A comparison of apical microleakage after lateral condensation of different tapered master cone in canals prepared by ProFile rotary instruments

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Abstract

Forty five mesial canals of extracted human mandibular molars were instrumented with ProFile ISO .06 nickel-titanium rotary instruments and obturated with lateral condensation using three different master cones: .06 tapered gutta-percha cone (group I), .04 tapered gutta-percha cone (group II), .02 tapered gutta-percha cone (group III). Zinc oxide eugenol sealer was used in all groups. After 48 hours in an incubator, the roots were coated with nail polish and were the submerged in methylene blue dye for 72 hours. The roots were then split longitudinally and the apical leakage measured and compared for each group. Although there was no statistical significant difference among groups ($P>0.05$), group (I) with .06 tapered gutta-percha master cone showed the lowest mean of dye penetration.

Keywords: Profile rotary instruments, Microleakage, Obturation

Introduction

Recent advances in instruments design and materials have resulted in the development of nickel-titanium rotary instrumentation for endodontic treatment of teeth. These new instruments have brought about innovations in blade designs, alternative sizing, and greater instrument tapers. Currently they are available in several configurations, including .02, .04, and .06 mm/mm tapers. Advantages of these instruments include ease and efficiency of use, fewer instrumentation errors, and better preparation of curved canals. In addition they can prepare canals in a manner that is both more centric and circular than is possible with stainless-steel instruments [(1)].

Obturation of canals prepared with nickel-titanium instruments may be achieved using a variety of thermoplasticized or lateral condensation techniques. The lateral condensation of gutta-percha is one of the most frequently used, extensively studied, and clinically proven of all root canal obturation techniques [(2)]. However, to date, studies are lacking on the evaluation the quality of obturation or seal obtained using this technique in canal prepared with nickel-titanium rotary instruments. The use of ProFile ISO .06 tapered nickel-titanium rotary instruments results in a canal preparation that tapers evenly from its working length to the canal orifice with canal diameter becoming progressively 0.06 mm larger each 1-mm increment from its apical to its coronal extent[(3)]. The use of conventional lateral condensation technique for obturation of this evenly tapered space would involve the fitting of an ISO- standardized master gutta-percha cone with an apical to coronal taper of 0.02mm/mm, followed by lateral condensation with hand or finger spreaders and the addition of numerous accessory gutta-percha cones in an attempt to obliterate the space between master cone and the walls of the prepared canal space [4,5].

Because three-dimensional obliteration of the prepared canal space is the goal of obturation [6], and to take the advantage of the more uniform canal preparation produced by rotary files [3], the use of master gutta-percha cone, which more closely matches the 0.06 mm/mm taper of the space prepared by the ProFile ISO .06 instruments before lateral condensation, and addition of accessory cones would seem to be a more efficient means of achieving this goal. Baumann et al.[7] found that the apical seal of canals obturated with .06 master cone, and sealer as good as conventional lateral condensation technique in canal prepared with profile system.

The aim of the present study was to compare apical microleakage in canals obturated by lateral condensation technique with different tapered master cone.

Materials and Method

Forty five mandibular first molar were selected and stored in 0.2% thymol solution immediately after extraction. All teeth were carefully debrided of soft tissue with periodontal curette. In addition, all mesial roots have similar shape and curvature. After sectioning all teeth at the cemento-enamel junction to provide a reproducible reference point, apical patency was verified in each root with a #10 K-type file and working length was established 1mm short of canal length, the point at which the #10 file was first visible at the apical foramen.

Each canal was prepared mechanically to the working length with rotary endodontic instruments profile taper .04, taper .06 (Dentsply, Maillefer, Switzerland) using a slow speed handpiece (300 rpm) with crown-down technique in the following manner:

A profile #25 taper .06 is used to about 1/2 of the canal followed by #25 taper .04 to about 2/3 of the canal in crown down manner, this is to prepare the coronal portion of the canal, for the apical portion, profile #15 taper .04 used to the working length followed by profile #20 taper .04, #20 taper .06, #25 taper .04, #25 taper .06, #30 taper.04, #30 taper .06 sequentially used to the working length. Sodium hypochlorite solution (5%) was used as an irrigant during preparation, and apical patency was verified with a #10 K- file after completion of instrumentation. The canal were then dried with paper points and the teeth were randomly divided into three experimental group of 15 teeth each to evaluate the amount of microleakage after lateral compaction technique in obturating their prepared canal when three different tapered master cones were used;

Group (I): obturated with an ISO .06 gutta-percha master cone (Dentsply, Maillefer)

Group (II): obturated with an ISO .04 gutta-percha master cone (Dentsply, Maillefer)

Group III: obturated with an ISO .02 gutta-percha master cone (Dentsply, Maillefer).

The canals in all three experimental groups were obturated with laterally condensed gutta-percha and ZOE (Dorifil-Dorident) sealer. A thin layer sealer was applied to the preparation walls with a paper point. The master cone was coated with sealer and seated; a finger spreader (Dentsply, Maillefer) was used for lateral condensation. The spreader was remained in the canal until accessory gutta-percha cone was ready to put in place. Accessory cones were added until the spreader reached the coronal third of the canal. Excess gutta-percha was then removed with a heated endodontic plugger, and the gutta-percha in the canal was vertically condensed. The same person performed all obturation techniques. Radiographs were taken for each root to visually evaluate the obturation. The coronal 2mm of each canal was sealed with Coltosol (Coltene, Alsatten, Switzerland) and the roots were then stored in 100% humidity for 48 hours to ensure the seating of sealer.

