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The evaluation of marginal adaptation of obturation with different taper gutta percha

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Abstract

Background and aim: Gutta-percha is the most commonly used material for root canal obturation which has been used with different tapers. The aim of this *in vitro* study was to compare the effect of master cone tapering on apical seal of straight and curved canals prepared with rotary NiTi systems. ***Materials and Methods:*** Forty-five extracted human mandibular molars with two separated canals and apical foramen and the curvature of less than 20° were studied. The specimens were assigned into 3 experimental groups regarding the taper of master cone (2%; 4% and 6%). The roots were prepared using rotary files of 6% up to 30 apical size using cold lateral condensation technique and filled with AH Plus sealer. Four 1mm sections were obtained from the apex tips of the specimens using section device and the sections were subjected to SEM observations. The measured spaces were statistically analyzed using analysis of variance test for the overall groups while the paired comparisons were done by Tukey test. ***Results:*** In the gutta-percha of 2% taper; no significant differences were observed regarding the spaces in the studies sections. Significant differences were found between the sections in the 4% taper gutta-percha so that the most and least spaces were reported for the 1st and 3rd sections. Significant differences were observed among sections in the 6% taper specimens for them; the most and the least spaces were reported for the 1st and 3rd sections. In the 1st sections; significant differences existed among the groups with the least spaces being related to the 2% taper and the most spaces being reported for the 6% taper. In the 2nd section; significant differences were found between 2% and 4% tapers and also between 4% and 6% taper; however no significant differences existed between 2% and 6% tapers with the least spaces being reported for the 4% taper group. In the 3rd group; significant differences were reported among the groups and the most and the least spaces were reported for the 2% taper and 4% taper group respectively. ***Conclusion:*** Although gutta-percha of different tapers are available for the root canal obturation; the 2% taper showed better marginal adaptation in the cases of apical seal required in the apex ends.

Keywords: Gutta-percha; apical seal; marginal adaptation.

Introduction

Nickel-Titanium (NiTi) rotary instruments have been used to prepare root canals in different shapes and tapers (2%, 4% and 6%). The advantages of these instruments include ease of use and efficacy, less procedural errors and better preparation of curved root canals. In addition, these instruments prepare the root canals in more rounded and central form compared to stainless steel instruments (1).

Root canals prepared with NiTi instruments can be obturated with thermoplasticized gutta-percha (softening gutta-percha with heat) or lateral compaction techniques. On the other hand, the main gutta-percha cones (the chief material used to obturate the root canals) have been manufactured by some companies with sizes and tapers corresponding to those of NiTi files.

The lateral compaction technique, contrary to the vertical compaction technique, does not provide a uniform mass of gutta-percha and it is possible that a large amount of sealer will be trapped within the obturation material during compaction of lateral gutta-percha cones; therefore, use of main gutta-percha cones with high taper might yield a more homogeneous and larger mass with less sealer being trapped (2). In addition, use of gutta-percha cones with greater taper decreases the number of lateral gutta-percha cones used and the time necessary for root canal obturation (3); however, this technique prevents penetration of the spreader or plugger effectively up to 1–2 mm of the working length due to the close proximately of the gutta-percha cone to the root canal wall (2). Therefore, it appears the compaction of the main gutta-percha cone in the apical area (root end) will be insufficient, compromising the seal of the canal (3).

Posterior teeth have a complex anatomy with curved and multiple canals and isthmuses. It is difficult and time-consuming to prepare and obturate these root canal systems; as a result, it is necessary to evaluate whether obturation of complex root canal system of these teeth with gutta-percha cones with tapers corresponding to the taper of the prepared root canal will provide a proper seal against microbial penetration or not.

