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Analysis of efficacy of two obturation techniques used in root canal treatment of anterior teeth: An *in vitro* study

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Abstract
Background: Sealing the root canal system is an important step in root canal treatment for a successful outcome. Several techniques and materials have been introduced for a three-dimensional obturation with higher density and homogeneity. Void-free filled canals carry a lower risk of apical periodontitis. [2] Gutta-percha has long been used as a popular root filling material. Hence; the present study was undertaken for assessing the efficacy Of Two Obturation Techniques Used in Root Canal Treatment of Anterior Teeth.
Materials and methods: The present study was conducted in the Department of Conservative dentistry and Endodontics of the Dental institution. For the study, we used 60 extracted permanent maxillary central incisors with single canal and completed apex formation. We excluded teeth with morphological anomalies and multiple root canals to avoid any bias in the results. For the preparation of root canals, access cavity was made and the canal was located using a #8 K-file. After the canals were located, we cut the crowns of the teeth such that the working length of the canal was standardized at 22 mm for all teeth. The teeth in Group 1 were obturated with size 30 gutta-percha master cone and size 15 gutta-percha accessory cones with conventional lateral condensation technique using finger spreaders. The teeth in Group 2 were obturated using energized warm lateral compaction with ultrasonic spreaders. A master gutta-percha cone was selected, adjusted until 'tug-back' was observed, seated to working length, and compressed with a finger spreader in the same manner as described above for the group 1.
Results: Mean gutta percha weight in Group 1 which were obturated with mechanical lateral condensation technique was 10.48 $\pm$ 1.8 g. Mean gutta percha weight in Group B which were obturated with warm lateral compaction with ultrasonic spreaders condensation technique was 14.65 $\pm$ 1.1 g.
Conclusion: Within the limitations of the present study, it can be concluded that obturation technique utilizing warm lateral compaction with ultrasonic spreaders is more efficacious as compared to conventional lateral condensation technique using finer spreaders.

Keywords: Gutta percha, obturation, Endodontics, Root canal

Introduction
Sealing the root canal system is an important step in root canal treatment for a successful outcome [1]. Several techniques and materials have been introduced for a three-dimensional obturation with higher density and homogeneity. Void-free filled canals carry a lower risk of apical periodontitis [2]. Gutta-percha has long been used as a popular root filling material. The chemical and physical properties of gutta percha enable its application in several obturation techniques [3]. Lateral consideration of gutta-percha has been proven to be a very popular and clinically effective filling technique. However, Schilder reported that final filling by lateral consideration resulted in a non-homogeneous mass of many separate gutta-percha cones pressed together and joined only by friction and the cementing substance [4, 5]. Warm gutta-percha best fulfills the requirements of a root canal filling because homogeneity is provided throughout the entire length of filling. The various thermoplastic techniques Mc Spadden method, ObturaII, Ultrafil, Endotec and Thermafil. In Obtura II, the gutta-percha is heated from temperature range of 160°C to 200°C which is then injected through the needle. In thermafil technique, a metal carrier is used to transport the gutta-percha to working length, then compacted using a single insertion motion. [6] Hence, the present study was conducted to analyze efficacy of two obturation techniques used in root canal treatment of anterior Teeth.

Materials and methods

The present study was conducted in the Department of Conservative dentistry and Endodontics of the Dental institution. The study was approved from the ethical committee of the institute prior to commencement of the study. For the study, we used 60 extracted permanent maxillary central incisors with single canal and completed apex formation. We excluded teeth with morphological anomalies and multiple root canals to avoid any bias in the results. The teeth were immersed in the dilute hypochlorite solution for 48 hours to remove any organic debris on the teeth. After 48 hours, the teeth were immersed in the normal saline solution until the commencement of the study.