The obturated roots were dried and coated on their external surfaces with nail varnish; except for the apical 2mm. then the specimens were immersed in methylene blue 1% and placed in an incubator at 37^0C for 72h. They were then thoroughly washed with water, the varnish was carefully removed with a lacron, and the teeth were dried. Using a diamond disk, two grooves were made longitudinally on the roots were then splitted in half by applying a gentle pressure. Liner apical dye penetration was measured for each specimen using stereomicroscope at X10 magnification. The resulting measurements of dye leakage were subjected to statistical analysis.

Results

The minimum and maximum values of mean and standard deviation values for each group are presented in table (1). Figure (1) shows the bar chart depending on the mean leakage in millimeters for the three experimental groups. It is apparent that group I, shows the lowest mean of dye penetration (2.89), followed by group II (2.99), then group III (3.02).

Analysis of variance (ANOVA) test, table (2) was performed to test the differences between the means of dye penetration among the three experimental groups. A non significant differences was found (P>0.05) among the experimental groups.

Discussion

The main objectives of endodontic therapy are cleaning, shaping, and obturation of root canal system in three dimension [8]. Most authors evaluate obturation quality by determining the amount of apical microleakage that occurs in obturated specimens.

Although the lateral condensation technique, as classically described, involves the use of an ISO-standardized .02 mm/mm tapered master cone gutta-percha [4,5]. This study showed there was no significant difference in microleakage in canals prepared with ISO .06 tapered nickel-titanium rotary instruments and obturated with gutta-percha master cone with different tapering (.06, .04, .02). This result was concord with other report [7,8,9]. Most authors [10,11,12] found that engine-driven, nickel titanium instruments, produce rounder and more central preparations than do hand instruments. This round, prepared canal space also appeared uniformly larger as one moved from the apical to the mid- root to the coronal cross-sectional level. Hembrough et al.[8] found that canal prepared with ISO.06 ProFile instruments and obturated either with .06 gutta-percha cones or a custom- fitted size medium, gutta-percha cones conform better to these round, tapered spaces than do ISO-standarized gutta-percha cones, with less number of accessory cone.

In this study the observation that the level of spreader and accessory cone penetration in group (I) didn't reach the mid-root level, while in group (III) specimens, demonstrated deep spreader and accessory cone penetration, and this disagrees with the finding of Allison et al.[13] that deep spreader penetration is necessary to achieve good obturation quality with lateral condensation technique. Hovland and Dumsha [14] demonstrated that microleakage occurs at the interface of the dentine and sealer, at the interface of the solid core and sealer, through the sealer itself, or by dissolution of the sealer, leakage dose not occur through the solid core [15]. Filling with a master cone with a larger taper may be advantageous in that a larger and more uniform mass of gutta-percha is introduced that potentially has less sealer entrapped in the filling mass [16].If obturation efficiency had been measured in terms of time, it is conceivable that obturation in group (I) would have been found to be more efficient than the other two groups.

It is concluded, there for that under the conditions of this study, the use of either .06 gutta-perch cone or a .04 gutta-percha cone in the lateral condensation technique for obturating canals prepared with ISO .06 ProFile rotary instruments is equally effective in term of microleakage, to the use of lateral condensation technique with an ISO- standardizes master gutta-percha.

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Table (1): Descriptive statistics for the three experimental groups.

Groups	**No. of teeth**	**Mean**	**S.D**	**Min. value (mm)**	**Max. value (mm)**
I	15	2.89	0.316	2.52	3.47
II	15	2.99	0.320	2.43	3.55
III	15	3.02	0.312	2.40	3.52

Table (II): ANOVA Test

Source of variation	**Sum of squares**	**d.f.**	**M.S**	**F**	**P-value**
Between	0.132	2	0.066	0.66	P>0.05
Within	4.209	42	0.100		
total	4.341	44			

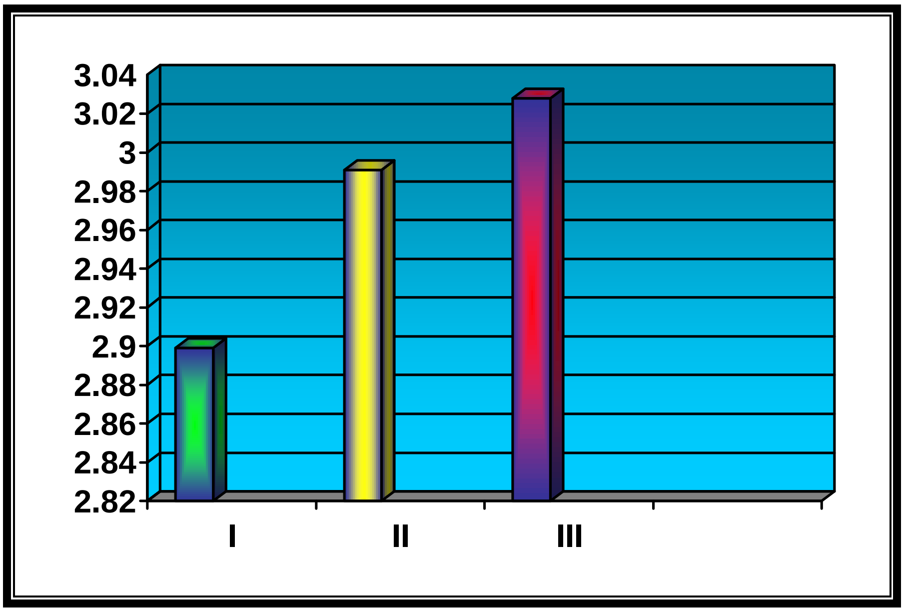

Figure (1): Bar chart graph to compare the mean dye penetration