Various techniques have been used in previous studies to evaluate microleakage, including dye penetration and radioisotope techniques, penetration of microorganisms and electrochemical methods, each with its advantages and disadvantages (1,2–4). For example, dye penetration technique has false positive (due to very small sizes of the particles) and false negative (due to the entrapment of air bubbles within the obturation material that prevent penetration of die) results (1–3). In addition, the molecular weight of bacterial endotoxins (the virulence factor of bacteria) is several times that of methylene blue as the most commonly used dye (3–5).
Marginal adaptation is a direct method for comparison of the sealing ability of root-end filling materials, in which SEM analyses are used (6). To compare the apical seal and microleakage of root canals obturated with gutta-percha, dye penetration, radioisotope, microorganism penetration and electrochemical methods can be used. However, after introduction of gutta-percha points with varying tapers for root canal obturation purposes, it is necessary to evaluate the marginal adaptation of gutta-percha points with greater taper with the use of newer techniques. In this context, in the present study the marginal adaptation between gutta-percha and dentin was evaluated by measuring the spaces between gutta-percha points and dentin with the use of SEM technique.

Materials and Methods

Extracted human mandibular molars were used for the purpose of the present study. The teeth included in this study had no signs of resorption, cracks or fractures and hadfully matured apices, and 2 root canals with separate apical foramina in their mesial roots (as evidenced by observing one distinct and separate file in each root after preparation of the access cavity). A total of 45 teeth were selected; teeth with a curvature under 20° were selected based on Schneider classification (7).

The teeth were immersed in 1% NaOCl solution until used for the purpose of the study. A scalpel blade was used to remove all the soft tissue remnants, calculi and bone from the tooth surfaces in a manner not to damage tooth surfaces. The teeth were stored in distilled water for 20 hours before being used (8).

After preparation of the access cavity, a #10 file was placed in each root canal and the teeth underwent digital radiography from the buccolingual aspect at a distance of 2 mm. Then all the radiographs were printed on A4 paper.

Based on Schneider method, first point ‘a’ was determined on the file and on the root canal orifice. A line was drawn from point ‘a’, parallel to the file, up to point ‘b’ at which the file was diverted from the line. The third point (c) was determined at the apical foramen and a line was drawn from it to point ‘b’. The angle created between these two linesindicated the canal curvature (Figure 1).

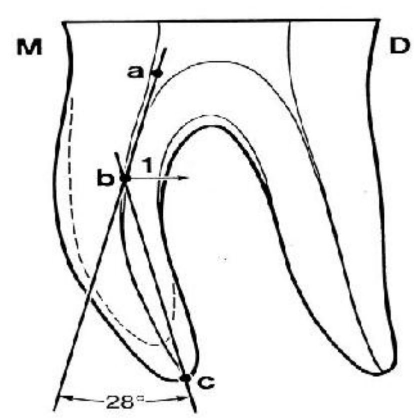

Figure 1: Schneider method

In order to prepare the root canals, the working length was determined after completion of the access cavity by placing a #8 or #10 K-file in each root until the file tip became visible at the apical foramen; 1 mm short of this file length was considered the working length (WL) (3).
The root canals were prepared with RaCe rotary files using the crown-down technique at the WL up to #30 apical file with 6% taper, according to manufacturer's instructions. Apical patency was ensured with a #10 file. The root canals were irrigated with 2 mL of 5.25% NaOCl solution between files and the smear layer was removed by final irrigation with 2.5 mL of EDTA for 5 minutes and 5 mL of 5.25% NaOCl solution (3,9). The samples were irrigated with distilled water for 3 minutes to eliminate the remnants of irrigation solutions. Finally, the samples were autoclaved in a container containing distilled water for 20 minutes at 121°C (10).

After sterilization, the root canals were obturated under sterile conditions, with the use of sterilized gloves and instruments, gutta-percha sterilized with NaOCl and sterile paper points. To this end, first the teeth were randomly divided into 3 groups (n=15) based on the taper of the main gutta-percha point (2%, 4% and 6%). The root canal walls were covered with a thin layer of AHPlus sealer by counter-clock-wise rotation of a #30 K-file. The #30 main gutta-percha point with the relevant taper was coated with sealer and placed in the root canal up to the WL. Then the obturation continued with the use of #25 finger spreader (which compacts gutta-percha in the lateral compaction technique) and placing #20 accessory cones with 2% taper. The procedure continued until the spreader did not penetrate into more than one-third of the coronal segment of the root canal. The coronal gutta-percha was cut way with heat and a plugger was used to condense gutta-percha vertically until proper vertical compaction was achieved. The samples in all the groups were incubated at 100% relative humidity and 37°C for 14 days for completion of the setting reaction of the sealer (8,11).

