In vitro Evaluation Of Three Techniques To Obtain 0.06 Taper Canal Preparations

Abstract

The aim of this study was to evaluate the ability of three obturation methods to seal root canals prepared using 0.06 taper rotary instruments. Forty-five extracted human single-rooted teeth were instrumented with 0.06 taper Profile nickel-titanium rotary files and randomly divided into three experimental groups containing 15 teeth each. The first group was obturated using the System B technique with 0.06 taper standardised gutta-percha points, the second group was obturated using the System B technique with non-standardised MF gutta-percha points, the third group was obturated by cold lateral condensation technique using standardised 0.02 taper master gutta-percha points. Apical leakage of the roots was evaluated by dye penetration using a stereomicroscope after sectioning the roots. The group obturated using System B and 0.06 taper gutta-percha points showed the least dye penetration. However, the difference in the linear extent of dye penetration was not statistically significant.

Introduction

The final stage of root canal therapy aims at providing a satisfactory seal of the root canal system. This is achieved through the process of obturation where the canal is filled with gutta-percha in standardised, conventional, or thermoplasticised forms in conjunction with endodontic sealer. In recent years, the process of cleaning and shaping the root canal system has undergone a degree of automation with the introduction of nickel-titanium (NiTi) rotary instruments. These instruments improve canal shape and minimise canal transportation. To improve the efficiency of NiTi instruments, varying taper NiTi files were introduced to facilitate obtaining a continuously tapering preparation from the apical foramen to the orifice with reduced preparation time. Paralleling the introduction of new instrumentation techniques was the introduction of new obturation techniques to seal root canals prepared using the 0.06 taper rotary instruments.

Materials And Methods

Forty-nine extracted human single-rooted teeth with mature apices were selected. Specimens were eliminated if they had previous root canal therapy or multiple canals. The external surface of the teeth was cleaned to remove debris and the teeth were stored...
in 10% formalin until needed. The crowns were removed at the cemento-enamel junction with a diamond bur in a high-speed handpiece under water coolant. Working length was determined visually by advancing a size 10 K-file into the root canal until the tip was just visible and then subtracting 1 mm from the measured length of the file. The coronal and middle thirds of the canals were initially prepared with size #2, #3 and #4 Gates Gllidden burs. Then, 0.06 taper Profile NITi rotary files (Maillefer Dentply, Ballaigues, Switzerland) were used to prepare the canals, starting with a size 15 file and finishing with a size 40 master apical file. During instrumentation, root canals were irrigated with copious amounts of 5.25% sodium hypochlorite. At the end of instrumentation each canal was flushed with 1 ml of normal saline and then dried with size 40 paper points. Forty-five teeth were randomly divided into three experimental groups containing 15 teeth each. The remaining four teeth were assigned to positive and negative control groups.

The experimental groups were obturated using the following obturation techniques. The first group was obturated using the System B technique. System B was used to generate a continuous wave of condensation as recommended by the manufacturer and by Buchanan (4). The canal walls were coated with AH26 sealer (Dentsply De Trey GmBH Konstanz, Italy) and a 0.06 taper standardised gutta-percha points (Autofil® greater taper gutta-percha, Analytic Endodontics, G'endora, CA) was placed 0.5 mm short of the working length. The fine System B tip (0.06 taper) was used to thermoplasticize and condense the gutta-percha. The heat source was adjusted to 200°C and the tip was activated and advanced through the gutta-percha until it was 3 mm short of the working length. The tip was then deactivated while still maintaining the apical pressure for 10 seconds. The tip was briefly activated for one second to heat and allow easy removal of the tip. The middle and coronal thirds of the canal were filled using the Obtura II (Obtura Corporation, Fenton, MO, USA) followed by compaction using Schilder plugs. The second group was treated in a similar manner to the first group except that non-standardised medium-fine (MF) gutta-percha points (Autofil® medium-fine gutta-percha, Analytic, China) were used as the master cone instead of 0.06 taper gutta-percha points. The canals in the third group were obturated by lateral condensation technique using standardised 0.02 taper master gutta-percha points (Sure Dent Corp., Seoul, Korea) and size XX accessory gutta-percha points. All samples were stored for 10 days in a humid chamber at 37°C to allow for complete setting of the sealer cement. In the experimental groups, the coronal access was sealed with casting wax and the entire root surface, except the apical 1 mm, was covered with two layers of nail varnish. In the negative control group, the coronal access was sealed with casting wax and the entire root surface, except the apical 1 mm, was covered with two layers of nail varnish. The positive control teeth showed complete dye penetration, whereas negative control group teeth showed no dye leakage. Two teeth, one from the 0.06 taper gutta-percha group and one from the MF non-standardised gutta-percha group, were excluded from the final sample due to vertical root fractures. The group obturated using System B and 0.06 taper gutta-percha points showed the least dye penetration, followed by the group obturated with System B and MF non-standardised gutta-percha points (Table 1). The group obturated with 0.02 taper standardised gutta-percha points using the lateral condensation technique showed the most dye leakage (Table 1). However, the difference in the linear extent of dye penetration was not statistically significant (p = 0.38).