For the preparation of root canals, access cavity was made and the canal was located using a #8 K-file. After the canals were located, we cut the crowns of the teeth such that the working length of the canal was standardized at 22 mm for all teeth. The biomechancal preparation of the canals was done using K-files. After completion of the biomechanical preparation of the canal, the teeth were randomly grouped into two groups, Group A and B, with 30 teeth in each group. The teeth in Group 1 were obturated with size 30 gutta-percha master cone and size 15 gutta-percha accessory cones with conventional lateral condensation technique using finger spreaders. The teeth in Group 2 were obturated using energized warm lateral compaction with ultrasonic spreaders. A master gutta-percha cone was selected, adjusted until 'tug-back' was observed, seated to working length, and compressed with a finger spreader in the same manner as described above for the group 1. Two accessory cones (size FF) were then inserted and compressed with the finger spreader, followed by the use of a 0.02-taper, spreader-like, smooth-sided nickel-titanium instrument (ESI instrument; Electro Medical Systems SA, Nyon, Switzerland) activated at the lowest power setting using an ultrasonic machine (MiniMaster LED, Electro Medical Systems SA). This ultrasonic spreader was gradually sunk apically up to 2 - 3 mm from the working length. Another accessory cone was subsequently inserted, compressed with a cold spreader, and then compressed using the ultrasonically activated instrument. This process was repeated until the cold spreader could not be inserted for more than 2 mm into the canal orifice. Excess gutta-percha cones were seared 0.5 mm below the orifice and compressed with a cold plugger. with size 30 gutta-percha master cone and size 15 gutta-percha accessory cones using mechanical lateral condensation technique (MLC) employing a reciprocating handpiece. All the procedures were performed by a single operator. The teeth were weighed before and after the completion of obturation. This difference in weight showed the weight of gutta percha mass. The data was stored for further evaluation.

The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistical significant.

Results

Table 1 shows the mean gutta percha weight in both the techniques. Mean gutta percha weight in Group 1 which were obturated with mechanical lateral condensation technique was 10.48 $\pm$ 1.8 g. Mean gutta percha weight in Group B which were obturated with warm lateral compaction with ultrasonic spreaders condensation technique was 14.65 $\pm$ 1.1 g. On comparing the results, it was seen that the results are statistically significant ($p<0.05$)

Table 1: Mean gutta-percha weight in Group 1 and Group 2

Groups	Mean Gutta-Percha weight	p-value
Group 1 (Mechanical lateral condensation technique)	10.48 $\pm$ 1.8 g	0.05
Group 2 (warm lateral compaction with ultrasonic spreaders condensation technique)	14.65 $\pm$ 1.1 g	

Discussion

In the present study, we observed that obturation of gutta percha with lateral compaction and ultrasonic spreaders is fairly efficacious as compared to lateral condensation technique with finger spreaders. The results were statistically significant The results were compared to previous studies from the literature. Ho ES *et al.* compared the density of gutta-percha root fillings obturated with the following techniques: cold lateral (CL) compaction, ultrasonic lateral (UL) compaction, and warm vertical (WV) compaction. Thirty-three extracted mandibular first molars, with two separate mesial canals in each, were selected. After instrumentation, the canals were stratified into three groups based on canal length and curvature, and underwent obturation with one of the techniques. No sealer was used in order to avoid masking any voids. The teeth were imaged pre- and post-obturation using micro-computed tomography. The reconstructed three-dimensional images were analyzed volumetrically to determine the amount of gutta-percha present in every 2 mm segment of the canal. P values < 0.05 were considered to indicate statistical significance. The overall mean volume fraction of gutta-percha was 68.51 ± 6.75% for CL, 86.56 ± 5.00% for UL, and 88.91 ± 5.16% for WV. Significant differences were found between CL and UL and between CL and WV, but not between UL and WV. The gutta-percha density of the roots treated with WV and UL increased towards the coronal aspect, but this trend was not noted in the CL group. They concluded that WV compaction and UL compaction produced a significantly denser gutta-percha root filling than CL compaction. The density of gutta-percha was observed to increase towards the coronal aspect when the former two techniques were used. Kumar NS *et al.* evaluated and compared the sealing ability between the clod lateral condensation, thermo plasticized gutta-percha, and flowable gutta-percha obturation technique, under a stereomicroscope at ×40 magnification. Sixty single rooted teeth were selected and canals were shaped with K3 NiTi files. Irrigation was performed with 5.25% NaOCl and 17% ethylenediaminetetraacetic acid (EDTA). The teeth were then separated into three groups depending on the type of obturation technique: Group A, obturated using the lateral condensation technique and AH Plus sealer; Group B, obturated with thermo plasticized gutta-percha tech (Obtura III Max) and AH Plus sealer; and Group C, obturated using flowable gutta-percha technique (Gutta Flow). After storing the teeth in 100% humidity for 7 days at 37°C, the roots of the teeth were sectioned at five levels. The sections were then observed under a stereomicroscope at ×40 magnification and the images were analyzed for area of voids (AV) and frequency of voids. The data were statistically analyzed using the SPSS version 17 software. The 95% confidence intervals (CI) were calculated. One-way analysis of variance with post

hoc test and non-parametric Mann–Whitney U test were carried out to compare the means. The lowest mean of AV was recorded in the thermo plasticized gutta-percha (Obtura III Max) group. This was statistically and significantly different from flow able gutta-percha (Gutta Flow) group. There was no significant difference between the thermo plasticized gutta-percha group and lateral condensation group with regard to the AV, but there was a statistically significant difference between the lateral condensation and flow able gutta-percha groups. The flow able gutta-percha group showed the maximum number of voids, which was significantly higher than those in the lateral condensation and thermo plasticized gutta-percha groups. They concluded that the thermo plasticized gutta-percha technique (Obtura III Max) had better adaptability to the canal walls when compared to the flowable gutta-percha (GuttaFlow) obturation and lateral condensation techniques [7, 8].

