

Three-dimensional evaluation of different thermoplasticized root canal obturation systems: an in Vitro Study

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Abstract:

Aim: To three dimensionally compare the homogeneity of root canals obturated with three different thermoplasticized obturating systems using Spiral Computed Tomography

Materials and Methods: 30 single rooted premolars were collected and decoronated, the root canals were prepared by using rotary files. The roots were randomly allocated into 3 groups, and each group was obturated by using three different thermoplasticized obturation systems namely Obtura III, Calamus Dual 3D and Bee Fill 2 in 1. The specimens were then analysed in both horizontal and vertical sections from the apex to the cemento-enamel junction of each specimens with section thickness of 0.6mm using Spiral Computed tomography. All the experimental groups were compared statistically using ONE WAY ANOVA test & the sub groups were compared using TUKEYS HSD test. The results showed no significant difference between the homogeneity of the obturation among the groups both in horizontal and vertical sections.

Conclusion: Obturation done with any of the three thermoplasticized obturation system does not compromise in obtaining apical seal when properly used.

Key words: Obtura III, Calamus Dual 3D, Bee Fill 2 in 1, Spiral Computed Tomography, Homogeneity.

I. Introduction

One of the keys to successful root canal therapy is to adequately obturate the prepared root canal space¹. Obturation of the canal system has historically been achieved with gutta-percha and a sealer². Root canal obturation aims to provide a complete filling of the canal in all dimensions to create a fluid-tight seal to prevent ingress of bacteria, their toxins and their flow into the periapical tissues³. Development and maintenance of the seal are essential to optimize the outcome of root canal treatment⁴. The success of a clean, well-prepared root canal system will be compromised if the root canal system is not properly obturated¹.

Epley et al¹ and Schilder⁵ suggested that the ideal root canal obturating material should be well-adapted to the canal walls and its irregularities and that the entire length of the canal be densely compacted with a homogeneous mass of gutta-percha. Most root canal fillings do not completely fill the root canal system⁶ these unfilled areas might create problems because they might contain bacteria that can multiply when in contact with nutrients via the periapical region or lateral canals⁷. It has been found from the previous studies that thermoplasticized injectable obturation techniques provides the best adaptation to prepared root canal walls⁸. In the present market there are a variety of thermoplasticized obturating systems but the efficiency of these systems are unknown. Hence the aim of the present study is to three dimensionally compare the homogeneity of root canals obturated with three different Thermoplasticized Systems using Spiral Computed Tomography.

II. Materials and Methods

30 single-canal extracted premolars with a curvature less than 10 degrees, was collected and stored in sterile water until use. Teeth with immature apices, those that had undergone root canal treatment, or those that had root caries or restoration was excluded from the study. The samples were decoronated with a diamond wheel saw to achieve a length of 12 mm. Access into the canals was carried out, and working length determined by introducing a size 10 file into the canal until it exited from the apex; this length was measured, and the working length was set 1 mm short of that length. After introduction of hand files and establishment of a glide path, ProTaper (Mallifer Dentsply Tulsa Dental,) files was used to clean and shape the root canal. During preparation and between each file, the canals were irrigated using 1 ml of 5.25% sodium hypochlorite and saline. All canals were prepared to a F3 ProTaper file. After completion of instrumentation, all specimens were given a final flush of 5 mL of 17% Ethylenediaminetetraacetic acid followed by saline. Finally the canals were dried with paper points. For obturation, the samples was randomly allocated into 3 groups and were obturated using 3 different thermoplasticized obturation systems namely Obtura III Max Heated Gutta Percha System Spartan Endodontics;

Calamus Dual 3D obturation System Dentsply and Beefill 2 in 1 (VDW Munich Germany) according to manufactures instructions .After obturation all roots were stored at 37°C with 100% humidity for about 72 hours to allow the sealers to set completely. After 72 Hours analysis of the specimens was done using Spiral Computed Tomography. All the experimental specimens were mounted on a wax block and placed on the couch of the computed tomography machine. It was moved longitudinally towards the gantry at the pitch of “1”and exposure with 120kv and 180mA was done for one second. Both vertical and horizontal sections of 0.6mm thickness were made which was followed by three dimensional reconstruction of the sections. The specimens were further analysed for variations in density in 1 to 4 mm from apex (SUBGROUP I), 5 to 8mm from the apex(Subgroup-II) and 9 to 12mm from the apex (Subgroup-III) individually in both vertical and horizontal sections. The specimens were analysed using Windows Advantage Work Station software for Homogeneity and adaptation to the canal wall and presence voids if any. The analysis of all the specimens was done followed by statistical analysis.



