

# Periapical Bone Healing after Apicectomy with and without Retrograde Root Filling with Mineral Trioxide Aggregate: A 6-year Follow-up of a Randomized Controlled Trial

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## Abstract

**Introduction:** In cases of post-treatment periapical disease, retreatment may be necessary. To choose the most appropriate retreatment method, knowledge of the long-term prognosis is important. Surgical endodontic retreatment (SER) is a relevant treatment method. This study assessed changes in outcome from 1 to 6 years after surgery. **Methods:** SER was performed on teeth randomly allocated to have a MTA root-end filling (MTA group) or smoothing of the orthograde gutta-percha filling after apicectomy (GP group). Patients participating in the 1-year follow-up were reinvited for a 6-year clinical and radiographic examination. Three observers assessed treatment outcome both clinically and radiographically from the 1-year and 6-year follow-up examination. **Results:** At the 6-year follow-up, 39 of 52 teeth were available and examined (75% participation rate). In the MTA group, 16 of 19 teeth (86%) and in the GP group 11 of 20 teeth (55%) were assessed as successful ( $P = .04$ ). In the MTA group and the GP group, 80% and 90%, respectively, of teeth assessed as successful at the 1-year follow-up remained successful. All unsuccessful teeth in the MTA group (3 teeth) were lost because of vertical root fracture. **Conclusions:** The proportion of healed cases was larger in the MTA group than in the GP group at both the 1-year and 6-year follow-up. Findings indicate that a 1-year follow-up may not be sufficient in assessing the long-term outcome of surgical endodontic retreatment. With a longer follow-up, other factors not directly related to the endodontic treatment may be relevant for a successful outcome. This needs further investigation in larger patient samples. (*J Endod* 2016;42:533–537)

## Key Words

Mineral trioxide aggregate, periapical surgery, radiographic, surgical endodontic retreatment, trioxide aggregate

The main goal of root canal treatment is either to prevent or treat apical periodontitis (1). If a periapical lesion develops or fails to heal after primary root canal treatment, the primary treatment is regarded as unsuccessful, and retreatment may be performed. Unsuccessful cases can be treated either by nonsurgical endodontic retreatment (NSER) or surgical endodontic retreatment (SER). NSER and SER of unsuccessful primary endodontic cases have been shown to be equally successful treatment strategies, but if NSER is expected to be technically challenging, the most appropriate treatment approach can be SER (2, 3).

In the clinical situation, diagnosis, treatment planning, and evaluation of the treatment outcome are based on subjective symptoms reported by the patient as well as clinical and radiographic findings. Since Rud et al (4) and Molven et al (5) introduced criteria for evaluation of the treatment outcome of SER, these criteria have been widely accepted and used in several studies (6–28).

Randomized controlled trials (RCTs) have proven SER to be a reliable and successful treatment approach in cases of chronic apical periodontitis on root-filled teeth with success rates of up to 89%–94% 1 to 2 years after treatment (29–31). SER has been found to be more successful than NSER after 1 year, but after 3 years of observation, studies have reported equal healing rates (32–35). This has partly been explained by the development of “late failures” in 5%–25% of SER cases (36). When patients have to choose between treatment modalities, knowledge of the long-term prognosis is important. Previous clinical cohort studies have assessed the outcome of SER 3 to 10 years after treatment (6, 10, 11, 13, 15, 18, 20, 21, 23, 25, 28), but differences in the techniques used, materials, and follow-up periods may complicate direct comparison and pooling of data for meta-analyses (23). Nevertheless, a recent meta-analysis of the outcome of SER using a microsurgical technique reported an estimated overall pooled success rate of 92% (37). The importance of a retrograde root-end filling to the outcome of SER has been shown previously (8, 38).

The aim of this study was to assess treatment outcome changes from 1 to 6 years after periapical surgery in teeth randomized to SER with and without placement of a mineral trioxide aggregate (MTA) root-end filling.

## Materials and Methods

The present study reports the results of a 6-year follow-up of a previously performed RCT of the 1-year outcome of SER using a microsurgical technique (8). The study in 2005 to 2006 was approved by the regional committee of ethics and registered in a public clinical trials registry ([ClinicalTrials.gov](http://ClinicalTrials.gov) ID: NCT00228280) and was conducted in accordance with the World Medical Association Declaration of Helsinki.

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The regional committee of ethics independently approved the repeated recall for the 6-year follow-up study.

Briefly, from June 2005 to October 2006, 44 patients (52 teeth) with chronic periapical infection on a root-filled single-rooted tooth participated in an RCT comparing treatment outcome of SER with root-end filling with MTA (ProRoot MTA White; Dentsply Tulsa Dental, Tulsa, OK) and SER with no root-end filling. A comparison was made between 2 treatment modalities in which 1 group of patients (MTA group) received a retrograde root-end filling of MTA, and the patients in the other group (GP group) had a smoothing of the orthograde gutta-percha filling after the apicectomy. All treatments were performed by 1 operator (R.C.) using a dental operating microscope (OPMI Pico; Zeiss, Oberkochen, Germany). For a detailed description of the surgical procedure, see Christiansen et al (8). During surgery, teeth were randomly allocated into 1 of 2 treatment groups, MTA or GP, by drawing a lot. Eight patients contributed with 2 teeth; the first tooth was randomized to 1 treatment group, and the second tooth was then allocated to the other treatment group. Treatment outcome was evaluated 1 year after treatment. A total of 39 patients (46 teeth) were available for the 1-year follow-up.

