a true cyst show that it is an entity completely enclosed in stratified squamous epithelium, without any apparent communication with the root canal. Therefore, it is less likely to heal by a nonsurgical endodontic treatment or retreatment. In the case of a true cyst, apical surgery is the treatment of choice.

Endodontic microsurgery

Endodontic surgery was traditionally considered to be the last treatment option, as it was viewed with negativity and uncertainty regarding its therapeutic result. This view was based on past experience with accompanying inappropriate surgical instruments, inadequate visualization, frequent postoperative complications and failures that often resulted in extraction of the tooth. However, in the early 1990s, new theories and equipment were developed in the field of surgery. The operating microscope, ultrasonic tips for root end preparation, surgical microinstruments and new, more biocompatible materials for root end filling led to better understanding of the apical anatomy, greater success rates and improved responses from patients. Therefore, endodontic surgery evolved into microsurgery. Endodontic microsurgery is an apical surgical procedure that combines the magnification and illumination provided by the operating microscope with the proper use of new microinstruments. The operating microscope, ultrasonic tips, microsurgical instruments and the latest root end filling materials constitute the “triad of endodontic microsurgery” that was introduced after 1992.

The use of the operating microscope in endodontic surgery allows for inspection of the apical surface at high magnification, thus revealing anatomical details such as isthmuses, canal fins and lateral canals that may cause endodontic treatment failure. Moreover, at higher magnification, an osteotomy can be made smaller, and by use of digital radiographs and video capture options offered by the microscope, communication with the referring dentist or specialist is significantly improved.

Surgical versus nonsurgical retreatment—Treatment decisions

The aim of the microsurgical technique is a minimally invasive procedure. This means a small osteotomy, about 3–4 mm in size, just enough to allow for an ultrasonic tip of 3 mm to prepare the root end...
Root canal system complexity demonstrated in clinical cases. Lateral canals and ramifications are evident on the post-op radiographs.

Tooth-related factors for decision making on nonsurgical or surgical retreatment.

Quality of restoration
Microleakage
History of crown deccementation
Clinical & Radiographic History
Post/Core/Build up
Canal Blockage
Perforations
Separated files
Missed canals
iatrogenically altered anatomy
Quality of filling
Type of filling
Overfilling
Intraradicular / Extraradicular infection
Operator skills
Armamentarium

Retreatment or Surgery?

The quality of the permanent restoration, the ability to access the root canals, the quality of the root canal filling, iatrogenic errors, and intraradicular or extraradicular infection are factors that must be taken into consideration for the final treatment plan (Fig. 2). If coronal microleakage has occurred or inadequate, open-margin restorations have been placed, nonsurgical endodontic retreatment is the treatment of choice. In the case of intracanal infection, apical surgery blocks the microorganisms inside the root canals, while endodontic retreatment eliminates them. In contrast, in the case of extraradicular infection, apical surgery eliminates bacterial infection, while endodontic retreatment isolates bacteria in the peri-radicular tissue.

However, the main factor that affects the treatment plan is communication with the patient. Modern treatment dictates that the clinician should inform the patient of the benefits and risks of each treatment option in a detailed manner and then provide the treatment that the patient selects.

In the case of a failed endodontic treatment with an esthetically very successful prosthetic restoration, if endodontic retreatment is considered to be time-consuming or even when the patient is unable to afford the cost of the procedure, apical surgery may be the treatment of choice.

The high magnification of the operating microscope provides the ability to see iatrogenic errors during apical microsurgery.
Fig. 3
A failed previous nonsurgical retreatment and apical surgery done on tooth #36. A pre-op radiograph showing persistence of the periradicular lesion. Apical surgery using a microsurgical protocol was determined to be the treatment of choice.

Figs. 4a & b
Inspection of the resected mesial and distal roots under 12× magnification of the microscope revealed (a) a gap in the filling on the mesiobuccal canal and (b) the untreated isthmus between the distal canals.

Fig. 5
Post-op radiograph showing root end filling with mineral trioxide aggregate.

Fig. 6
Radiographic examination at one year. Complete healing was evident.

Conclusion
The microsurgical technique based on the operating microscope, microsurgical instruments, ultrasonic root end tips and root end filling materials that are more biocompatible provides a predictable, minimally invasive solution and is often more favorable than endodontic retreatment. The choice between endodontic retreatment or apical microsurgery is a decision that is based on three pillars: the tooth in question, the patient and the dentist.

Editorial note: A list of references is available from the publisher.