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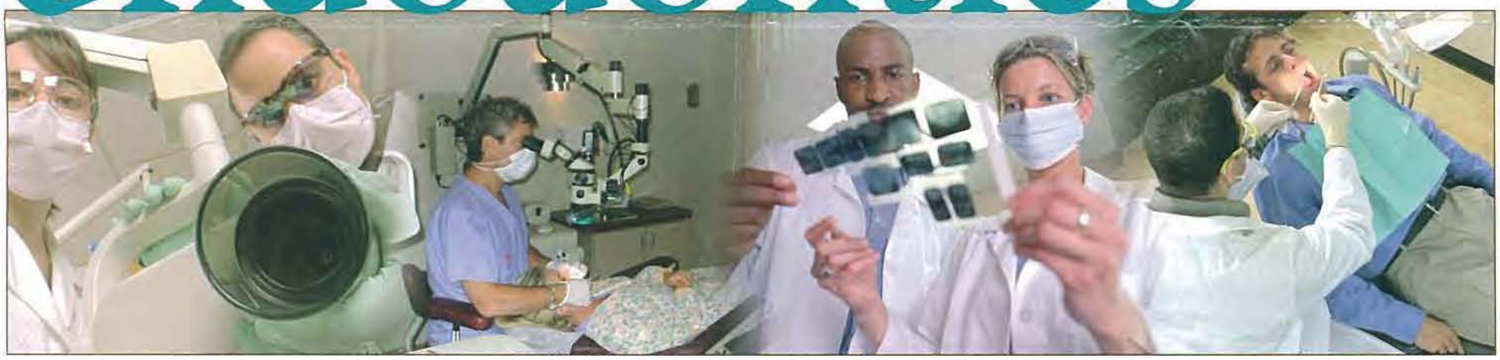

# Orthograde Retreatment: 4- to 6-year Outcomes

The goal of endodontic treatment, to prevent or heal apical periodontitis (AP), is not always achieved. Management of persistent or recurring AP can be divided into orthograde (nonsurgical) and surgical retreatment. Established in 1993, the Toronto Study Project prospectively investigated 4- to 6-year outcomes of treatment provided by endodontic residents.

de Chevigny et al from the University of Toronto, Ontario, analyzed data from the Toronto Study to systematically assess the 4- to 6-year outcomes of orthograde retreatment and to identify outcome predictors. In phases 3 and 4 of the study, all patients referred to the University of Toronto's Graduate Endodontic Clinic for management of post-treatment AP between January 1998 and December 2001 were informed about the benefits and risks associated with orthograde retreatment, apical surgery, and extraction and replacement. A total of 383 patients (477 teeth) who selected orthograde retreatment were included in the study.

Graduate endodontic students evaluated the previous root filling based on material (gutta-percha, silver point, paste or cement), density (absence or presence of voids), and whether the length relative to the radiographic root end was adequate (0–2 mm) or inadequate (short [>2 mm] or long [extruded]). The root-filling quality was then characterized as either adequate (no voids and adequate length) or inadequate (voids present or inadequate length). The residents determined and carried out a treatment plan for the teeth based on clinical considerations.

Of 477 teeth retreated, 333 were lost to follow-up and 18 were extracted, leaving 126 (26%) available for examination. Upon examination, 104 teeth (83%) were classified as healed (a periapical index [PAI] score of ≤2 and no

signs or symptoms other than tenderness to percussion), and 22 teeth (17%) were classified as diseased (a PAI score of ≥3 and presence of signs or symptoms other than tenderness to percussion). Three of the diseased teeth were not properly restored, and 4 were found to be fractured on examination.

Of the 229 teeth examined from all 4 phases of the study, 187 (82%) were classified as healed. Data were analyzed to determine outcome association with preoperative, intraoperative and postoperative variables. Under multivariate analysis, 3 preoperative variables proved statistically significant ($p < .05$) predictors of persistent AP: previous root-filling quality (odds ratio [OR] 4.18), perforation (OR 4.01) and radiolucency (OR 3.33; Table 1). In teeth with radiolucency, outcome predictors were the number of treatment sessions and previous root-filling quality.

### Conclusion

Orthograde retreatment demonstrated a strong overall healing rate of 82%. Teeth that previously received inadequate root filling, which were without perforation and radiolucency, showed better outcomes.

*de Chevigny C, Dao TT, Basrani BR, et al. Treatment outcome in endodontics: the Toronto Study—phases 3 and 4: orthograde retreatment.* J Endod *2008;34:131-137.*

**Table 1.** *Significant predictors of 4- to 6-year outcomes of orthograde retreatment in teeth with preoperative radiolucency, assessed in pooled phases 1–4 (n = 147, fractures excluded)*

| Predictor | OR for disease | 95% confidence interval | p value |
|---|---|---|---|
| **Preoperative** | | | |
| Root-filling quality (0, inadequate; 1, adequate) | 7.68 | 2.36–26.89 | <.001 |
| **Intraoperative** | | | |
| Treatment sessions (0, single; 1, multiple) | 12.08* | 1.84–infinity | .005 |

*Multivariate analysis with logistic regression. *Unstable model, exact logistic regression used.*

## GuttaFlow vs Gutta-percha for Filling Lateral Grooves and Depressions

Gutta-percha has been used for obturation of the root-canal space for more than a century. To seal as much of the cleaned and shaped root-canal system as possible, dentists first used the traditional cold lateral technique, followed by the warm vertical compaction method, believing that compaction of thermoplasticized gutta-percha would better adapt the gutta-percha to the anatomic complexities of the root canal.

