Clinical and Patient-centered Outcomes of Nonsurgical Root Canal Retreatment in First Molars Using Contemporary Techniques

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Abstract

Introduction: There have been many recent technical advances in modern endodontics that have the potential to affect treatment outcomes. Reports on treatment outcomes using contemporary techniques are relatively scarce, especially in the field of nonsurgical retreatment. The purpose of this study was to determine the success of nonsurgical root canal retreatment in molars using contemporary endodontic techniques. **Methods:** Sixty-three patients referred for retreatment in first molars were enrolled in the study. The retreatment procedures were performed by endodontic residents using a semistandardized treatment protocol. Patients were followed-up at 6, 12, and 24 months. Treatment outcomes were categorized into healed, healing, or nonhealing based on clinical and radiographic criteria. Healed and healing were considered as successes, and nonhealing was considered a failure. Outcomes were also evaluated using patient-centered criteria that included oral health–related quality of life scores and subjective chewing ability. **Results:** Fifty-two of the 63 patients were available for final analysis. Five cases (9.6%) were determined to be nonhealing at the last follow-up with new or persistent periapical lesions. Thirty-seven (71.2%) patients had complete resolution of apical periodontitis, and the remaining 10 (19.2%) remained asymptomatic and showed radiographic evidence of healing. Oral health–related quality of life scores and chewing ability improved significantly over time ($P < .05$), with the biggest increase observed within the first week of treatment completion. **Conclusions:** This study showed that endodontic retreatment using contemporary techniques significantly improved patients' quality of life and chewing ability over time, with a success rate of 90.4% after 2 years. *(J Endod 2017;43:231–237)*

Key Words

Chewing ability, outcome, quality of life, retreatment, root canal

Significance

This prospective cohort study showed that endodontic retreatment using contemporary techniques significantly improved patients' quality of life and chewing ability over time, with a success rate of 90.4% after 2 years.

Retaining a pulpally involved tooth typically requires endodontic treatment followed by a permanent coronal restoration. Root canal treatment has a high success rate, with a reported survival rate of greater than 97% (1–3). When original root canal treatment fails, retreatment or apical surgery is often indicated. Prognosis generally becomes less favorable with repeated procedures (4, 5). The survival rate of retreatment cases at 5 years is reported to be 89% (6).

According to 2 recent meta-analyses, the pooled weighted success rate for nonsurgical retreatment was 76.6% (7) and 78% (8), with a range of 62%–86% in the reported literature (8). The large range of variation can be attributed to patient population, operator skill level, treatment protocol, assessment criteria, and preoperative apical diagnosis. The most important predictors for retreatment success identified in these meta-analyses include preoperative periapical status, size of lesion, apical extent of the root filling, and quality of coronal restoration (9). Other potential predictors include the presence of preoperative complications such as perforation and intraoperative complications such as pain and swelling (5, 7).

The majority of outcome studies on retreatment have been retrospective in nature, with only 8 prospective studies published between 1995 and 2016 (7, 10–16). Among these prospective studies, only 3 were published after 2005. One investigated the outcome of retreatment after failed apicoectomy (14). The other study with a large sample size and a 2-year follow-up reported a success rate of 85.6% when both "healed" and "healing" were pooled and considered successful (7). The techniques used in endodontic retreatment have evolved rapidly in recent years. The use of surgical operating microscopes has enhanced the operators' ability to locate missed canals, visualize root canal obstructions, and improve manual dexterity (17, 18). The incorporation of ultrasonic instruments into the endodontic armamentarium has drastically improved the efficiency in removing canal obstruction and the effectiveness of irrigation (19, 20). These new advancements have improved the efficiency and technical outcomes of endodontic retreatment; however, whether these improvements can translate into improved clinical outcomes has not been determined.

In addition to the clinical and radiographic criteria, patient-centered outcome measurements are also important in evaluating the effectiveness of a treatment. Oral

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health–related quality of life (OHQOL) is a multidimensional concept that captures how oral health and dental treatment affect the person's ability to function (chewing and speech), psychological states, social factors, and pain or discomfort (21). A modified version of the Oral Health Impact Profile has been previously validated and can be used to measure OHQOL among endodontic patients (22). Because 1 one of the most important functions of the dentition is mastication, patients' subjective ability to chew is a good measurement to determine how a treatment can help restore function (23).

The purpose of the current study was to determine the outcomes of nonsurgical endodontic retreatment in first molars using contemporary techniques. Success was measured using clinical and radiographic criteria as well as patient-centered criteria including OHQOL and subjective chewing ability.

Materials and Methods

This was a prospective cohort study. The research protocol was approved by the Institutional Review Board at Texas A&M University Baylor College of Dentistry, Dallas, TX. Informed consent was obtained from all study subjects.

