Apical sealing ability of root canal filling using two different tapered accessory points

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Abstract

The apical sealing ability of root canal fillings is an important issue for desirable outcome of treatment. The aim of this in-vitro study was to assess the apical microleakage of root canal obturation with MF and .02 tapered gutta-percha as accessory cones using lateral condensation., Fifty six extracted human anterior teeth with single, straight canals were randomly divided in to two experimental groups of 23 teeth each and two control groups of 5 teeth each. The teeth were instrumented with Race rotary Ni-Ti files to a master apical file of #30. Teeth in group 1 were obturated with.06 tapered master cone and.02 tapered gutta-percha as accessory cone with AH26 sealer using lateral condensation. Teeth in group 2 were obturated similarly, except MF gutta-percha was used as accessory cones. Positive control teeth were instrumented but not filled. Negative control teeth were instrumented, obturated and externally sealed. All the specimens were sectioned buccolingually and the maximum of leakage was measured using a stereomicroscope at 8X magnification. Data were analyzed using T-test and 0.1 mm accuracy.The positive and negative controls validated the testing model. There was significant differences between two groups. The average dye penetration in group 1 and group 2 were 3.5-12.5 and 1.75-10.5 mm, respectively.,The most dye penetration was in group 1 and the lowest level of leakage was in group 2, which obturated laterally with.06 master cone and MF accessory gutta-percha.

Key words: 0.06 gutta-percha, standard gutta-percha, lateral condensation, microleakage

Introduction

Three-dimensional filling of the root canal system with gutta-percha and sealer is an aim of root canal treatment (1). Before this can be achieved, the root canal must be chemomechanically prepared to a sufficient shape and size to eradicate microorganisms and facilitate filling the root canal (2). Nearly %60 of endodontic failures is due to incomplete obturation (3). The purpose of obturation the root canal system is to prevent leakage of bacteria and their products in to periradicular tissues and to seal within the root canal any irritants that cannot be fully removed (4). Lateral condensation technique is used by many clinicians throughout the world to fill root canals due to its simplicity and adaptability to most cases (5, 6). Lateral condensation technique does not create a homogeneous mass of gutta-percha, because a great number of cones are compacted against each other (7). There is a possibility of a high percentage of sealer in the apical region and poor adaptation to root canal walls (8). Recent advances in instrument design and materials have resulted in the development of nickel-titanium rotary instruments, with different tapers, sizes and blade design (9).

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Recently, greater taper gutta-percha cones have been developed for use with rotary nickel-titanium file systems (10). It seems that filling with gutta-percha cones having the same taper with rotary nickel-titanium instruments may decrease the micro leakage (9). Many studies have been performed about efficiency and quality of root canal fillings using different master cones (4, 11). In 2001 Bal et al. demonstrated, the bacterial penetration between canals obturated with.06 tapered master cone and MF tapered accessory cones in one group with the other group filling with.02 tapered master cone and MF tapered accessory cones. They concluded that, there was a not significant difference between two groups (4). The purpose of this in vitro study was to evaluate the apical sealing ability of root canal filling when two different tapered gutta-percha MF and standard, as accessory cones were used.

Materials and Methods

Fifty six extracted fully developed human maxillary and mandibular anterior teeth with single, straight canals without cracks, caries and external resorption were selected. They divided randomly in to two experimental groups of 23 teeth each and two control groups of 5 teeth each. They stored in 5.25% Naocl for 1 hour and then immersed in saline until use. All teeth scaled with a periodontal scaler to remove soft tissue and calculus. The teeth were radiographed to confirm the presence of a single canal. After the teeth were decoronated to have a root length of 13 mm, the access cavity was prepared. The working length was determined by inserting a #10 K-file (Dentsply, Maillefer, Ballaigues, Switzerland) in to the canal until it was just visible at the apical foramen, then subtracting 1mm. The specimen instrumented using a crown-down technique with Race rotary nickel-titanium files (FKG, Switzerland) to a master apical file size of 30. Canal preparation sequences were in this manner:

1. Canal Pre-enlargment by Race #40/.10 and 35/.08 in the coronal 4 mm of canal
2. Deep body shaping using Race #40, 35, 30, 25/.06
3. Apical preparation by 25/.06

