Assessment of the Nonoperated Root after Apical Surgery of the Other Root in Mandibular Molars: A 5-year Follow-up Study

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Abstract

Introduction: If a surgical approach is chosen to treat a multirooted tooth affected by persistent periapical pathosis, usually only the affected roots are operated on. The present study assessed the periapical status of the nonoperated root 5 years after apical surgery of the other root in mandibular molars. **Methods:** Patients treated with apical surgery of mandibular molars with a follow-up of 5 years were selected. Patient-related and clinical parameters (sex, age, smoking, symptoms, and signs of infection) before surgery were recorded. Preoperative intraoral periapical radiographs and radiographs 5 years after surgery were examined. The following data were collected: tooth, operated root, type and quality of the coronal restoration, marginal bone level, length and homogeneity of the root canal filling, presence of a post/screw, periapical index (PAI) of each root, and radiographic healing of the operated root. The presence of apical pathosis of the nonoperated root was analyzed statistically in relation to the recorded variables. **Results:** Thirty-seven patients fulfilled the inclusion criteria. Signs of periapical pathosis in the nonoperated root 5 years after surgery (PAI $\geq$ 3) could be observed in only 3 cases (8.1%). Therefore, statistical analysis in relation to the variables was not possible. The PAI of the nonoperated root before surgery had a weak correlation with signs of apical pathosis 5 years after surgery. **Conclusions:** Nonoperated roots rarely developed signs of new apical pathosis 5 years after apical surgery of the other root in mandibular molars. It appears reasonable to resect and fill only roots with a radiographically evident periapical lesion. *(J Endod 2015;41:442–446)*

Key Words

Apical surgery, long-term study, mandibular molars, nonoperated root, periapical index

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Periapical inflammatory changes of the alveolar bone are most often caused by bacterial invasion via the pulp and the root canal system. The therapy of choice is orthograde root canal treatment with the objective to completely clean, disinfect, shape, and fill the root canal system, thereby sealing it off from the oral environment (1, 2). However, if the root canal filling is insufficient, microorganisms may persist in untreated or unfilled root canal spaces or may reinvade after treatment (eg, by way of coronal leakage) (3, 4). As a consequence, apical periodontitis may persist or flare up (5, 6). Review articles report success rates of 60%–94% after conventional endodontic treatment. However, epidemiologic studies document a prevalence of persistent apical periodontitis in root canal–treated teeth ranging from 43%–65% (7–10). Multirooted teeth are at an increased risk of persistent apical periodontitis (11), mainly because of the complex root canal anatomy and, as a consequence, missed or inadequately prepared and filled canals and isthmuses.

To maintain an endodontically treated tooth with persistent periapical pathosis, orthograde revision should be considered as a first choice to remove remaining bacterial niches in the root canal system and to place an adequate root canal filling. If nonsurgical endodontic retreatment is not feasible because of obstruction of the canal by a post, screw, or obliteration, for example, or if associated with risks of root fracture, periapical pathosis should be approached with apicoectomy and placement of a root-end filling.

The main goal of apical surgery is to prevent bacterial leakage from the root canal system into the periradicular tissues by placing a bacteria-tight root-end filling (12). However, there is evidence that "poor density" of the existing orthograde root canal filling reduces the chance of periapical healing after apical surgery, as recently documented in a meta-analysis (13). Insufficient coronal restoration may also have a negative effect on treatment outcome after apical surgery (14) and orthograde endodontic treatment (3, 4). Bacteria may migrate from the oral cavity or from bacterial niches along the existing root canal filling and may cause periapical infection. As a consequence, one may speculate that apical surgery should be performed in all roots of multirooted teeth, even if periapical pathosis is only present in 1 of the roots. To the authors' knowledge, the incidence of new periapical lesions in nontreated roots of teeth previously subjected to apical surgery of the other root(s) has never been reported.

If a surgical approach is chosen to treat a multirooted tooth affected by periapical pathosis, usually only the affected roots are resected and root-end filled. However, this concept is based on experience rather than on evidence. Mandibular molars showed the lowest estimated healing rate after apical surgery in a meta-analysis (13). Hence, the appropriate treatment selection in mandibular molars is particularly critical, and treatment alternatives must be considered.

The decision-making process for tooth retention (apical surgery) or tooth extraction is complex and might also be affected by a possible indication to perform surgery on both roots of mandibular molars, even if only 1 root shows signs of apical pathosis.

The objective of the present study was to evaluate the periapical status of the nonoperated root 5 years after apical surgery of the other root of the same mandibular molar.

Materials and Methods

Patient Selection

The present retrospective study was based on a database of patients treated with apical surgery on mandibular molars from 2000 to 2008 in the same university clinic. The follow-up had to be 5 years. Only 2-rooted mandibular molars, which had previously been root canal treated and were later subjected to apical surgery of 1 root only, were included in this study. Resurgery cases were excluded.