Patient Population

Sixty-three patients referred to the graduate endodontic clinic at Baylor College of Dentistry for retreatment were recruited to participate in the study. The inclusion criteria were as follows:

1. Adult patients 18–80 years of age
2. Generally healthy without any immunocompromising systemic diseases such as uncontrolled diabetes, AIDS, and so on
3. Teeth requiring treatment were either previously endodontically treated maxillary or mandibular first molars with opposing dentition

Exclusion criteria included:

1. Vertical root fracture
2. Advanced periodontal disease
3. Nonrestorable teeth
4. Major malocclusion. Restorability was determined jointly by the supervising endodontic faculty and the attending restorative faculty.

The preoperative diagnosis was determined based on clinical and radiographic findings using the American Association of Endodontists Consensus Conference–recommended diagnostic terminology. Teeth included in the study had a pulpal diagnosis of previously treated and a periapical diagnosis of normal, symptomatic apical periodontitis, asymptomatic apical periodontitis, or chronic apical abscess.

Treatment Protocol

All treatments were performed by second- or third-year endodontic residents using a predetermined treatment protocol between 2008 and 2013. Patients were anesthetized, and a dental dam was placed according to standard practice. Caries and defective restorations were removed, and an access cavity was made to establish straight-line access. Previous obturation materials and root canal obstructions were removed using a combination of heat, solvent, hand files, rotary files, and ultrasonic instruments. The working length was determined using an electronic apex locator and confirmed with digital radiographs. Root canal instrumentation was accomplished using hand files and nickel-titanium rotary files in a crown-down approach and in combination with chemical irrigation using 20 mL 5.25% sodium hypochlorite (NaOCl) and 5 mL 17% EDTA. Mesial canals in the mandibular molars and buccal canals in the maxillary molars were prepared to an apical size of #35 to 40 with a taper of 0.04 or 0.06; distal canals in the mandibular molars and palatal canals in the maxillary molars were prepared to an apical size of #40 to 60 with a taper of 0.04 or 0.06 depending on the original canal size and anatomy. Passive ultrasonic irrigation with NaOCl was performed for approximately 15 seconds in each canal using a #15 stainless steel file with an NSK ultrasonic unit (NSK America, Hoffman Estates, IL) to aid in the cleaning of the canal system. All treatments were performed under surgical operating microscopes.

Treatment was completed in 2 to 3 visits. An intracanal calcium hydroxide dressing (UltraCal; Ultradent, South Jordan, UT) was placed between visits; and IRM (Dentsply International, York, PA) was used as the interim filling material.

At the obturation visit, calcium hydroxide was removed with copious irrigation with 5.25% NaOCl combined with nickel-titanium rotary instrumentation. Passive ultrasonic irrigation was again used with NaOCl to ensure thorough removal of the medicament. The smear layer was removed with 5 mL 17% EDTA. Canals were subsequently dried with paper points and obturated with gutta-percha (GP) and AH Plus sealer (Dentsply, Tulsa, OK) or Resilon (RS) (Pentron Clinical Technologies, Wallingford, CT) and RealSeal SE (SybronEndo, Orange, CA) with the warm vertical compaction technique using System B (SybronEndo) and Obtura (Obtura Spartan, Algonquin, IL). An IRM temporary restoration was placed. Patients were subsequently referred back to their general dentists for a permanent coronal restoration. Permanent buildup was placed if it was requested by the referring dentist.

Outcome Assessment

Patients were recalled at 6, 12, and 24 months after the placement of a permanent coronal restoration. At each follow-up, standard clinical examinations were performed to determine the integrity of the coronal restoration and the presence of signs and symptoms. The presence of any pain or discomfort to palpation, percussion, or biting with a Tooth Slooth (Professional Results Inc, Laguna Niguel, CA) was recorded. Six-point periodontal probing was also performed and recorded. The presence of any sinus tract was also noted. Digital periapical radiographs were exposed and evaluated by 3 calibrated observers to determine the periapical status. The treatment outcomes were classified into 3 categories according to the following definitions:

1. Healed: the absence of any clinical signs or symptoms and normal periapical tissue with an intact periodontal ligament space and lamina dura or a slightly widened periodontal ligament around extruded material
2. Healing: the absence of any clinical signs or symptoms and periapical radiolucency still present but reduced in size
3. Nonhealing: the presence of signs or symptoms and/or the emergence of new periapical radiolucency or unchanged or enlarged periapical radiolucency

"Nonhealing" was considered "failure," and "success" was the combination of the "healing" and "healed" groups.

At the preoperative visit and all the subsequent follow-up visits, patients were presented with the modified OHQOL questionnaire and the chewing ability questionnaire (Figures 1 and 2). Responses were marked on a Likert scale of 1 through 5, with 1 being "never" and 5 being "all the time."

Statistical Analysis

The rate of "healed," "healing," and "nonhealing" is expressed as a percentage. The influence of various preoperative and treatment factors on the outcomes was evaluated using the Fisher exact test using GraphPad Prism 6 (GraphPad Software, La Jolla, CA). A P value $<.05$ was considered statistically significant.