In 2004, Coltène/Whaledent, Inc. (Cuyahoga Falls, Ohio) introduced GuttaFlow, a cold, flowable, self-curing obturation material that combines gutta-percha in particle form with a polydimethylsiloxane-based sealer into capsule form that can be injected directly into the canal. Used with a master gutta-percha cone, GuttaFlow requires no manual compaction for placement. The material is designed to fill the space between the root-canal wall and the master cone, along with lateral canals, completely.

Since GuttaFlow does not require heat for effective use, no shrinkage is believed to occur; indeed, the manufacturer reports that the material expands 0.2% upon curing. To test these claims, Zielinski et al from Oregon Health and Science University conducted a split-tooth model test to compare the flow of GuttaFlow with gutta-percha into lateral grooves and depressions in the apical 7 mm.

Using a maxillary canine to fabricate a split-tooth model with depressions and lateral grooves placed in the canal walls at 1 mm, 3 mm, 5 mm and 7 mm from the working length (WL), the authors created 4 groups. Models in the first group were obturated with GuttaFlow. In the other 3 groups, models were obturated with gutta-percha using the System B plugger (Analytic Endodontics, Orange, Calif.) inserted to either 5 mm, 4 mm or 3 mm from the WL and Roth's 801 sealer (Roth International, Chicago, Ill.).

GuttaFlow completely obturated the grooves and depressions at all levels from the WL. At 1 mm from the WL, GuttaFlow showed significantly better flow into grooves, compared with the other 3 groups. At the same level, GuttaFlow flowed significantly better than gutta-percha into depressions, compared with the 5-mm- and 4-mm-from-WL groups, but not the

**Table 2.** *Number of specimens with flow of GuttaFlow or gutta-percha into each depression at the various levels from the WL*

| | Depression level from WL | | | |
|---|---|---|---|---|
| | 7 mm | 5 mm | 3 mm | 1 mm |
| GF | 15/15 | 15/15 | 15/15* | 15/15† |
| GP5 | 15/15 | 15/15 | 10/15 | 7/15 |
| GP4 | 15/15 | 15/15 | 15/15* | 9/15 |
| GP3 | 15/15 | 15/15 | 15/15* | 15/15† |

*GF, GuttaFlow; GP5, GP4 and GP3, gutta-percha with System B plugger penetration to 5 mm, 4 mm and 3 mm from the WL, respectively. *GF, GP4 and GP3 had significantly better flow than GP5 at 3 mm from the WL; †GF and GP3 had significantly better flow than GP5 and GP4, which were not significantly different from each other, at 1 mm from the WL ($p \leq .05$).*

**Table 3.** *Number of specimens with flow of GuttaFlow or gutta-percha into each lateral groove at the various levels from the WL*

| | Groove level from the WL | | | |
|---|---|---|---|---|
| | 7 mm | 5 mm | 3 mm | 1 mm |
| GF | 15/15 | 15/15 | 15/15* | 15/15† |
| GP5 | 15/15 | 15/15 | 1/15 | 0/15 |
| GP4 | 15/15 | 15/15 | 14/15* | 0/15 |
| GP3 | 15/15 | 15/15 | 15/15*, | 4/15‡ |

*GF, GuttaFlow; GP5, GP4 and GP3, gutta-percha with System B plugger penetration to 5 mm, 4 mm and 3 mm from the WL, respectively. *GF, GP4 and GP3 had significantly better flow than GP5 at 3 mm from the WL; †GF had significantly better flow than GP5, GP4 and GP3 at 1 mm from the WL ($p \leq .05$); ‡GP3 had significantly better flow than GP5 and GP4 at 1 mm from the WL.*

3-mm group. The 3-mm group flowed significantly better into grooves and depressions at the 1-mm level, compared with the 5-mm and 4-mm groups (Tables 2 and 3).

### Conclusion

This study suggests that GuttaFlow flows significantly better in the apical 2 mm of a split-tooth model than gutta-percha placed using a warm vertical technique. However, further study is required to evaluate the practicality of its use.

*Zielinski TM, Baumgartner JC, Marshall JG. An evaluation of GuttaFlow and gutta-percha in the filling of lateral grooves and depressions.* J Endod 2008;34:295-298.

## Interaction Between NaOCl And CHX for Irrigating Root Canals

The removal of bacteria and tissue from the root-canal system is vital to prevent apical periodontitis. Since mechanical instrumentation alone cannot adequately remove bacteria and tissue from all root-canal surfaces, and such instruments form a smear layer on those surfaces, irrigation must be employed as a supplement.