All patients participating in the 1-year follow-up were contacted and reinvited for a 6-year postoperative clinical and radiologic examination. The follow-ups were performed March to October 2012. The flow of participants and reasons for loss to follow-up can be seen in Figure 1. Six patients (7 teeth; 6 MTA and 1 GP) did not participate in the 6-year follow-up; 3 patients (3 teeth) had died, 2 patients (3 teeth) refused to participate because of impaired general health, and 1 patient (1 tooth) did not respond to the invitation. Furthermore, 3 patients (3 teeth) had had all teeth extracted during the follow-up period and were not seen for clinical and radiologic examination but were included and counted as failures in the final analysis. A total of 30 patients (36 teeth), 16 women and 14 men, participated in the 6-year follow-up examination. A total of 33 participants, 17 women and 16 men, (39 teeth) were included in the final analysis. The MTA group included 10 maxillary premolars, 6 maxillary incisors, and 3 mandibular premolars; the GP group included 9 maxillary premolars, 1 maxil-

lary canine, 7 maxillary incisors, 2 mandibular premolars, and 1 mandibular canine. In cases in which the tooth had been extracted, dental records from the dental school or private practice were examined to find the reason for extraction.

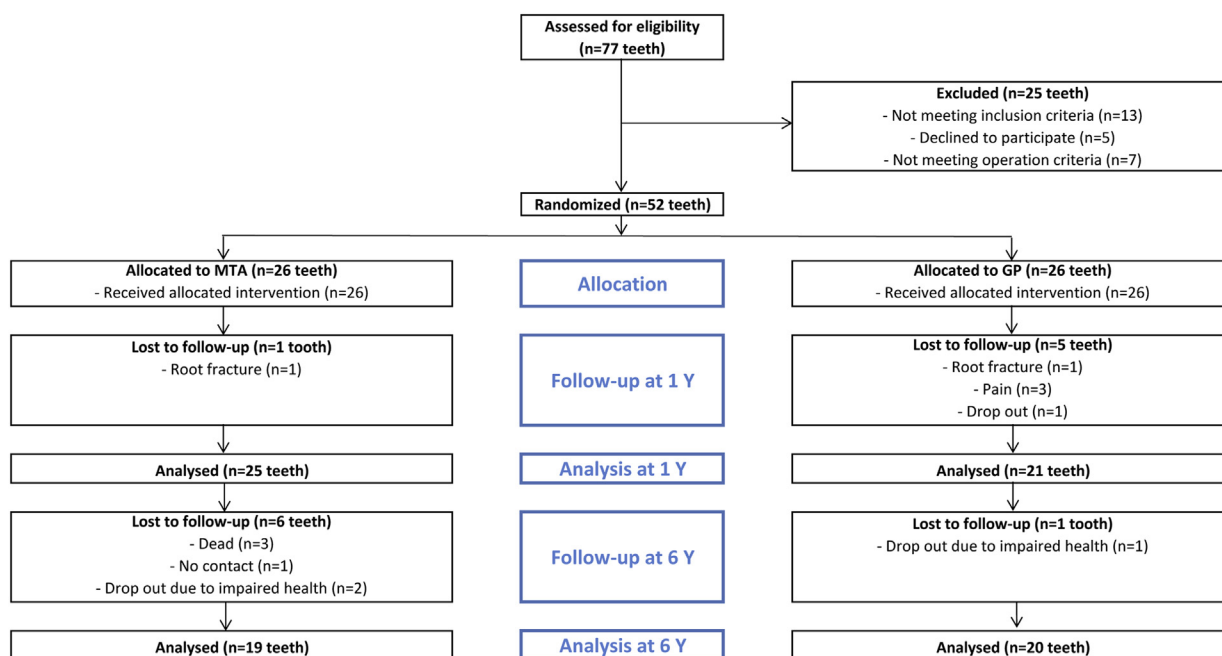
A periapical radiograph was obtained using a Gendex 1,000 DC X-ray unit (Gendex Corporation, Milwaukee, WI) using a paralleling technique, 65 kV, 10 mA, and a film focus distance of 28 cm. The exposure time was adjusted according to the individual patient and region. A storage phosphor plate system was used with a spatial resolution of 755 × 1025 pixels (Dürr Dental VistaScan Plus; Dürr Dental AG, Bietigheim-Bissingen, Germany). All radiographic images were exported from the used system as a tagged image file format to Adobe Photoshop (Adobe Systems Inc, San Jose, CA) and blinded for treatment method by an individually fitted gray area in the apical third of the root.

The blinded 1- and 6-year postoperative periapical radiographic images were assessed individually in random order by 3 experienced observers, 1 radiologist (R.S.N.), and 2 endodontists (C.K. and L.L.K.). Periapical images taken 1 week postoperatively were used for comparison. All periapical images were scored according to the criteria described by Rud et al (4) and Molven et al (5, 39):

1. Complete healing
2. Incomplete healing (scar tissue)
3. Uncertain healing
4. Unsatisfactory healing

Extracted teeth were registered as a separate outcome category. Both written scoring criteria and “atlas drawings” by Molven et al (5) were available to observers during scoring of the images. The periapical scores for the 3 observers were converted to a consensus score by selecting the most frequent score. In 6 cases of disagreement, the observers discussed until a consensus was reached. The clinical examinations were performed by 1 experienced examiner (C.K.). Recorded clinical variables and categories are shown in Table 1.

Data were described and analyzed with the tooth as the unit of analysis. Treatments were compared by computing the difference between the proportions of success. The difference was assessed with



**Figure 1.** A flow diagram of the number of teeth included in the study.

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