The canals were irrigated between files with 2 ml of 5.25% Sodium hypochlorite. After the master apical file was reached, the smear layer was removed with 5 ml of 17% EDTA (pulp dent, USA) followed by a final flush of 5 ml of Sodium hypochlorite. After instrumentation was completed, the canals were dried with paper points (Roeko, langenau, Germany). A thin layer of AH26 sealer (Dentsply Detery, Konstanz, Germany) was applied to the preparation walls with a sterile paper point (Roeko, langenau, Germany). Teeth in group 1 were obturated with a.06 tapered master cone (Diadent group) and AH26 root canal sealer (Dentsply Detery, Konstanz, Germany) using lateral condensation of.02 tapered accessory cones (Diadent Group). Teeth in group 2 were filled using the same method as described above except medium-fine (MF) accessory cones (Caulk, Milford, DE) were used. Accessory cones were added to all specimens until the endodontic spreader (Union Broach, New York, NY, USA) no longer penetrated deeper than the coronal one-third of the canal. Then a heated instrument was used to sear the filling materials off at orifices and gutta-percha condensed vertically with a #10 plugger (Hu-Friedy, Chicago, IL). After placing a restoration of glass-ionomer (GC America Inc. Alsip, IL, USA) all experimental and control teeth were srored in a humidor at 98.F and 100% humidity for 72 hours to allow the sealer to set completely.

In group 1 and 2, the whole length except for the apical 2mm was covered by two layer of nail polish. The negative control teeth (five teeth) were instrumented, obturated with.06 tapered master cone and.02 tapered and MF accessory cones and the whole length of the roots were covered by two layers of clear nail polish. The five teeth that instrumented and obturated with only a.06 tapered master cone as a single cone were used as positive controls. In this group the surface of the roots was not covered by nail polish. All

specimens were passively immersed in Indian ink for 72 hours and then rinsed with running water for 1 hour. Grooves were made along the mesial and distal external surfaces of the root using a diamond disc and the roots were longitudinally splitted. The larger amount of linear leakage of dye in two split root segment was blindly measured at 8X magnification under optical stereomicroscope (Blue light, XTD series, USA) with 0.1 mm accuracy by three evaluators. To determine whether there was a significant difference in dye penetration, a two sample independent T-test was used. A p-value of 0.05 was regarded as significant.

Results

The positive controls demonstrated completely dye penetration showing the efficacy of root canal sealer in apical seal.

Table 1: Mean leakage and SD in experimental and control groups

Group	N	Range	Minim	Maxim	Mean	Std. Deviation	Variance
Standard	23	9.0	3.5	12.5	6.66	2.04	4.194
Count	23						
MF	23	8.7	1.7	10.00	4.8952	1.6829	2.826
Count	23						

The negative controls did not leak for the entire observation period indicates that nail polish produced a tight seal and the leakage was only through the apex, thus validating the testing model. The results of experimental groups have been shown in figure 1. Between experimental groups, the most leakage was in group 1 that obturated laterally with standard gutta-percha (.06 master cone .02 accessory cone) (P=0.002). Group 2 which obturated laterally with.06 master cone with MF accessory cones showed the lowest leakage. According to the results, the mean leakage in group 2 (4/89 mm) was significantly less than group 1(6/66 mm). (Table 1)

Discussion

Cold lateral condensation of gutta-percha is the most widely used technique for root canal obturation (5). However, to date, studies are lacking on the effectiveness of this technique in obturating canals prepared with Ni-Ti rotary instruments. These instruments have been developed in order to fewer instruments errors because of their unique physical properties (12). In order to provide a more uniform root canal shape with a predictable taper in the apical region, the use of rotary Ni-Ti instruments were deemed necessary (13). Therefore Race Ni-Ti rotary files as one of the most routinely used files were used in this study for canal preparation (14). Obturation of canals prepared with rotary Ni-Ti files maybe achived using a variety of thermoplastisized or lateral condensation techniques (4). Now, master cones are available in different taperes, matching the canals which prepared with.04 and.06 rotary Ni-Ti instruments (9).

