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Sealing ability of a new thermoplasticized obturation technique: A fluid filtration evaluation

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ABSTRACT

BeeFill system is a new thermoplasticized obturation technique. The aim of this study was to compare the apical seal of canals obturated by this system comparing with cold lateral condensation technique by using fluid filtration method. Sixty freshly extracted human premolars with single canal were selected. Canals prepared by step back technique. In group A, 20 canals obturated with lateral condensation technique and AH26 sealer whereas in group B, 20 canals were obturated by using BeeFill system and AH26 sealer. After the evaluation of the apical seal by fluid filtration method, the results showed that apical seal in group B was better than group A with no significant difference.

Key Words: BeeFill, thermoplasticized gutta-percha, fluid filtration, apical seal, obturation

INTRODUCTION

Three dimensional seal of the canal space plays a critical role in decreasing periapical inflammation and microbial leakage. This prevents microleakage through the canal space and makes a biologic environment for healthy periapical tissue. Different devices, instruments, and materials have been developed for recovery of quality and effectiveness of preparation and obturation requirements [1].

Cold lateral condensation technique is the most common way for obturation that in most canals is usable and requires a continuous tapered canal and apical matrix. This technique is most effective in tapered and noncomplex canals, but complexity in tapering and morphology could make air voids or remaining sealer. Root canal contains accessory canals and some communications between canal and periodontal ligament which are difficult to obdurate [1]. In order to eliminate some of these problems, Schilder described an idea that compaction of thermoplastisized gutta-percha would permit full adaptation of the gutta-percha to the root canal, introduced it as warm vertical compaction [2].

Root canal obturation with injected thermoplasticized gutta-percha was introduced by Yee et al. in 1977 [3]. They

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showed that by using a sealer, the injection technique was as effective as other obturating systems. Nowadays, some modifications and newer methods have been described using high or low temperature thermoplastisized injectable gutta-percha like Obtura II and Ultrafill. BeeFill system is a new injectable gutta-percha obturation system that heats gutta-percha to 200°C. In the opinion of manufacturer, this system has flexible and bendable connulas which make it suitable for curved canals, and has ergonomically designed handpiece with a 3600 operation angle.

The aim of this study was to evaluate the sealing ability of high temperature thermoplasticized gutta-percha BeeFill system compared with cold lateral technique by fluid filtration technique.

MATERIALS AND METHODS

Sixty freshly extracted human single root premolar teeth with mature apices were selected. Radiographs were used to confirm single canal, no calcifications, fractures, or root resorption. The teeth were decoronated with a multipurpose bur and high speed handpiece, so that the length of all roots was adjusted to approximately 14 mm. The teeth were randomly divided into two experimental groups of 20 teeth each and two control groups of 10 teeth each.

Working length was measured by passing a #10 K-Flexofile (DentsPly, Maillefer, instruments SA, Ballaiguse, Switzerland) carefully along the canal until the tip was just visible at apical foramen. This length was recorded and 1 mm was subtracted to give the working length. All root canals were prepared by one operator with flexofile hand instrument and step back technique. The master apical file in all groups was #40. The smear layer was removed from all specimens by irrigating with 17% EDTA solution (Pulpdent, Watertown, MA) and %2.5 NaOCl, respectively. Canals were then irrigated freely with double distilled water delivered in a disposable endodontic syringe with a long 27-gauge needle.

One experimental group (group A) were obturated by lateral condensation technique so that a #40 gutta-percha cone (Dentsply Lexicon, Tulsa, OK) was selected that fitted snugly at the working length. If necessary, the apical portion was adjusted with a scalpel blade until tug back was achieved. The root canal was irrigated and then dried with paper point (Dentsply, Maillefer, Swiss). AH26 sealer (DeTrey, Dentsply, konstanz, Germany) was placed into the canal using a flexofile with a counter –clockwise motion. Lateral condensation was commenced using a size C finger spreader (Dentsply, Maillefer, Swiss). The void left by the spreader was filled with an auxiliary gutta-percha point size #25. After the entire canal was filled the excess gutta-percha was removed with a hot instrument to just below the orifice and the reminder condensed vertically with a small plugger.