After obturation of the root canals, the tooth crowns were removed with a diamond saw (MACATOM) in a straight handpiece at low speed and under continuous water spray, at 1 mm coronal to the CEJ. The samples were mounted in acrylic resin and an automatic tri-axial cutting machine (Nomov Fannavaran Co., Mashhad, Iran) was used to prepare four 1-mm-thick cross-sections from the mounted specimens from the root apices. The first cross-sections were not evaluated in any of the samples and the three remaining cross-sections from each sample were prepared for SEM evaluations. The samples were gold-sputtered and evaluated by SEM. The largest spaces between gutta-percha points and the dentinal walls were measured at two points (6).

The space sizes in the three study groups were analyzed with ANOVA. Post hoc Tukey tests were used for two-by-two comparisons.

Results

In the 2% taper group, the mean spaces between gutta-percha and dentinal walls in cross-sections 1, 2 and 3 were 521, 5.73 and 5.04 mm, with no significant differences based on ANOVA results ($P>0.05$).

In the 4% taper group, the mean spaces between gutta-percha points and dentinal walls in cross-sections 1,2 and 3 were 6.12, 4.88 and 3.68 mm, respectively, with significant differences (P<0.000‘1). The maximum and minimum spaces were detected in cross-sections 1 and 3, respectively. In addition, two-by-two comparisons showed significant differences between the groups in this respect ($P<0.0001$).

In the 6% taper group, the mean spaces between gutta-percha points and dentinal walls, in cross-sections 1,2 and 3 were 6.89, 5.4 and 4.31 mm, respectively, with significant differences ($P<0.0001$). In this group, too, the maximum and minimum spaces were detected in cross-sections 1 and 3, respectively. In addition, two-by-two comparisons revealed significant differences between the groups in this respect ($P<0.0001$).

On the other hand, there were significant differences in the mean spaces between gutta-percha points and dentinal walls between the first cross-sections of the three groups with 2%, 4% and 6% tapers ($P<0.0001$); in this context, the mean space in the 2% taper group was less than that in the 4% taper group, which was in turn less than that in the 6% taper group. In addition, there were significant differences in two-by-two comparisons of groups with different tapers in relation to the mean spaces between gutta-percha cones and dentinal walls ($P<0.05$).

Evaluation of the results of mean spaces between gutta-percha cones and dentinal walls in cross-section 2 between groups with 2% and 4% tapers revealed significant differences ($P<0.001$), with no significant differences between the 2% and 6%taper groups ($P=0.29$). In addition, there were significant differences in the mean spaces between gutta-percha cones and dentinal walls between the 4% and 6% taper groups ($P<0.005$).

Furthermore, there were significant differences in the mean spaces between gutta-percha points and dentinal walls between the third cross-sections of the three groups ($P<0.0001$). In this context, the mean space in the 4% taper group was less than that in other groups, with the highest mean in the 2% taper group. In addition, two-by-two comparisons revealed significant differences in the mean spaces between gutta-percha points and dentinal walls between the groups with different tapers ($P<0.001$).

Discussion

After the introduction of NiTi files, the results of preparation of curved root canals have improved (3). In the present study, the mesial root canals of mandibular molars with curvatures under 20° were evaluated and RaCe files with 6% taper were used for preparation of the root canals. RaCe files can create a proper shape with minimum transportation and changes in the transverse cross-section of curved canals (12). Since the use of NiTi files with 6% taper results in a more homogeneous canal shape by effective elimination of irregularities, the obturating materials will have better adaptation with the root canal walls (13). Elimination of the smear layer might increase the resistance of the obturated root canals against penetration of bacteria from the coronal direction. Due to the weak bond of the smear layer to the underlying dentin (around 5 MPa), this layer might detach from dentin, resulting in an increase in microleakage. On the other hand, a combination of 17% EDTA and 5.25% NaOCl has been used as an effective method for the removal of the smear layer from the root canal walls and the dentinal tubules (10).