Another observation during the evaluation of the samples was that two (14.2%) of the teeth obturated with 0.06 taper gutta-percha points and one tooth (7.2%) of the teeth obturated with MF non-standardised gutta-percha points were overfilled, whereas none of the lateral condensation group showed extension of core filling material beyond the anatomic apex.

### Results

The positive control teeth showed complete dye penetration, whereas negative control group teeth showed no dye leakage. Two teeth, one from the 0.06 taper gutta-percha group and one from the MF non-standardised gutta-percha group, were excluded from the final sample due to vertical root fractures. The group obturated using System B and 0.06 taper gutta-percha points showed the least dye penetration, followed by the group obturated with System B and MF non-standardised gutta-percha points (Table 1). The group obturated with 0.02 taper standardised gutta-percha points using the lateral condensation technique showed the most dye leakage (Table 1). However, the difference in the linear extent of dye penetration was not statistically significant (p = 0.38).

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### Discussion

This study evaluated the ability of three obturation methods to seal root canals prepared using the 0.06 taper NITi rotary instruments. Gutta-percha points of 0.06 taper and conventional non-standardised MF gutta-percha points were used with the System B in the continuous wave of condensation technique (4). In addition, conventional cold lateral condensation using standardised 0.02 taper gutta-percha points were used. The mean linear apical dye leakage was least with 0.06 taper gutta-percha with System B group, followed by non-standardised MF gutta-percha with the System B group, and most linear apical leakage occurred with the lateral condensation technique with standardised 0.02 taper gutta-percha points; however, the difference was not statistically significant (p = 0.38), indicating that under the conditions of the current experiment all the three techniques produced similar quality of root canal obturation for canals prepared with 0.06 taper NITi files.

The similarity of apical dye leakage between the System B continuous wave of condensation and cold lateral condensation was in agreement with previous studies (6, 7) that compared cold lateral condensation technique with the System B technique. In addition, using the bacterial leakage method, no difference was found in the coronal seal between laterally condensed 0.06 and 0.02 taper gutta-percha (5). Although coronal seal was similar with laterally condensed 0.06 and 0.02 taper GP, spacer penetration was greater when the 0.02 taper GP points were used than when 0.06 taper points were used (5). This suggests that 0.06 taper GP points are better used with the warm vertical condensation technique because decreased spacer penetration has been associated with increased apical leakage (8). This study is the first to evaluate 0.06 taper gutta-percha points with the System B continuous wave of
condensation technique. However, the findings suggest no added advantage in using 0.06 taper points over non-standardised MF points, and also that a similar apical seal is achieved, as measured by apical dye penetration, when the continuous wave of condensation technique was compared to the cold lateral condensation technique.

Using the fluid filtration system, no significant difference in apical leakage was found between cold lateral condensation and System B at 24 hours; however, after one month cold lateral condensation showed more apical leakage than System B (9). Our system evaluated apical dye leakage after 72 hours, and therefore, was more similar to the 24-hour fluid filtration test. Longer testing times might be necessary for differences between different techniques in our system to develop. However, longer exposure to fluids might not reflect the in vivo situation. In fact, although the root apex is continuously exposed to tissue fluids, it is not similar in composition or in quantity to the fluid used in the dye or fluid filtration leakage systems.

Our observation in this study of core filling material extrusion beyond the apex when using the System B for obturation (n = 3) deserves further investigation. Although gutta-percha demonstrates minimal toxicity and minimal tissue irritability (10) it will be a foreign body in the periapical area and therefore extrusion of gutta-percha beyond the anatomic apex should be avoided. In our study, only a small percentage of the sample obturated with System B showed extrusion of core filling material beyond the apex compared to other studies using the System B where 43% of the sample showed extrusion of filling material beyond the apical foramen (11). Nonetheless, development of instrumentation and/or obturation practices that result in consistently confining core filling material to the root canal system would add an advantage to the continuous wave of condensation obturation technique.

The development of new instrumentation techniques using NiTi rotary instruments has lead to a more standardised root canal preparation in the practice of endodontics. In line with the great advances in instrumentation techniques are attempts to improve endodontic obturation techniques. In this study, we tested a new form of gutta-percha that was designed to produce superior obturation of canals prepared using 0.06 taper NiTi rotary instruments by having the same 0.06 taper as the NiTi file. Our findings suggest that the newer 0.06 taper gutta-percha points did not significantly improve apical seal, as measured by apical dye leakage, over non-standardised gutta-percha points with System B or over 0.02 taper GP points with cold lateral condensation. Therefore, older, more conventional, techniques of obturation using non-standardised GP points with System B or cold lateral condensation can still be used to fill canals prepared with 0.06 NiTi instruments and will produce an apical seal of similar quality to 0.06 taper GP points.

References
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