Fig 1 Samples in Spiral CT Machine

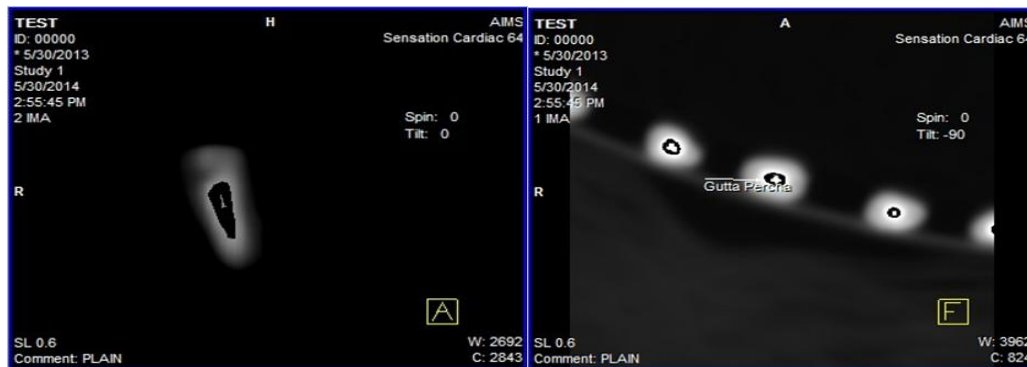


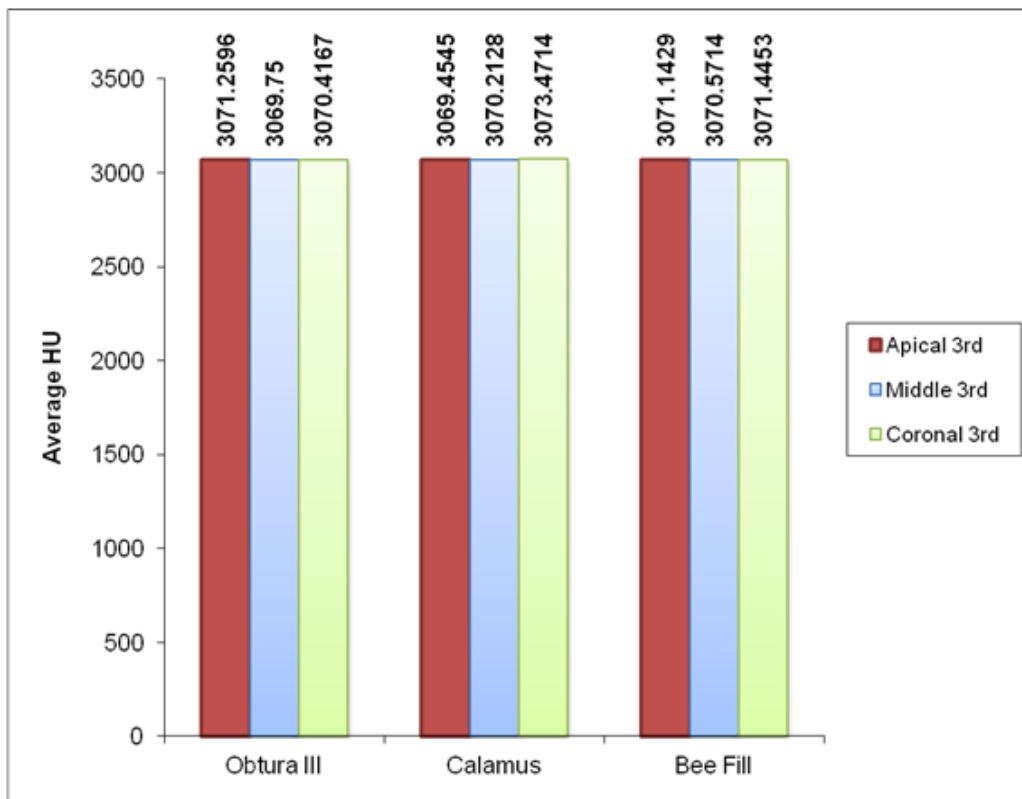
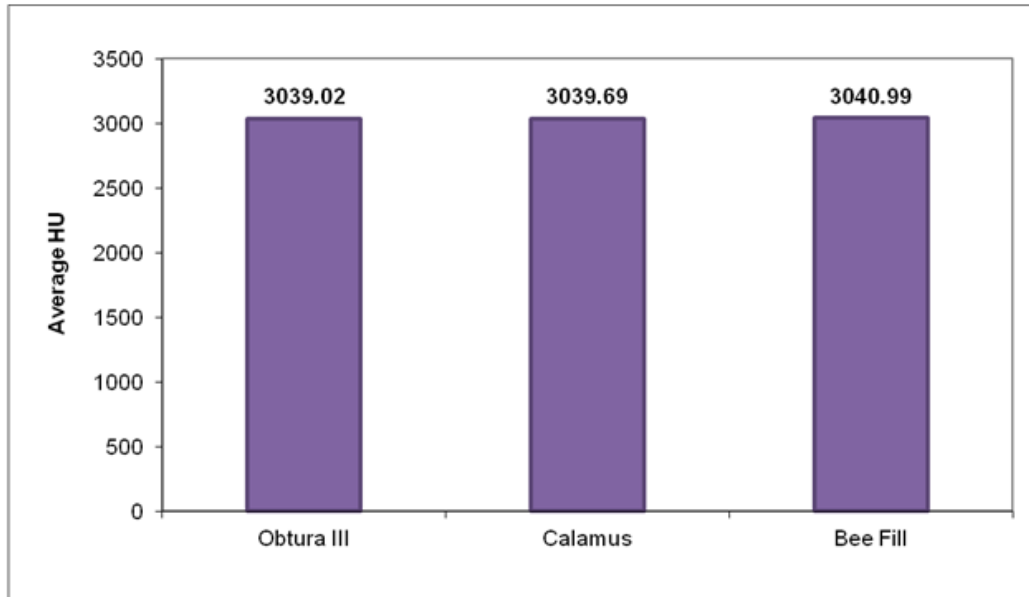
Fig 2 Spiral CT images of Vertical and Horizontal section