The other experimental group was obturated by BeeFill system (VDW, GmbH, Munich, Germany). The AH26 sealer was used with same manner. Before obturation of canal, plugger with suitable size selected so that passed through the canal until 3-4 mm shorter of working length. Temperature of system capable to set at 60-200ºC and the flow between percent 20 to %100, that in this study we used temperature of 180ºC and flow %60. Cartridges of gutta-percha put into handpiece of system and thermoplasticized gutta-percha came out by touch of finger with sensor. After injection of 3-4 mm gutta-percha, it was packed with suitable pluger then in renewed injected gutta-percha, tip of needle of handpiece touched before obturation and gutta-percha injected and packed. All experimental samples were covered with two layers of nail polish except the apical 2 mm.

10 canals in negative control group divided into 5 samples. 5 canals obturated by cold lateral condensation and 5 canals by BeeFill system. In negative control group all of external surface of root and apical foramen covered with two layer of nail varnish for any leakage. In positive control group with 10 samples, canals prepared but were not

obturated, and root did not cover with nail varnish.

After one week that specimens were stored in 100% humidity and 37°C, apical seal evaluated by fluid filtration method as Wu and Wesselnik study [4, 5].

In this technique the root was connected to tube filled with water that is under 0.2 atm pressure. A bubble, inserted in the water, was used to measure the endodontic leakage. The volume of the fluid transport was measured by observing the movement of the air bubble. The observation was performed by a digital camera (Olympus, C 765, Japan). First observation was done after 30 seconds for localization of the bubble and then digital photographs were taken after one week. At last a designed soft ware was used for measuring bubble movement and the data were calculated in ($\mu L/min/CmH_2o$). The data analyzed with Independent T-test. The significance for statistical test was $P < 0.05$.

RESULTS

There was no overfilling in group A or B. One sample Kolomogorov-Smirnov test improved normal distribution of data. The results showed that in positive control group leakage was %100 and in negative control group 0. The data of maximum, minimum and mean leakage have been shown in Table 1.

