OUTCOME OF ROOT CANAL TREATMENTS PREPARED WITH TRI-AUTO ZX AND HAND FILING. AN IN VIVO STUDY

S. Özer
Endodontic Department of Oral Health Center, Diyarbakır, Turkey

ABSTRACT
The aim of the present study was to evaluate the outcome of root canal treatments prepared by Tri-Auto ZX and conventional hand filing, in vivo. The subjects of this study were 50 patients. In group I, root canal enlargements of 25 teeth were completed by Tri-Auto ZX. Group II, was control group. In both groups, root canals were obturated with cold lateral compaction. Time used for all preparation procedure and flare-up incidence were recorded. Root canal preparation times were 9 minute less with Tri-Auto ZX when compared with hand filing (16.7 min vs. 25.7 min, p<0.001). Five patients (20%) had flare-up in group I, whereas it was 12 (48%) in group II. Clinical symptoms and/or radiographic radiolucency was observed in three teeth (12%) of the Tri-Auto ZX group and five teeth (20%) in the hand filing group. There was no statistically significant difference (p>0.05) for the presence of disease, incidence of flare-up between the groups after two years. Using Tri-Auto ZX or hand filing in the preparation of root canals did not result in difference in the clinical treatment outcome. Using Tri-Auto ZX significantly reduced flare-up incidence and chair time when compared with hand filing.

Introduction
Complete cleaning is fundamental to proper root canal therapy (1). Confinement of the cleaning procedure to the canal prevents irritation of the periapical tissues and possible overextension of the root filling (2). Overinstrumentation is avoided by accurate location of the canal terminus by means of radiographs, use the tactile sense and electronic measurements. Many mechanical preparation systems have been developed for greater speed and efficiency of treatment. However, in engine-driven mechanical preparation, the operator loses most of his tactile sense (3), and it is hard to know the exact location of the file during the root canal enlargement procedures. As a result, precise enlargement of the apical portion of the canal has been difficult, and the danger of destruction of the apical constriction has always been present (3, 4).

Nickel-titanium has been used recently in the construction of a new generation of endodontic instruments. Their increased flexibility and shape memory potentially allows shaping of narrow, curved root canals without causing aberrations (5-7). By the nature of their design, these files are driven apically when continuously rotated clockwise. Occasionally the file goes beyond the desired length, and overinstrumentation occurs (8). To avoid these disadvantages of engine-driven preparation and nickel-titanium files, a new handpiece monitoring the location of the file tip and the torque applied to the file during all instrumentation procedures have been developed and Tri Auto ZX has been introduced (9). Some of the features of this handpiece are a rechargeable battery, a rotation speed of 280 rpm, adjustable torque, and a built-in apex locator. The apex locator triggers
reversal of rotation when the file reaches a predetermined level, referred to as the Auto Apical Reverse (AAR) level; the apical extent of the instrumentation can mechanism. Preventing damage to the periapical tissues during root canal preparation is aimed by the use of those functions.

The aim of the present study is to evaluate the treatment outcome of root canal treatments prepared with Tri Auto ZX and hand filing, in vivo.

**Materials and Methods**

The subjects of this study were 50 patients, who needed endodontic treatment, that attended the Ege University Dental School, Izmir, Turkey. They were informed about the treatment protocol and all patients were treated by one trained endodontist. During the study, age and gender were not taken into consideration and patients who had temporo mandibular joint (TMJ) disorders were discarded from the study. Also the ones suffering from potentially significant diseases such as immunosuppression, active malignancies, bone disorders, diabetes mellitus and blood diseases were not included in the study because of concerns regarding bone healing. 50 mandibular first and second molar teeth were included (Table 1). 50 patients, having acute symptoms prior to our treatment were treated in the emergency department of our endodontics clinic and pulps were extirpated. Only teeth having vital pulps were preferred for the study. After the procedure, sterile cotton pallets were placed into the pulp chamber and cavities were temporary sealed with Cavit G (ESPE, Seefeld, Germany). No intra canal medicament was placed into the canals to prevent the parameters affecting healing. Patients were recalled one week later for the endodontic treatment. Until the appointment, they were told to take NSA (Non-steroid antinflammatory) for probable mild pain. The criteria for inclusion in the study were that (a) The patient had no history of periodontitis and the tooth which required RCT was periodontally healthy, (b) The patient had a good preoperative periapical radiograph of the tooth requiring RCT that demonstrated the absence of apical periodontitis (AP), (c) Teeth requiring RCT should have no obstruction like pulp stones and excessive calcification through the root canal coronoapically.

Since there were no subgroups (with AP, without AP, necrotic pulps, pulps having extended vitality results and emergency patients), patients were distributed in a similar composition by a blinded person and each group contained 25 teeth.

In both groups, standard endodontic accesses were performed by using round burs 801-020 ML (Diatech, Charleston, U.S.A). After having the cavities, they were irrigated with 1 ml of 2.5% NaOCl and prepared for root canal enlargements. The methodologic aspects specific to this study are detailed below.