The root canal system should be obturated effectively from the coronal third to the apex to increase the success of endodontic treatment. Although an apical seal is of utmost importance, inadequate obturation of the coronal areas might result in bacterial contamination of the root canal. Therefore, some studies have evaluated apical and coronal microleakage of root canals (13).

The cold lateral compaction technique is one of the reliable techniques for obturation of root canals, which is usually carried out with the use of standard cones with 2% taper. It has been reported that use of gutta-percha cones with tapers corresponding to those of NiTi files might result in a decrease in microleakage (13).

Given the availability of different techniques for the evaluation of microleakage, the results achieved from the application of these techniques have been different. Leakage takes place through different ways: the sealer–tooth interface, the obturating material itself through the bubbles within the sealer and the sealer–obturating material interface. Since gutta-percha is not very permeable, leakage usually occurs through the permeability of the obturating material–dentin interface. If a 10-µ slit is created between the root dentin and the obturating material, it is possible for the bacteria, measuring 2 µm (*Lactobacilli*) or 0.5 µm (*Streptococci*) to penetrate (14). Therefore, microleakage will decrease with an improvement in the adaptation of the obturating material with the root canal walls. Differences in the results of microbial leakage in the study groups also depends on the thickness of the sealer; in this context, with the advent of main gutta-percha points with greater taper, it is possible that a greater amount of sealer might be trapped in the anastomoses, fins and ovoid root canals (15).

It has been demonstrated that the penetration depth of spreader in the lateral compaction technique affects the quality of the apical seal (2). Based on the results of the present study, apical microleakage in teeth in which the spreader tip is placed at a distance of 1 mm from the WL in the presence of master cone has been very low compared to cases in which this distance has been longer. It should be pointed out that in the present study, penetration of a radioactive indicator was used for estimation of microleakage, which might not provide exact information in relation to the clinical conditions (2).
Baumgarthner et al (2003) evaluated spreader penetration in the lateral compaction technique with the use of gutta-percha cones with 2% and 4% tapers and showed that in canals with curvatures over 20° NiTi spreaders exhibited deeper penetration compared to stainless steel spreaders (16). In this study, when gutta-percha cones with 2% taper were used in root canals with 0-20° curvatures, there were no significant differences between penetration depth of NiTi and stainless steel spreaders; in addition, penetration depth of spreaders with the use of gutta-percha cones with 4% taper was less than that of those with tapers under 2% (16).

Based on the results of the present study, with gutta-percha cones with 2% taper and in cross-section 1, there were less spaces compared to gutta-percha cones with 4% and 6% tapers; in addition, gutta-percha cones exhibited better adaptation with the dentinal walls. It appears this is due to the deeper penetration of spreader in this area, lower volume of the remaining sealer and as a result, possibly less spaces. However, in groups with gutta-percha cones with 4% and 6% taper, in which there was less spreader penetration, adaptation decreased and the size of spaces increased, and in the group with gutta-percha cones with 6% taper larger spaces were reported compared to the group with 4% taper due to less spreader penetration.

However, in cross-section 2, the results were different from cross-section 1; in the gutta-percha group with 2% taper the spaceswere larger. Since gutta-percha had less taper in this group, possibly the amount of remaining sealer in that area was more than the two other groups. In addition, since the odds ofbubbles increase with an increase in the amount of remaining sealer, in general the amount and size of the spaces will increase. On the other hand, in the gutta-percha group with 4% taper the space sizes were less than those in other groups, which might be attributed to better adaptation of gutta-percha and the amount of remaining sealer and as a result, the presence of less spaces.

In cross-section 2, there were no significant differences between the two gutta-percha groups with 2% and 4% tapers; however, the space sizes in the gutta-percha group with 6% taper were less than those in the gutta-percha group with 2% taper. In this context, maybe there was better adaptation and less sealer volume due to the higher taper.