Surgery

All surgeries were performed by 1 experienced oral surgeon (T.v.A.) as previously described (15, 16). A microsurgical technique was used including a surgical microscope and an endoscope to inspect the resected root surface for accessory canals, isthmuses, and cracks. The root-end filling was either performed with SuperEBA (Staident International, Staines, UK) or ProRoot MTA (Dentsply Tulsa Dental Specialties, Tulsa, OK) after preparing the root-end cavity with sonic microtips (Kavo Dental, Biberach, Germany). In other cases, a shallow concavity was first prepared into the root end and then sealed with a resin composite (Retroplast; Retroplast Trading, Rorvig, Denmark) bonded with Gluma (Heraeus Kulzer, Dormagen, Germany).

Collection of Clinical Data

Patient-related parameters including sex (male or female), age at time of surgery (<45 years or ≥45 years), and smoking habit (smoker or nonsmoker) as well as clinical parameters before surgery such as symptoms (pain or no pain) and signs of infection (no signs, redness, tenderness on palpation, tenderness on percussion, swelling, fistula, and abscess) were recorded.

Evaluation of Radiographs

Three examiners (R.D.K, D.G, J.D) independently evaluated the preoperative periapical radiographs and the radiographs taken 5 years after surgery.

For each image, the tooth number (first mandibular molar or second mandibular molar) and the operated root (mesial or distal) were recorded; furthermore, the type (crown, filling, provisional, or other) and quality (adequate, unsure, or insufficient) of the restoration were assessed. The marginal bone level from the cementoenamel junction or, if not visible, from the margin of a crown or filling was measured (mesial and distal ≤3 mm, mesial or distal >3 mm, or mesial and distal >3 mm).

The length of the root canal filling in relation to the apex (0–2 mm from apex, >2 mm short of apex, or overfilled), the homogeneity of the root canal filling (homogeneous or inhomogeneous), and the presence of a post or screw (yes or no) were recorded for each root.

Both roots before surgery and the nonoperated root after 5 years were examined for apical pathosis and scored according to the periapical index (PAI) according to Ørstavik et al (17) (Table 1).

The roots were then dichotomized to reflect absence (scores 1 and 2) or presence (scores 3–5) of apical pathosis. If a root presented a PAI greater than 2, the size (<5 mm, 5–10 mm, or >10 mm) and type (apical, lateral, interradicular, or periradicular) of the lesion were assessed.

The radiographic healing of the operated root (5 years after apical surgery) was determined using the classification by Molven (complete, incomplete, uncertain, and unsatisfactory healing) (18).

TABLE 1. Periapical Index

1	Normal periapical structures
2	Small changes in bone structure
3	Changes in bone structure with some mineral loss
4	Periodontitis with well-defined radiolucent area
5	Severe periodontitis with exacerbating features

Based on data from; Ørstavik D, Kerekes K, Eriksen HM. The periapical index: a scoring system for radiographic assessment of apical periodontitis. Endod Dent Traumatol 1986;2:20–34.

Statistics

All data were collected in Excel spreadsheets (Microsoft, Redmond, WA). For each radiographic parameter, a final category was chosen when at least 2 examiners agreed on the same category. Interexaminer agreement was assessed with Fleiss kappa statistics.

For statistical analysis, the status of the nonoperated root 5 years after surgery was dichotomized into "healthy" (PAI 1 or 2) and "apical pathosis" (PAI ≥ 3). Percent frequencies were generated with regard to the variables.

The probability of a nonoperated root to have periapical pathosis 5 years after surgery was estimated according to the patient's outcome, and a 95% confidence interval was calculated using the method of Clopper and Pearson (19). To check the impact of the recorded variables on the outcome, 2 methods were applied: logistic regression and the Fisher exact test. All statistical analyses were performed with Software R, Version 3.1.0 "Spring Dance" (The R Foundation for Statistical Computing, Vienna, Austria).

Results

Thirty-seven patients, 18 men (48.6%) and 19 women (51.4%), with 37 single mandibular molars fulfilled the inclusion criteria. They had a mean age of 43.8 years (range, 31–61 years). Thirty patients (81.1%) were nonsmokers. The operated teeth included 36 first mandibular molars and 1 second mandibular molar. The most frequently operated root was the mesial root (n = 26, 70.3%). The examination of the preoperative and postoperative variables is summarized in Table 2.

Signs of periapical pathosis in the nonoperated root 5 years after surgery (PAI ≥ 3), given that there were no signs of pathosis at the time of surgery, could be observed in only 3 of 37 cases (Figs. 1 and 2). The estimated probability was 8.1% (95% confidence interval, 1.7%–19.6%).

Except for the measurement of the marginal bone level (kappa value = 0.17), a good agreement was observed among the 3 examiners regarding the collected variables, with kappa values ranging from 0.37 to 0.86.

Discussion

The present study evaluated the periapical status of nonoperated mandibular molar roots 5 years after apical surgery of the other root of the same molar. Three of 37 (8.1%) nonoperated roots of mandibular molars presented signs of newly developed pathosis 5 years after apical surgery on the other root.

Because of this small number, statistical analysis (logistic regression and the Fisher exact test) of the impact of preoperative and postoperative variables on the PAI of the nonoperated root over an observation period of 5 years was not possible. Likewise, the impact of the retrofilling material could not be evaluated.

The only parameter that seemed to have a (weak) correlation with signs of apical pathosis 5 years after surgery was the PAI of the nonoperated root before surgery. Of 16 mandibular molars showing a PAI of 2 (small changes in bone structure) before surgery, 3 (18.8%) developed