**Group I**

After opening the access cavity, irrigation was performed with 1 ml of 2.5% NaOCl, following the procedure of drying the pulp chamber with a cotton pellet. Root canal lengths were determined by the electronic root canal length measurement (EMR) mode of Tri- Auto ZX. Control radiographs were taken to ensure the working length. If there was a difference between EMR and radiographic determination (RD), RD was considered to be the correct one, considering 1 mm coronally from the radiological apex. Coronal initial preparation was completed with Quantec Flare Series (Tycom Dental, Irvine, CA, USA) including .08, .10 and .12 tapers and apical preparation was completed with Quantec LX files numbered from 1 to 9 according to the manufacturers’ instructions. Quantec LX files ranging between 1-9 have the same patency of conventional hand files, sizing between 15-45. The canal was instrumented with a step-down technique. The automatic apical reverse (AAR) mode of
TABLE 1

Clinical and radiographic status of the endodontically treated teeth at the two year examination

<table>
<thead>
<tr>
<th>Treatment Group</th>
<th>Tri Auto ZX n=25 (%)</th>
<th>Hand Filing n=25 (%)</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful</td>
<td>22 (88)</td>
<td>20 (80)</td>
<td>NS</td>
</tr>
<tr>
<td>Failure</td>
<td>1 (4)</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>(1) Clinical Failure</td>
<td>2 (8)</td>
<td>2 (8)</td>
<td>NS</td>
</tr>
<tr>
<td>(2) Both clinical and radiograph</td>
<td>1 (4)</td>
<td>2 (8)</td>
<td>NS</td>
</tr>
<tr>
<td>(3) Present radiolucent area, no clinical signs</td>
<td>3 (12)</td>
<td>5 (20)</td>
<td>NS</td>
</tr>
<tr>
<td>Total (1)+(2)+(3)</td>
<td>5 (20)</td>
<td>12 (48)</td>
<td>**</td>
</tr>
</tbody>
</table>

NS, non significant;  ** p<0.01.

Tri-Auto ZX was set to 1.0 during all root canal preparations. Distal root canals were enlarged to size 45 whereas it was size 35 for mesiobuccal and mesiolingual canals. Final preparation size was equal for both groups. Root canals requiring preparation exceeding size 45 for distal, size 35 for mesial root canals or less, and these were discarded from the study concerning their prevention about standardization. An EDTA-containing paste (RC-Prep, Premier Dental Products, Philadelphia, PA, USA) was used as a chelating agent and 2.5% NaOCl as an irrigant. An intracanal dressing of chemically pure calcium hydroxide (Ultracal, Ultradent, UT, USA) mixed with distilled water was placed for the inter-appearance dressing and the access cavity was sealed with Cavit (ESPE, Seefeld, Germany).

**Group II**

Having the access cavities prepared, root canal lengths were determined by radiographic evaluations, subtracting 1 mm from the radiological apex. The preparations of the canals were completed using stainless steel Hedstrom Files (Thomas-Endo, France) by step-back technique. Gates-Gliddens were used to shape the coronal thirds, apical preparation was completed by files ranging from 15 to 45 and all canals were prepared within this range. Distal root canals were enlarged to size 45 whereas it was size 35 for mesiobuccal and mesiolingual canals. Final preparation size was equal for both groups. Root canals requiring preparation exceeding size 45 for distal, size 35 for mesial root canals or less, and these were discarded from the study concerning their prevention about standardization. Following the next sessions, if the teeth were symptom free, control radiographs were taken with gutta-percha to ensure the working length and root canals were obturated by cold lateral compaction using Diaket as sealer. The symptomatic teeth were medicated with calcium hydroxide (Ultracal, Ultradent, UT, USA) until the next session for healing.

In the following session, if the teeth were symptom free; the temporary fillings were removed and the canals were prepared for the root canal obturation. In both groups, teeth were obturated with cold lateral compaction and Diaket (Espe, Seefeld, Germany) was used as sealer. The base of the pulp chamber was restored with a polycarboxilate cement, Poly F Plus Bondex (Dentsply, De Trey, Germany) and the final restoration was completed with composite filling, Filtek TM Z250 (Espe, Seefeld, Germany).

During the endodontic treatment, root canal preparation time and number of flare-ups were recorded. All study patients were recalled at six-month intervals for two
years. One blind examiner carried out all the clinical examinations. The tooth was regarded as ‘successful’ if there was no clinical symptom such as pain, tenderness to percussion, mobility, soft tissue pathosis like sinus tract, abscess and rated as normal in the radiographic examination. Periapical radiographs were taken and evaluated by the same blind examiner. The radiographs were evaluated for the periapical status of the tooth. The periapical status at different roots were graded according to the most severely affected root. It was categorized as follows (10).

a. Normal-Normal appearance of the surrounding osseous structure
b. AP-Observation of periapical radiolucency
c. Not Classified- Insufficient quality of radiograph to evaluate periapical status
A treatment failure was recorded if the tooth had been extracted.

**Statistical Analysis**
Statistical analysis was performed by using Cochran Q test and the difference related with time was evaluated by McNemar test. Independent Student t-test was performed to compare the time used for the course of root canal enlargements for the two groups. The level of significance used in all tests was set at 95%.

