Analysis of the Cause of Failure in Nonsurgical Endodontic Treatment by Microscopic Inspection during Endodontic Microsurgery

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Abstract

Introduction: This study examined the clinical causes of failure and the limitation of a previous endodontic treatment by an inspection of the root apex and resected root surface at 26× magnification during endodontic microsurgery. **Methods:** The data were collected from patients in the Department of Conservative Dentistry at the Dental College, Yonsei University in Seoul, Korea between March 2001 and January 2011. All root-filled cases with symptomatic or asymptomatic apical periodontitis were enrolled in this study. All surgical procedures were performed by using an operating microscope. The surface of the apical root to be resected or the resected root surface after methylene blue staining was examined during the surgical procedure and recorded carefully with 26× magnification to determine the state of the previous endodontic treatment by using an operating microscope. **Results:** Among the 557 cases with periapical surgery, 493 teeth were included in this study. With the exclusion of unknown cases, the most common possible cause of failure was perceived leakage around the canal filling material (30.4%), followed by a missing canal (19.7%), underfilling (14.2%), anatomical complexity (8.7%), overfilling (3.0%), iatrogenic problems (2.8%), apical calculus (1.8%), and cracks (1.2%). The frequency of possible failure causes differed according to the tooth position ($P < .001$). **Conclusions:** An appreciation of the root canal anatomy by using an operating microscope in nonsurgical endodontic treatment can make the prognosis more predictable and favorable. *(J Endod 2011;37:1516–1519)*

Key Words

Cause of failure, endodontic microsurgery, non-surgical endodontic treatment, resected root surface, root canal anatomy

Nonsurgical endodontic treatment is a predictable and reliable treatment with high success rates ranging from 86%–98% (1, 2). Nevertheless, for a variety of reasons, endodontic failure still occurs, and presence of clinical signs and symptoms along with radiographic evidence of periapical bone destruction indicates the need for retreatment (3, 4).

The first and most important step for retreatment is to determine the cause of endodontic failure. Normally, the etiologic factors of endodontic failure can be placed into 4 groups: (1) persistent or reintroduced intraradicular microorganism, (2) extraradicular infection, (3) foreign body reaction, and (4) true cysts (5). Among those, many studies reported that microorganisms in the root canals or periradicular lesions play a major role in the persistence of apical periodontitis lesions after a root canal treatment (6–8).

Endodontic failure related to microorganisms can be caused by procedural errors such as root perforation, ledge formation, separated instruments, missed canals, as well as anatomical difficulties such as apical ramification, isthmuses, and other morphologic irregularities (8, 9). Nevertheless, a precise diagnosis can be made only after surgery or extraction, and there are few reports dealing with the clinical implications and microbiologic persistence (10). A precise inspection of the root apex or resected root surface is one of the best advantages of endodontic microsurgery (11, 12). It helps identify the cause of endodontic failure, so that causative factors can be removed completely during the surgical procedure.

Therefore, this study examined the clinical causes of failure and the limitation of a previous endodontic treatment by examining the root apex and resected root surface at 26× magnification during the endodontic microsurgery of failed teeth with a previous endodontic treatment.

Materials and Methods

Case Selection

The data were collected from patients in the Department of Conservative Dentistry at the Dental College, Yonsei University in Seoul, Korea between March 2001 and January 2011. All root-filled cases with symptomatic or asymptomatic apical periodontitis were included, regardless of whether initial root canal treatment or nonsurgical retreatment had been performed. Teeth with signs of cracks or horizontal and vertical fractures and those with a history of endodontic surgery were excluded. All patients

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were placed on a preoperative regimen of antibiotics and anti-inflammatory drugs. Oral amoxicillin (250 mg) 3 times daily was prescribed starting 1 day before surgery and was continued for a total of 7 days. Ibuprofen (400 mg) was administered 1 hour before and after surgery in all patients.

Surgical Procedure

With the exception of incisions, flap elevation, and suturing, all surgical procedures were performed by using an operating microscope (OPMIRPICO; Carl Zeiss, Göttingen, Germany). All clinical procedures were the same as those reported in a previous study (11, 13) and were carried out by the same operator.

Briefly, the flap was reflected after deep anesthesia, and the osteotomy was performed. After removing the soft tissue debris, an additional 2- to 3-mm root tip with a 0°–10° bevel angle was sectioned with a 170 tapered fissure bur under copious water irrigation. The resected root surfaces were then dried by using a Stropko (SybronEndo, Orange, CA) irrigator/drier, stained with methylene blue, and examined with micromirrors (ObturaSpartan, Fenton, MO) under 26× magnification to determine the possible cause of failure. The root-end preparation and root-end filling were performed. The wound site was closed and sutured with 5 × 0 monofilament sutures, and a postoperative radiograph was taken.