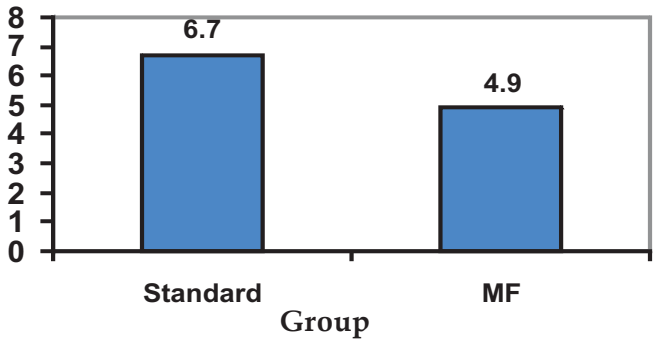
Many studies have compared sealing ability of lateral condensation technique with other obturation methods (9, 15, 16). Most authors assess obturation quality by determining the amount of apical or coronal microleakage. Sealing of the apical third was critical to achieve high success rates in root canal treatment, led us to choose this part

of the canal for evaluation (17). In lateral condensation technique numerous accessory cones are used to obliterate the space between master cone and canal walls. It is confirmed that gutta-percha does not provide an apical seal without using a root canal sealer (18, 19). Microleakage occurs along the interface between dentin and gutta-percha, dentin and sealer or gutta-percha and sealer (20). It may be through the mass of the sealer (21) but does not occur through the solid mass of gutta-percha (22).

Some studies showed that epoxy resin-based sealers have low shrinkage during setting and more dimensional stability than the others, so we used AH26 sealer in this study (23,24). De moor and De Boever studied on long term sealing ability of AH plus and AH26 root canal sealers in conjunction to different obturation technique. They concluded that all lateral condensation, Hybrid and Thermafil techniques showed dye penetration (25).

In this study, the apical sealing ability of two different accessory cones in root canal filling was compared. The method for evaluating obturation quality in this study was dye penetration along the surface of gutta-percha and canal walls. The results of this study demonstrated that canals obturated with.02 tapered accessory cones resulted in lower apical seal, compared to MF accessory ones. However, the master cones were similar and was.06 tapered gutta-percha in both groups. In this study the dye penetration occurred within AH26 root canal sealer. These findings may be explained by the results of Gound study that showed canal fillings with Fine accessory cones were heavier than those obturated

Fig 1: Mean leakage in two experimental groups



with MF or size 25 accessory cones (26). Hembrough et al, found less accessory cones required, when a master cone is used that matches the tapering of rotary instruments in canal preparation (27).

Allison et al, reported that insertion of a spreader tip within 1 mm of the working length resulted in better apical seal (28). As Wilson explained that greater taper of cones decrease the spreader penetration depth (29), we can conclude that more amount of microleakage was seen in group 1 that obturated with.02 tapered accessory cones in contrast to group 2 that obturated with MF accessory cones. Al-Hadlaq and Al-Rabiah evaluated the ability of.06 taper standardized, non- standardized MF gutta-percha points and.02 taper master cone, using system B or lateral condensation to seal root canals prepared with.06 taper rotary instruments. They concluded that apical microleakage was significantly less in MF gutta-percha obturated canals (30).

In the present study, there was a significant differences in apical microleakage between group 1 and 2 ($P < 0.05$). However the mean leakage was less in canals filled with non- standardized MF gutta-percha as accessory cone than in those obturated with standardized.02 tapered gutta-percha, attributable to the lesser mass of obturation material in the standard group.

The teeth evaluated in this model were straight with single canals that would be

prepared simply with rotary Ni-Ti instruments. Although root posterior teeth have curves, isthmuses and fins. Further investigation is necessary to evaluate whether obturating these complex roots with standardized or conventional gutta-percha cones will result in an acceptable seal. Also the use of different tapered standard and conventional gutta-percha points for canal obturation, both in vitro and clinically, is suggested.

Conclusion

Under the condition of this study, canals obturated with.06 tapered master cone and MF accessory cones with lateral condensation technique showed less apical microleakage than those obturated with.06 tapered master cone and .02 tapered accessory cones.

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