While a combination of sodium hypochlorite (NaOCl) and EDTA has been proven to be effective in removing bacteria, tissue and smear layer, NaOCl can damage or destroy tissue if it is extruded out of the root-canal apex and into the periapical tissues. NaOCl also corrodes and weakens endodontic instruments and has a disagreeable odor.

Because of these drawbacks, chlorhexidine gluconate (CHX), a broad-spectrum antimicrobial agent that disrupts the membranes of microbes, has been suggested for use as an irrigant and intracanal medicament. A 2% solution of CHX has antibacterial efficacy comparable to NaOCl, but without its tissue dissolution capabilities. However, it produces an orange-brown precipitate in the presence of NaOCl and when mixed with EDTA, produces a whitish-pink precipitate.

Researchers identified a significant amount of parachloroaniline (PCA) in the precipitate. Used in pesticides and dyes, PCA can further degrade into 1-chloro-4-nitrobenzene.

The amount of PCA left on the root-canal surface is unknown, as are the effects of the precipitate on the root-canal surface. Precipitate can attach to the root surface and may slowly leach into the periapical tissues. Also, the precipitate on the root surface could affect the seal of an obturated root canal, especially with resin sealers in which a hybrid layer is required.

Using an environmental scanning electron microscope, Bui et al from Oregon Health and Science University attempted to evaluate the effect of a combination of NaOCl and CHX on root dentin surfaces and dentinal tubules. Thirty extracted sin-



gle-rooted human teeth were instrumented and irrigated with both NaOCl and CHX to produce a precipitate. Seven negative and 7 positive control teeth were irrigated with NaOCl only; the canals in the negative control group were aspirated and dried with paper points, while the canals in the positive group were left flooded and allowed to air dry.

After drying, the authors analyzed the canal surfaces, determining the amount of remaining debris and the number of patent tubules. There were no significant differences in remaining debris between the negative control group and the experimental groups. However, the experimental groups had significantly fewer patent tubules than the negative control group.

### Conclusion

The presence of NaOCl in the root canal before CHX irrigation did not leave behind statistically significant precipitate on the canal walls. But the reaction between NaOCl and CHX coated the canal surface and tended to occlude the dentinal tubules in the coronal and middle thirds of the canal. Using EDTA alone would be convenient; however, EDTA also produces a precipitate in the presence of CHX. More studies are needed to characterize the interaction between EDTA and CHX. It is recommended that EDTA be used to remove the NaOCl prior to using CHX.

*Bui TB, Baumgartner JC, Mitchell JC. Evaluation of the interaction between sodium hypochlorite and chlorhexidine gluconate and its effect on root dentin.* J Endod *2008;34:181-185.*

## Anesthetic Efficacy Of a Repeat Intraosseous Injection

Several studies of intraosseous injections for pulpal anesthesia have reported success rates >90% in mandibular first molars and maxillary lateral incisors. Onset is immediate, but the degree of profound pulpal anesthesia decreases steadily over 60 minutes.

Jensen et al from Ohio State University conducted a prospective, randomized, single-blinded crossover study to determine the anesthetic efficacy of a repeat intraosseous injection given 30 minutes after a primary intraosseous injection. Fifty-five patients (18 women, 37 men) aged 19–41 years (average 26 years) received an intraosseous injection of 1.4 mL of 2% lidocaine with 1:100,000 epinephrine (Xylocaine; AstraZeneca LP, Wilmington, Del.). Thirty minutes later, the patients randomly received either another intraosseous injection of 1.4 mL Xylocaine or a placebo. At a later appointment, the procedure was repeated in reverse; thus, each patient served as his or her own control. All injections used the X-tip intraosseous anesthesia system (Dentsply Inc., York, Pa.).

Following the initial injection, the first molar and adjacent teeth were pulp-tested every 2 minutes until the second injection was administered. After a 6-minute hiatus, testing resumed every 2 minutes, for a total period of 120 minutes. The criterion for pulpal anesthesia was defined as no response from the patient when the pulp tester was set at maximum output (a reading of 80) for 2 consecutive readings within 10 minutes.

Success of the initial intraosseous injection was 100% for the first molar, 95% for the second molar and 86% for the second premolar. In the teeth that received an initial intraosseous injection followed by placebo, pulpal anesthesia steadily declined over 60 minutes. For the first molar, pulpal anesthesia began declining at 15 minutes; by 30 minutes, approximately 30% no longer had pulpal anesthesia. There were significant differences between the repeat injection group and the placebo group from minutes 36–84 (first molar), minutes 36–82 (second molar) and minutes 37–73 (second premolar).

### Conclusion

Repeating the intraosseous injection 30 minutes after an initial intraosseous injection provided an additional 15 minutes of pulpal anesthesia. Clinicians should evaluate the requirements for onset, success and duration of pulpal anesthesia when selecting a technique.

*Jensen J, Nusstein J, Drum M, et al. Anesthetic efficacy of a repeated intraosseous injection following a primary intraosseous injection.* J Endod *2008;34:126-130.*

### In the next issue:

- Periapical surgery using MTA
- Articaine infiltration for anesthesia of mandibular first molars
- Intraflow osseous injection

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