Assessment of Possible Cause of Failure in the Endodontic Treatment

During the surgical procedure, the surface of the apical root to be resected was assessed after hemostasis. The surface was examined and recorded carefully at 26× magnification to determine the state of the previous endodontic treatment by using an operating microscope. When the cause of the previous endodontic failure was obscure, the resected root surface after the root-end resection was stained with methylene blue and inspected in the same manner. The causes of failure were categorized as follows: (1) missing canal: untreated canal regardless of the presence of an isthmus; (2) leaky canal: a gap between the previous root filling and dentin or obvious leakage after methylene blue staining; (3) apical calculus; (4) anatomical complexity: isthmus between the 2 canals filled, apical ramification that has not been treated; (5) underfilling: fillings more than 2 mm short of the apex in the preoperative radiographs; (6) apical cracks; (7) iatrogenic problem: perforation (transportation), file separation; (8) overfilling: excess root filling; and (9) etc: unknown.

Figure 1 gives an example of each category.

To analyze the frequency of each cause of failure according to the tooth position, a Pearson χ^2 test was used with a significance level of .05.

Results

Among the 557 cases with periapical surgery, a total of 493 roots were analyzed. Figure 2 shows the possible causes of failure in the previous root canal treatment. The most common possible cause of failure was a leaky canal (30.4%), followed by a missing canal (19.7%), underfilling (14.2%), anatomical complexity (8.7%), overfilling (3.0%), iatrogenic problems (2.8%), apical calculus (1.8%), and apical cracks (1.2%). Teeth on which nothing was found after the surgical procedure were observed in 18% of all cases.

The frequency of possible failure causes differed according to the tooth position ($P < .001$). Table 1 lists the overview of cause of failure per tooth position. In the maxillary anteriors and premolars, a leaky canal was the most common cause of failure. On the other hand, in the maxillary molar, mandibular premolar and molar, a missing canal was the most common cause. A missing canal and leaky canal showed a similar frequency in the mandibular anterior teeth.

Discussion

The underlying reason for the failure of endodontic treatment is almost invariably due to a bacterial infection (5). The bacteria might be located within a previously missed or uninstrumented portion of

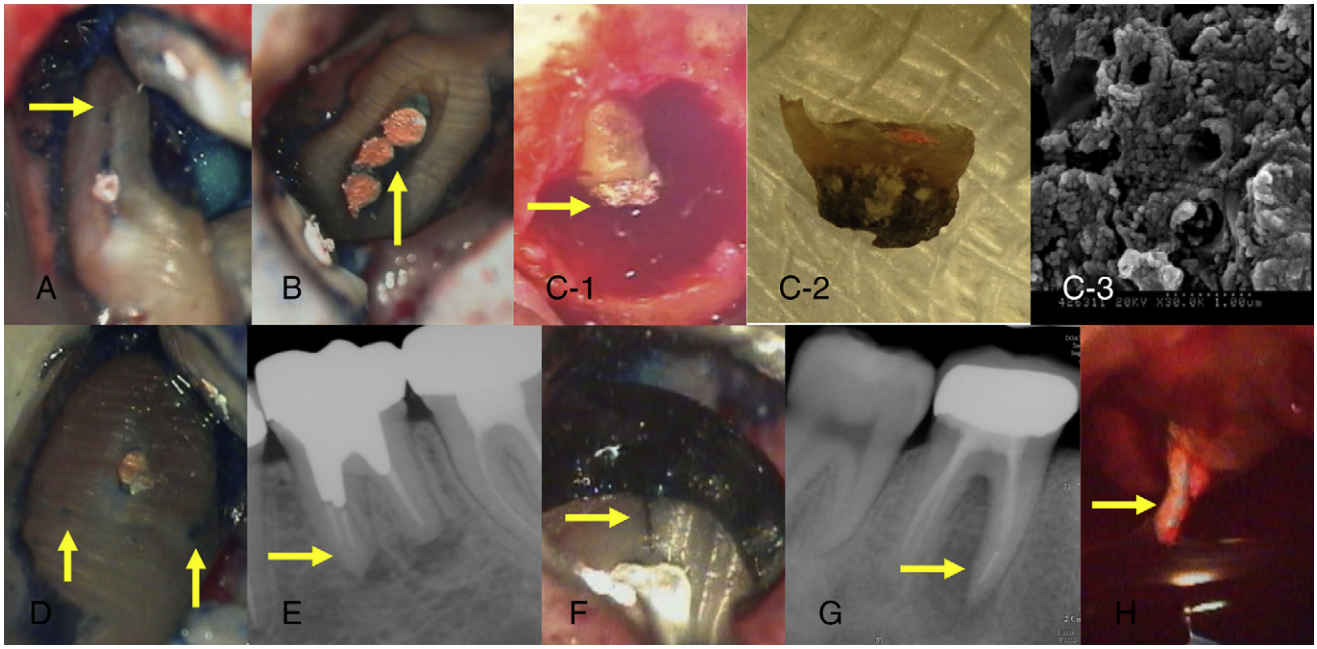

Figure 1. Example of each category of the causes of endodontic failure. Note the arrows. (*A*) Missing canal: second mesiobuccal canal with an isthmus in maxillary molar. (*B*) Leaky canal: gap between gutta-percha and dentin. (*C-1*) and (*C-2*), Apical calculus: calculus deposition caused by chronic sinus tract. (*C-3*), SEM image of apical calculus (×30K). (*D*) Anatomical complexity: accessory canals that have not been touched. (*E*) Underfilling. (*F*) Crack: apical crack at lingual side of root. (*G*) Iatrogenic problem: broken file in mesial root in mandibular molar. (*H*) Overfilling: overextended gutta-percha.