Figure 1: Mean leakage in two groups

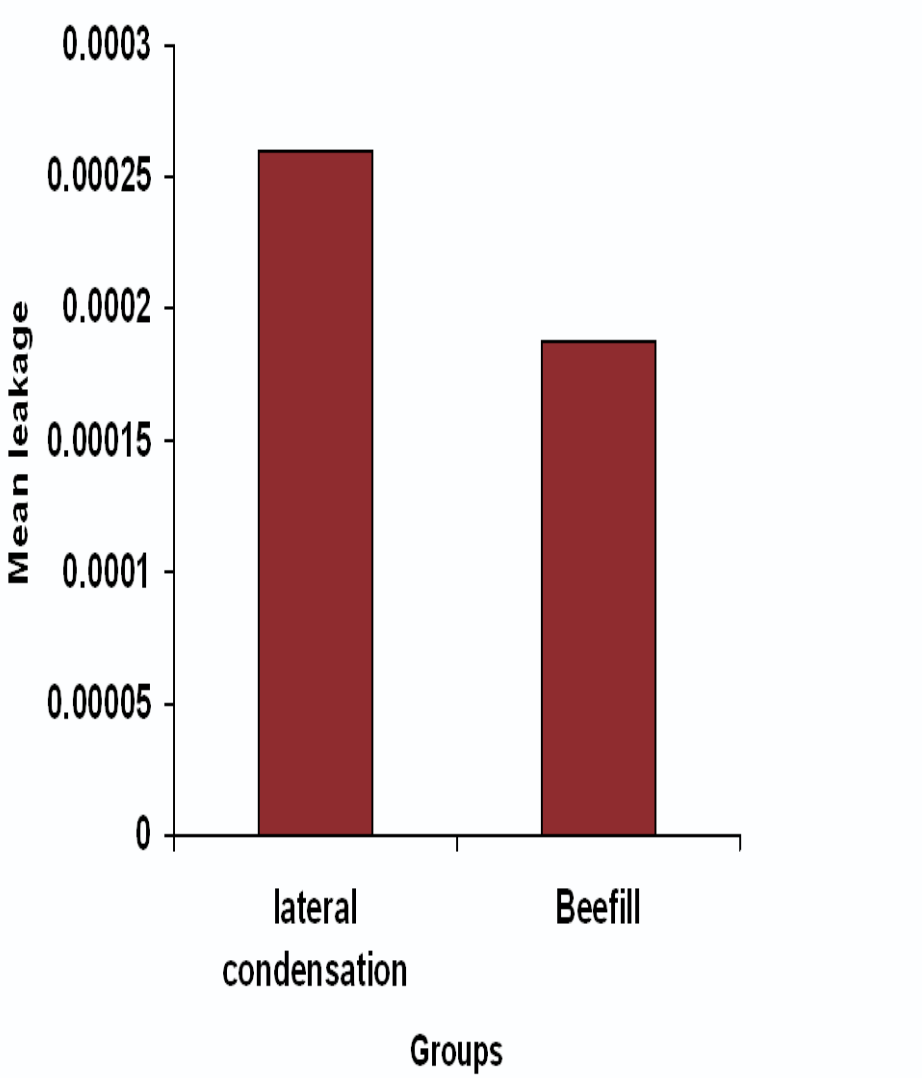

Table 1: Description of data in two groups

Mean	Max	Min	Obturating system
0.0002597742284	0.00047560460	0.00005830705	Lateral condensation
0.0001875400	0.00041394470	0.00004051230	BeeFill

Based on results leakage in group B was less than group A, but there were no statistically significant differences between two groups ($p>0.05$) (Fig. 1).

DISCUSSION

In this study the single canal human premolars were selected and considerable effort was made to balance the groups with regard to length, apical diameter and working length. This was necessary because random allocation of specimens into groups has been found far from ideal. To reduce variability all canals were prepared by one operator using standard technique. The smear layer was removed because it has been assumed by most authorities that better adaptation of heated gutta-percha can be achieved in its absence.

Root canal sealer was used because it has found in both clinical practice and in experimental research that adding a sealer improves the sealing ability of gutta-percha, regardless to the technique used [6].

The use of thermoplasticized gutta-percha such as Obtura II and Ultrafill technique is especially beneficial for irregular canals. The adaptation of the softened gutta-percha to the canal walls has been shown to be significantly better than lateral condensation technique [7].

In the present study, the method for evaluating sealing ability was fluid filtration that seems to produce more consistent and credible data rather than dye penetration technique [8]. This method presents several advantages over the common dye penetration method: the samples are not destroyed, permitting the evaluation over the time; the results are automatically recorded avoiding any operator bias and the results are very accurate because very small amount can be recorded. No tracer is needed with the related problems of molecular size, affinity for dentin, or PH. No intricate materials are required as in bacterial penetration or radioactive studies [4].

In 57% of dye penetration measurements performed over a period of 10 years, the penetrated less than 2 mm from the apical foramen [4].

Very short, cul-de-sac type voids located in the 2 mm apical root canal cannot provide pathways for the bacteria and toxins present in the more coronal root canal. A wide void permits the passage of more bacteria and the diffusion of larger quantities of toxins to the periapex than a narrow void of the same length. Therefore, root fillings with wider voids may represent a higher risk of failure than filling with narrow voids. However, voids of same lengths, regardless of their diameters and volumes, result in a comparable degree of linear dye penetration. When the fluid filtration transport method is used, fluid movement accrues only through voids that are completely open, while cul-de-sac type voids prevent fluid movement [9]. The fluid transport is capable of demonstrating the existence of at least one continuous void along the root filling and suggests the presence of pathways between the coronal and apical end of a root filling.

Under the condition of the present study, the mean value of leakage for thermoplastycized BeeFill system was lower than cold lateral condensation. This may be explained by the superior flow properties of heated gutta-percha and the movement the materials into the canal irregularities. This

result was achieved by Al-Dewarni et al but they found significant differences, may be due to different methods of evaluation [6].

Gin-ichiro Hata et al. [10] compared sealing ability of Thermafill, Obtura II and different type pf Ultrafill obturating system with measuring the penetration of resin into spaces in the gap between the canal wall and gutta-percha.

They found no significant differences in the mean leakage area at the same level for the different obturation material. [10]

Based on results of Gernhardt et al. [11], apical seal in samples obturated with AH plus sealer and thermoplasticized gutta-percha was better than group that obturated with endoRez and cold lateral condensation technique.

CONCLUSION

The use of thermoplasticized gutta-percha such as Obtura II and Ultrafill is especially beneficial for irregular canals and the adaptation of softened of gutta-percha to the canal walls has been shown to be significantly better than lateral condensation. With attention to result of our study and simple application BeeFill system, can introduced it as a new thermoplasticized obturation technique but progressive application of it in clinic requires more studies.

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