

Introduction of a novel obturation method:

The single-matched, taper-sized gutta-percha cone technique

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_Root-canal treatment consists of 3-D filling of the root-canal system with gutta-percha and sealer, with the goal of maximising the amount of solid core material and minimising the amount of sealer.¹ Before this can be achieved, the root canal must be chemo-mechanically prepared to a sufficient shape and size in order to eradicate micro-organisms within the root canal system and facilitate filling of the root canal.²

The single-cone obturation technique was introduced in the 1960s with the development of ISO standardisation for endodontic instruments and filling points.³ After reaming a circular stop preparation in the apical 2 mm of the canal, a single gutta-percha was selected to fit with tug-back to demonstrate inlay-like snugness of fit. The single-cone technique consists of a single cone filled at room temperature with a sealer layer whose thickness depends on the fit of the single cone to the walls of the canal.⁴

The introduction of NiTi rotary instruments makes the creation of predictably centred preparations more realistic than ever in curved canals⁵ and, in many cases, may make accurate apical cone fit a possibility.⁶ Preparation of the canal using certain rotary NiTi files and filling the canal with a non-standardised cone may result in a shape that does not match the corresponding gutta-percha point.⁷⁻⁹ This would result in either the pooling of sealer or voids in the inner or outer walls of the canal. Obturation cones are now produced to match the taper and size of canals prepared with rotary instruments in order to provide 3-D obturation of the root canal over its entire length. This obturation can be achieved without requiring accessory cones or spending time on lateral condensation. Manufacturers of matched

taper points claim that they can replicate tapered canals effectively, as they correspond to canal shapes created by instruments of similar tapers. The use of a NiTi file-matched, taper-sized cone system promotes the single-cone cementation technique and has been advocated for obturation of curved root canals.¹⁰ The aim of this study is to describe a root-canal filling method using the single-matched, taper-sized gutta-percha cone technique.

_Description of the technique

Access to the root-canal system was carried out using a size 10 file that was introduced into the canal. Full working length was established by deducting 1 mm from the actual canal length. After introduction of hand files and establishment of a glide path, the canal was prepared with a NiTi rotary system according to the manufacturer's instructions. During preparation and between each file, 2% sodium hypochlorite was used as an irrigant. After completion of instrumentation, a final flush using 17% EDTA was performed and dried with paper points.

A single gutta-percha cone that matches the taper and size of the final rotary instrument was then selected and fitted to the designated working length with tug-back.

AH Plus Root Canal Sealer (DENTSPLY DeTrey) was mixed manually and applied into the root canal using a lentulo spiral. The single-matched cone was then coated with additional sealer to the proper length. A heating instrument was used to cut the match point within 3 mm of the orifice, which was then condensed vertically using an endodontic plugger.



Fig. 1

Discussion

The original single-cone technique performed with conventional sealers has been found to be less effective in sealing root canals than the warm vertical compaction technique.^{11,12} Several root-canal filling techniques have been developed to overcome the shortcomings of the single-cone technique. One is the warm, vertical gutta-percha technique. The primary criticism of this technique is that only a single, uncondensed cone is present in the apical region for sealing the root-canal apex. Unlike the lateral condensation technique, the plugger depth for the continuous wave of obturation technique is recommended to be within 3 to 5 mm of the working length.^{13,14} It has been reported that the filling of the root-canal system using the lateral condensation technique has a better treatment outcome than the single-cone filling technique.¹⁵ However, these fillings were done with standardised 0.02 taper gutta-percha cones, usually with zinc oxide eugenol based sealers. Because large volumes of this soluble sealer were used, dissolution of the sealer may have had a negative effect on the outcome.¹⁶

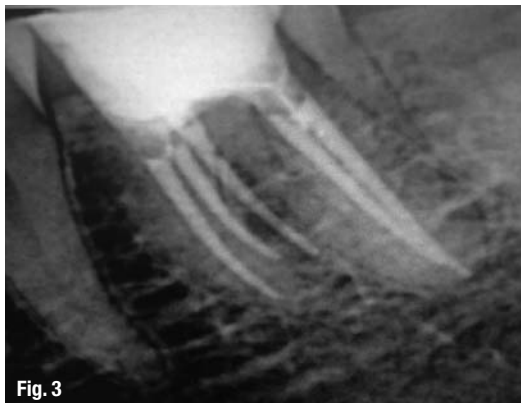
Schäfer *et al.* compared the solubility of resin-, silicone-, calcium hydroxide-, zinc oxide-eugenol- and glass-ionomer-based sealers in water and artificial saliva, and reported that the resin-based AH Plus lost the least amount of weight of all sealers tested in all liquids.¹⁷ Pommel *et al.* compared single-cone, lateral condensation, vertical condensation, Thermafil and System B techniques using a zinc oxide-eugenol-based sealer, and reported that the single-cone technique had the highest leakage.¹⁸ On the other hand, Wu *et al.* studied the leakage of single-cone fillings using a silicone-based sealer

for one year and concluded that single-cone fillings prevented fluid transport for one year.¹⁶