Naseri M *et al*. compared the quality of four different root canal obturation techniques: cold lateral condensation (CLC), warm vertical condensation (WVC), Obtura II (OII) and Gutta Flow (GF) by using micro-computed tomography (micro CT). A total of 20 extracted maxillary first molars prepared with Pro Taper files, were randomly divided into four groups. Micro CT was used to measure the internal volume of root canals. Following application of AH26 sealer to canal obturation, new micro-CT images were taken and the volume percentage (VP) of voids, gutta-percha and sealer at different levels were calculated with CT software. Data was statistically analyzed using Kruskal-Wallis and Mann-Whitney U tests. The highest percentage of filling material was observed in GF group followed by OII with no statistically significant difference. These two groups had a significantly more acceptable filling than WVC and CLC groups. Voids were detected in all samples. There was a significant difference between the highest and the lowest percentage of voids in CLC (19.6%) and GF groups (6.7%), respectively. In the apical third, CLC and OII showed the highest and the lowest percentage of voids (5.5% and 2.6%) and the lowest and highest percentage of gutta-percha (76.52% and 94.26%), respectively. These differences were statistically significant. They concluded that none of the root canal filled teeth were gap-free. GF and CLC techniques showed the highest and lowest VP of obturation materials, respectively. Samadi F *et al*. evaluated the percentage of gutta-percha-filled area (PGFA) using microscopic analysis of the cross-sections in the apical third of root canals when filled either with Thermafil technique, Warm Vertical Condensation technique and Cold Lateral Condensation technique without using sealers. Sixty single rooted extracted per-manent teeth were collected. After crown amputation, the teeth were randomly divided into three experimental groups of 20 specimens each. Group I–Thermafil obturation technique, group II–warm vertical condensation obturation technique and group III–cold lateral condensation obturation technique. Obturation was performed by specific techniques without using sealers. After obturation, the teeth were cross-sectioned horizontally at 2 to 3 mm from apex with the help of double sided diamond disk. Sections were digitally photographed and measured under Stereomicroscope at magnification of 50×. Using a KS 100 imaging system the area of canals and the gutta-percha was recorded, also the percentage of gutta-percha filled area (PGFA) was calculated. Maximum group difference was observed between groups I and III while minimum difference was observed between groups I and II. Thus, all the between group differences were statistically significant. They concluded that the Thermafil Obturation technique produces significantly higher percentage of gutta-percha filled area (PGFA) than the warm vertical condensation technique or cold lateral condensation technique [9, 10].

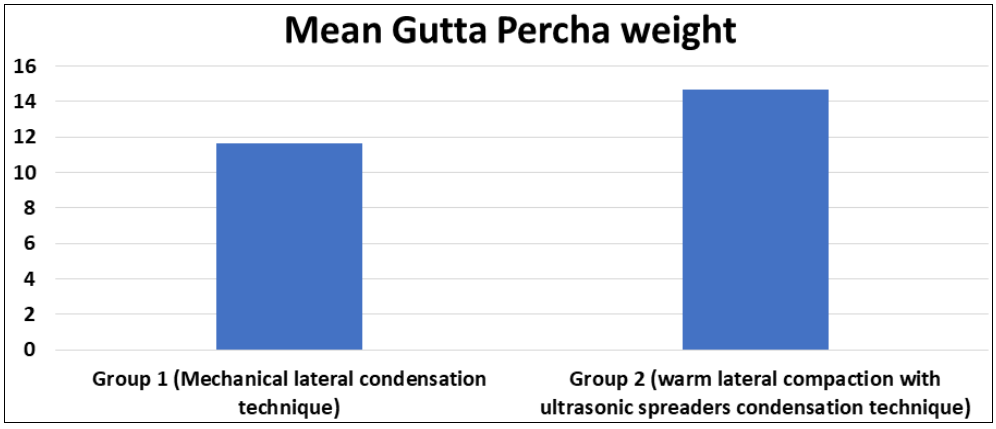

Fig 1: Mean gutta percha weight in Group 1 and Group 2

Conclusion

Within the limitations of the present study, it can be concluded that obturation technique utilizing warm lateral compaction with ultrasonic spreaders is more efficacious as compared to conventional lateral condensation technique using finer spreaders.

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