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Comparison of Apical Sealing Ability of Two Root Canal Filling Techniques

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Abstract: ***Success in root canal treatment was founded upon the triad of thorough canal debridement, effective disinfection and obturation of the canal space. Three - dimensional obturation of the canal space to the working length has been depicted as the most critical component of root canal treatment for sealing and isolating the canal space from irritants that remain after shaping and cleaning, and for eliminating leakage from the periradicular tissues or oral cavity into the filled canal space. The aim of our in vitro study was to evaluate the sealing quality of the core - carrier system GuttaCore and compare it with central cone technique with tapered gutta - percha cones regarding apical leakage.24 human single rooted teeth were used for the study. Root canal preparation was done using ProTaper Universal rotary system up to F3. The teeth were randomly assigned into 2 groups, depending on the root canal filling technique. The specimens were immersed in 2% methylene blue dye and the linear dye leakage at the apical third was measured in mm. Statistical analysis showed that Guttacore group had significantly less leakage in apical third than the central cone technique. Under the conditions of this study, it could be concluded that obturator techniques showed better sealing results as the central cone technique in the apical third of root canals.***

Keywords: apical sealing, microleakage, Protaper rotary instruments, Guttacore

1. Introduction

Success in root canal treatment was founded upon the triad of thorough canal deb - ridement, effective disinfection and obturation of the canal space [7]. Three - dimensional obturation of the canal space to the working length has been depicted as the most critical component of root canal treatment for sealing and isolating the canal space from irritants that remain after shaping and cleaning, and for eliminating leakage from the periradicular tissues or oral cavity into the filled canal space [20, 21].

Over the years, several filling techniques have been suggested to accomplish a hermetic seal of the root canal system. Schilder suggested that the ideal root canal obturating material should be well adapted to the canal walls and its irregularities [25]. In 1976, Grossman studied the physical properties of filling materials and found adhesion to be a very desirable property in root canal cements. Caicedo and von Fraunhofer agreed with these findings and reiterated that endodontic cements must seal the root canal space and ideally should adhere to both the gutta - percha cone and the canal walls. The prerequisite of good endodontic fillings is to obturate the complex root canal system with gutta - percha and sealer [22, 24]. It is speculated that the dissolution of sealer over time might be responsible for leakage, thus promoting endodontic failure. Therefore, good endodontic fillings should bring the obturation material into as close contact as possible to the root canal wall and minimize the sealer content [10].

Up to now, gutta - percha has been the most suitable obturation material for straight and curved roots, because, particularly after heating, the material becomes viscous and can be condensed to the root canal walls [15, 18]. Earlier studies have shown that root canal systems can be obturated by over 95 % with gutta - percha using different filling techniques [12, 13]. Less favourable results are due to the geometrical differences between the root canal shape after instrumentation and perfectly round single cone gutta - percha points. Thus, the relative amount of sealer in the single cone technique is usually bigger compared to other obturation techniques, because only sealer or entrapped air can fill the space next to the gutta - percha point. Simplified techniques of thermoplasticizing gutta - percha have become progressively popular [1, 2, 11]. Schilder introduced warm vertical compaction concept of gutta - percha, in 1967, using an electrically heated Plugger to down - pack. Another method stated as "obturator technique" was adapted by Johnson, in 1978, and consists of metal carrier with thermally plasticized gutta - percha [6]. This system has been subjected to several enhancements: The metal support was substituted by a plastic one that was replaced recently by a gutta - percha core obturator GuttaCore (Dentsply, Tulsa, OK) and GuttaFusion (VDW, Germany) [8, 9]. Gutta - percha core obturator and warm vertical compaction techniques have been described by their proponents as being easy to manipulate and effective in filling the complexities of the root canal system compared to other methods available currently [3, 4, 5]. During the obturation, some variables may impact the adhesion of gutta - percha on the canal walls such as the dentin surface treatment, cement surface tension, type of filling material and methods [28]. One potential disadvantage of a carrier - based root filling system is denudation of the core with stripping of the gutta - percha coating. Stripping of gutta - percha from the carrier might happen during the insertion of the carriers into the root canal space, particularly in narrow or severely curved canals. This would result in voids and inadequate filling of the root canal space. Another potential disadvantage of currently available carrier - based obturation systems is that the volume of gutta - percha is not uniformly distributed around the carrier. This might cause stripping of the gutta - percha from the carrier material when the obturator is inserted into the root canal space leading to possible voids. The frictional forces present between the gutta - percha and the root canal walls may create an extrusion effect, whereby

the filling material is retained at the orifice of the canal. All this failure can lead to decrease of endodontic success.