In cross-section 2, there were significant differences between gutta-percha groups with 4% and 6% tapers, with greater space sizes in the 6% taper group, which might be attributed to less spreader penetration in the gutta-percha group with 6% taper, resulting in poor adaptation between gutta-percha and dentinal walls.

The results of cross-section 3 were different from those of cross-sections 1 and 2. Based on the results of the present study, the most abundant spaces were detected in the gutta-percha group with 2% taper, which might be attributed to the greater volume of the sealer remaining in this group. In addition, the minimum space sizes were observed in the gutta-percha group with 4% taper, which were smaller than those in the gutta-percha group with 6% taper. This might be attributed to easier and deeper penetrations of spreader in the 4% taper group compared to the 6% taper group, resulting in better adaptation of gutta-percha with the canal walls, which finally decrease the amount of remaining sealer.

Conclusion

Based on the results of the presentstudy, the apical seal is very important and despite the introduction of gutta-percha cones with different tapers, use of gutta-percha cones with 2% taper yielded better results. Although gutta-percha cones with 4% taper exhibited better marginal adaptation at distances of 3 and 4 mm from the apex compared to gutta-percha cones with 2% taper, at a distance of 2 mm from the apex the best adaptation was achieved with gutta-percha cones with 2% taper.

References

1. Merces A, Carlos A, Camara A .Comparison of root canals obturated with ProTaper gutta-percha master point using the active lateral condensation and the single cone techniques: a bacterial leakage study. Braz J Oral Sci 2011;10:37-41.
2. Aneet SB, Hicks LM, Barnett F. Comparison of laterally condensed .06 and .02 tapered gutta-percha and sealer in vitro. J Endod 2001;27:786-788.
3. Heredia M, Gonzalez J, Luque C. Apical seal comparison of low-temperature thermoplasticized gutta-percha technique and lateral condensation with two different master cons. Med Oral Patol OralCir Bucal 2007;12:E175-179.
4. Saatchi M, Etesami L. *In vitro* comparison of apical leakage in the lateral condensation technique using master gutta-percha cones of 2% and 4%. Tehran Dental School Journal 2007;20:108-112 (farsi).
5. Abarca AM, Bustos A, Navia M. A Comparison of apical sealing and extrusion between Thermafil and lateral condensation techniques. J Endod 2001;27:670-72.
6. Badr AE. Marginal adaptation and cytotoxicity of bone cement compared with amalgam and mineral trioxide aggregate as root end filling materials. J Endod 2010:36:1056-1060.
7. Zhu Y,Ying-Xin G, Li C. Reliability of two methods on measuring root canal curvature. Int Chin J Dent 2003;3:118-121.
8. www.Mehretaban.com
9. Torabinejad M, Gerald W. Endodontics principles and practice. 4th ed. Saunders Elsevier; 2009: 298-319.
10. Eldeniz AU,Qrstavik D.A laboratory assessment of coronal leakage in root canals filled with new and conventional sealers. Int Endod J2009;42:303-312.
11. De-deus G, Murad C, Fidel S. Sealing ability of oval-shaped canals filled using the system B heat source with either gutta-percha or Resilon: an exvivo study using a polymicrobial leakage model. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2007;104(4):e114-e119.
12. Cohen C, Hargreaves KM. Pathways of the pulp. 10th ed. St Louis. Mosby Elsevier;2011:283-348.
13. Murat M, Yaman S. Comparison of apical and coronal sealing in canals having tapered cones prepared with rotary NiTi system and stainless steel instruments. J Oral Sci2009;51:103-107.
14. Osins B,Carter JM,Shin-Levine M. Microleakage of four root canal sealer cements as determined by an electrochemical technique. Oral Surg 1983;56:80-88.
15. Monticelli F, Schuster GS, Looney SW. Efficacy of two contemporary single – cone filling techniques in preventing bacterial leakage. JEndod 2007;33:310-313.
16. Wilson BL, Baumgartner JC. Comparison of spreader penetration during lateral compaction of .04 and .02 tapered gutta-percha. J Endod 2003;29(12):828-831.

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