Observation and Statistical Analysis

The assessment was done using spiral computed tomography for variation in the density and homogeneity in terms of Hounsefield units. The values were recorded in both horizontal and vertical sections. The results were tabulated and graphically analyzed. All the experimental groups were compared statistically using ONE WAY ANOVA test and the sub groups were compared using TUKEYS HSD test. In all the groups ($p>0.05$) was considered statistically significant.

III. Results

There was no statistically significant difference among the three different thermoplasticized obturating systems. A Slightly higher Hounsefield units was seen in the apical third of the Obtura III which was not statistically significant



IV. Discussion

Achieving a complete seal of the root canal system is of greatest importance in endodontic therapy, The Washington study has concluded that nearly 60% of all endodontic failure is due to incomplete obturation of the root canal⁹.

In order to standardise the study, the root lengths was kept constant to 12 mm. Canal was enlarged upto F3 protaper file.

Teeth with immature apices, previously undergone RCT & tooth with Root caries were excluded from the study and a single operator performed the entire procedure.

In this study alternating solutions of NaOCl and normal saline were used for canal irrigation. The canals were finally irrigated with 17% EDTA and normal saline to facilitate removal of dentin debris and smear layer from the root canal¹⁰.

Spiral computed tomography was chosen over other diagnostic aids for analysis of the specimens because of its various advantages like Three-Dimensional volume measurements are possible without sectioning the specimens and thus avoiding the loss of material during sectioning¹¹ and three dimensional reconstructions¹²

Each section was analyzed for variations in the density of the obturation in Hounsefield Units (HU), and presence voids if any.

During the analysis it was found that the Hounsefield units increase from the apex to the cemento-enamel junction in vertical sections which could be due to the increase in the obturation mass from the apex to the CEJ. Similarly there was a decrease in the Hounsefield units from the centre towards the periphery in horizontal sections which could be due to the decrease in the obturation mass towards the periphery. These findings were observed in all the samples. However there were no voids in any of the specimens.

The results showed that there was slightly higher homogeneity of the obturating material in the apical 3rd of the first group compared with that of the other two group but was not statistically significant. This could be due to the reason that obtura III is more ergonomic to handle compared to Calamus Dual 3D Obturation System and Bee Fill 2 in 1.

However there are limitations in the study as it was performed in tooth with straight canals and in invitro conditions. Hence further in vivo studies are required to find its applicability in curved canals before accepting this as a routine obturation procedure.

V. Conclusion:

Obturation done with Any of the three Thermoplasticized obturation system does not compromise in obtaining apical seal when it is properly used. Hence it can be concluded that none of the three obturating system is inferior to one another.

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