2. Material and Methods

The aim of our ***in vitro*** study was to evaluate the sealing quality of the core - carrier system GuttaCore (Dentsply) and compare it with central cone technique with tapered gutta - percha cones regarding apical leakage.

24 human single rooted teeth were used for preparation of 24 specimens with equal working length. Root canal preparation was done using ProTaper Universal rotary system (Dentsply, Maillefer, Ballaigues, Switzerland) following the recommended sequence (S1, S2, F1, F2 and F3).2 % Sodium hypochlorite was used as an irrigant to flush the canal clean of dentinal chips and remove the organic debris.17 % EDTA was used as a lubricant and to help in removal of smear layer and inorganic debris. The canals were also finally thoroughly flushed with distilled water.

The specimens were randomly assigned into 2 groups, depending on the root canal filling technique:

Group I (n=12) - Central cone technique - tapered gutta - percha cones F3 and sealer AH - plus
Group II (n=12) - Core **- carrier system GuttaCore,** that consists of a cross - linked gutta - percha core, and sealer AH - plus.

The specimens were stored at 37ºC and 100% humidity for one week to allow the sealer to set.

One week after the sealing each root was blotted dry and then covered with two coats of nail polish, except for the apical 2 mm. Nail polish was allowed to air - dry for 24h. The specimens were immersed in 2% methylene blue dye for 72 h.

At this point, the sample was rinsed under the water for 15 minutes. Two opposing longitudinal grooves were made into the dentin on the root surfaces, in order to facilitate the split of the root in half. Each section was then viewed under a stereomicroscope at 20× magnification. Evaluation of the staining of each part was done for three times. The linear dye leakage at the apical third was measured in mm.

Statistical analysis was done with SPSS 19.0 statistical software package, using Mann - Whitney Test and p value <0.05 was considered as significant value.

3. Results

Results of microleakage of dye in each group are presented in Table 1 (**Table 1**).

Table 1: Comparison of microleakage between two different root canal filling techniques

Group	N	Min	Max	Mean	SD	SE Mean	p - value
I	12	0.0	3.0	1.46	0.94	0.27	0.026*
II	12	0.0	2.0	0.63	0.68	0.20	

Statistical analysis determined that ***Group II*** present less leakage in apical third than ***Group I (*Figure 1**). The results are statistically significant (p<0, 05).

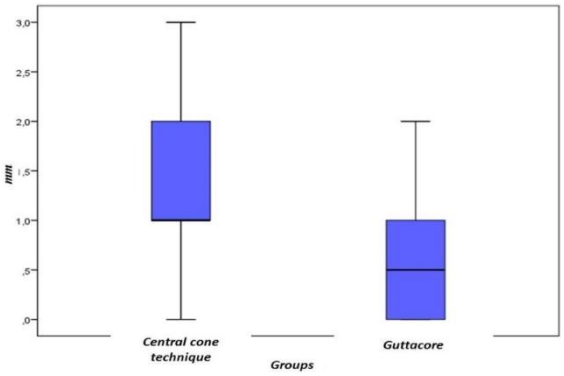

Figure 1: Apical microleakage

4. Discussion

The prerequisite of good endodontic fillings is to obturate the complex root canal system with gutta - percha and sealer [19, 27]. It is speculated that the dissolution of sealer over time might be responsible for leakage, thus promoting endodontic failure [26]. Therefore, good endodontic fillings should bring the obturation material into as close contact as possible to the root canal wall and minimize the sealer content. Voids in contact with the root canal wall (‘interfacial gaps’) are potentially problematic, because they can facilitate harbouring of bacteria [14, 16, 17]. The single cone technique using matching single cones has been described by some authors as being comparable to other root filling techniques, whereas other studies reported inferior results with this technique [23]. Achieving a hermetical seal by entirely filling the root canal space decreases the risk that microorganisms left in the canal might come in contact with oral or periapical fluids. Therefore, investigations on the sealing ability should proceed until the ideal endodontic sealer is found.

The present study demonstrate that regarding the adaptation of gutta - percha to the root canal wall Guttacore leads to significantly denser root canal fillings than the single cone technique. Although we used ‘cone - fitting’ gutta - percha (R30, 30.09 taper) from the same producer for the single cone technique the large areas there were areas filled by sealer only or that contained voids. Even if this technique might be less time - consuming than warm obturation or cold lateral condensation, dentists should be aware that root canal shape is far from being round in the apical region when an instrumentation of 30.09 taper is performed.

5. Conclusions

Under the conditions of this study, it could be concluded that obturator techniques showed better sealing results as the central cone technique in the apical third of root canals.

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