With NiTi rotary preparation of the root canal and the use of a sealer, single-matched, taper-sized cones could provide 3-D filling of the root canal over its entire length without requiring accessory cones or time spent on lateral condensation. Laboratory evidence suggests that a comparable cross-sectional area of the canal can be occupied by gutta-percha using single-matched, taper-sized cones as compared with lateral condensation, and that this technique can be performed in significantly less time.¹⁹ Hembrough *et al.* compared the root-canal filling quality and efficiency of lateral condensation using variously tapered gutta-percha cones after preparation of single-rooted, straight root canals with ProFile 0.06 tapered rotary files.²⁰ They found that 0.06 tapered gutta-percha cones were more efficient than 0.02 tapered gutta-percha cones in terms of the number of accessory points used, while the filling quality (measured as the linear amount of sealer present between the gutta-percha mass and the canal wall) was not significantly different for either method. Although this was a lateral condensation study, the authors were only able to place an average of one accessory cone in the 0.06 tapered cone group, thereby effectively describing a single-matched, taper-sized cone technique. Bal *et al.* compared the sealing ability of root canals prepared with 0.06 tapered rotary NiTi instruments and filled with either a 0.06 or a 0.02 tapered gutta-percha master cone using lateral condensation and found no difference.²¹ Zmener *et al.* prepared the root canals using a rotary system and filled them using the single-cone and lateral condensation techniques.²² They reported that the difference between single-cone and lateral condensation filling was not significant with the use of a methacrylate-based sealer. De-Deus *et al.* investigated the sealing ability of four



Fig. 2



root-canal sealers (Pulp Canal Sealer, Sealapex; both SybronEndo; EndoREZ, Ultradent; AH Plus) at two different thicknesses. In the thin-layer groups, the sealers demonstrated similar results. In the thick-layer groups, AH Plus had the best performance.²³ Overall, greater sealer thickness negatively influenced the sealing ability of the root-canal filling, except in AH Plus samples. Wu *et al.* compared sealer distribution in root canals filled by single-cone, lateral condensation and vertical condensation using epoxy-resin cement. They reported a significantly higher percentage of sealer-coated canals in the single-cone group and a better sealer distribution.²⁴

The matched-cone technique, however, uses master cones with a greater taper that match the geometry of the final NiTi instrumentation systems.¹⁹ The use of contemporary root-canal sealing systems that claim to create bonds along the sealer-gutta-percha interface via modifications of the sealer or the root filling material may also support the use of a single-matched, taper-sized cone technique.²⁵⁻²⁷

It is well known that in order to seal the entire root-canal system, the largest area has to be filled by gutta-percha cones, and the root-canal sealer is only employed as an additional measure to promote better adhesion between root-canal walls and the

cones. Moreover, sealers are able to fill irregular areas that gutta-percha cones are unable to fill.

The single-matched, taper-sized cone technique has many advantages, including:


- _ safe coronal extrusion of excess cement with minimal extrusion of sealer in the apical direction;
- _ a uniform mass of gutta-percha with less sealer at the canal wall interface and within the filling mass;
- _ a higher percentage of sealer-coated canals and a better sealer distribution;
- _ significantly less implementation time;
- _ ease of learning;
- _ elimination of lateral stresses during obturation that may result in overfills and root fractures;
- _ higher quality obturation compared with other methods;
- _ no potential risk of tissue damage due to an increase in root surface temperature;
- _ no potential for obturation material shrinkage; and
- _ lower cost.^{1,19,20,28-32}

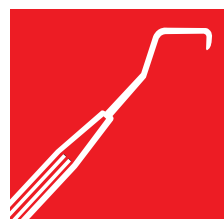
An *in vitro* evaluation of single-matched, taper-sized cone obturation with a fluid filtration method demonstrated results comparable with those of the lateral condensation and Thermafil techniques.³³

_ Conclusion

Use of the single-matched, taper-sized cone technique for cold obturation relies on the original canal shape and the ability to create a tapered circular preparation. A small diameter canal would be suitable for this technique. Oval-shaped and larger diameter root canals would require excessive preparation for this to be effective. Further study is needed to evaluate the sealing ability of the single-matched, taper-sized cone technique in order to determine whether these obturation cones will have an acceptable apical seal.

Editorial note: A list of references is available from the publisher.

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