**Results and Discussion**
In this study, a total of 50 mandibular molar teeth in 50 patients were investigated. One tooth in group II was extracted due to the vertical fracture on the third examination and clinically it was classified as ‘failure’. A total of 49 teeth from 49 patients were reviewed at the end of two year evaluation. The observation period was 48 months. 25 teeth were prepared with Tri-Auto ZX in engine driven and 25 teeth were prepared with step back technique in hand filing techniques. Five patients (20%) had flare-up in group I, whereas it was 12 (48%) in group II within two weeks during root canal treatment between the sessions. There was statistically difference (p<0.01) (Table 1) between groups in terms of incidence on flare-up. Clinical symptoms and/or radiographic radiolucency was observed in three teeth (12%) of the Tri-Auto ZX group and five teeth (20%) in the hand filing group. There was no statistically significant difference (p>0.05) (Table 1) for the presence of disease between the groups after two years.

Time needed to complete the whole course of preparation was 16.7±8.6 for Group I and 25.7±8.1 for group II (Table 2). This difference was statistically significant (p<0.001). On the average, root canal preparation using Tri Auto ZX was about 9 minutes faster than hand filing. One tooth failed because of fracture on the fourth examination and sample size reduced to 24 in group II but this decrease did not effect the outcome results, significantly.

Root canal treatment is affected by such clinical factors as effective biomechanical instrumentation of the root canal, dissolution of organic components to eliminate bacterium, disinfection and a hermetically sealed obturated canal (11-14). Furthermore, good working safety is a main prerequisite for the use of any instrument.

To the best of our knowledge, three-dimensional filling of the root canal with gutta-percha and sealer is the main prerequisite of the root canal treatment (15). Before the obturation, root canal must be chemomechanically enlarged to a sufficient size and shape to eliminate bacteria within the root canal system and facilitate filling of the root canal. A tapered preparation with minimal apical enlargement is desired to maintain maximum apical seal and allow sufficient irrigation of the root canal (16).
Nickel-titanium rotary instruments prepare root canals in a crown-down technique in the same standard as traditional techniques using hand files and step back method and have the advantage of increased speed of preparation and decreased operator fatigue (17). The method and materials used for preparing and filling canals are numerous, but there is little data to prove that one technique is superior to another in obtaining a successful outcome.

The application of nickel-titanium to endodontic instrumentation has resulted in the production of engine driven rotary instruments. Root canals have started to be prepared more effectively and rapidly when compared with hand filing (18-21). Another benefit of this technology has been a dramatic decrease in post-operative sensitivity for those patients having a root canal done with rotary instrumentation. This result is a combination of the file design (22). Reddy and Hicks (23) were the first to compare apical debris extrusion between hand instrumentation and engine-driven nickel-titanium instruments. The authors suggested that rotation during instrumentation on ni-ti tended to pack the dentinal debris into the flutes of the files and directed them toward the orifice. The engine-driven techniques extrude smaller amounts of debris and irrigants, presumably due to the rotary motion, which tend to direct debris toward the orifice, avoiding its compaction in the root canal (24). However, in hand filing, the filing action of the instrument may act as a piston, pumping the irrigation solution and debris through the apex (25). Since exclusively using clockwise or alternate rotary motions, debris is extruded beyond the apical foramen and it is considered as one of main responsible factors of flare-up. Tri Auto ZX system protects against overpreparation and prevents flare-up. These finding were also confirmed by Grimberg et al. (26) and the device was found useful and reliable.

In the present study, flare-up incidence in group I was significantly less than in group II (p<0.01) (Table 1). We believe that Tri-Auto ZX’s automatic apical reverse (AAR) mechanism actively prevented accidental overinstrumentation and the flute design of the files extruded debris from the apical foramen (5-7). This may be the explanation of our decreased rates of pain since the material extruded from the apical foramen is related to post-instrumentation pain or to a flare-up (27). The AAR setting was set to 1.0 during all root canal preparations and it was also found to be appropriate for clinical applications by Campbell et al.(8). In a previous study, Campbell et al (8) found that electronic length and apical reverse length functions of the Tri Auto ZX are highly accurate in locating the apical constriction of root canals in vitro. An in vivo study by Zmener (28) confirms these findings, suggesting that Tri Auto ZX was accurate for detecting and measuring the distance to root perforations when the device was set to 1.0.

In the present study, root canal enlargements of mandibular molar teeth were performed because mandibular molars, in some cases, are the most difficult teeth to treat. It is found that, the design of the file holder requires attachment below the handle resulting in approximately a 3-mm reduction in file length, which necessitated the use of 30-mm long files many times and it was hard for many patients for opening their mouths to that distance. Even with these shortcomings, with practice, the Tri Auto ZX has the potential to be easier and more time efficient than hand instrumentation.

Conclusions

It is concluded that, root canal treatments prepared by Tri-Auto ZX were clinically acceptable candidates versus hand filing. Tri Auto ZX is a safety electronic handpiece for usage in endodontic clinics. Another finding is that, the time required for root canal enlargement with Tri Auto ZX required significantly less time than hand filing, in vivo.
REFERENCES