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COMPARISON OF THE HOMOGENEITY OF TWO OBTURATING MATERIALS – THERMOPLASTICIZED GUTTA-PERCHA AND COLD FLOWABLE GUTTA-PERCHA – AN INVITRO STEREOMICROSCOPIC STUDY.

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ABSTRACT

AIM: To compare the homogeneity of thermoplasticized gutta-percha and cold-flowable gutta-percha after obturation.

MATERIALS AND METHODS: Forty single-rooted teeth were selected and the canals were shaped with ProTaper Next rotary files and irrigated with 3% sodium hypochlorite and 17% EDTA. Group A - obturated with Obtura II and AHplus sealer, and Group B- obturated using GuttaFlow. The roots of the teeth were sectioned at five levels and were observed under a stereomicroscope at 40 × magnification and the images were analyzed.

RESULTS: The number of voids were more in the Group B –GuttaFlow (56%) when compared to Group A- Obtura II (15%). The area of the voids in the GuttaFlow was small and were seen mostly in the core, whereas the area of the voids in Obtura II was large but were seen equally in the core and at the periphery.

CONCLUSION: The Obtura II and GuttaFlow showed acceptable adaptation to the canal walls but Obtura II has more homogeneity when compared to GuttaFlow.

KEYWORDS : Homogeneity, thermoplasticized gutta-percha, Obtura II, Cold-flowable gutta-percha, GuttaFlow

INTRODUCTION:

Three-dimensional obturation of the root canal is utmost important for the long-term success of the endodontic therapy. The obturating material should seal all the portals of the entry into the root canal (apical, coronal and lateral) with uniform density and homogeneity. [1-3] Several materials and techniques have been proposed to achieve the three-dimensional obturation of the root canal which include materials like gutta-percha, resins, cements, pastes and metals like silver and techniques like lateral compaction, warm vertical compaction, thermomechanical compaction, thermoplasticized gutta-percha, continuous wave compaction, solid-core obturation etc. [4, 5]

Warm gutta-percha techniques provide better homogeneity when compared to lateral compaction which solely relies on the sealer to seal all the gaps between the gutta-percha and defects in the canal. Thermoplasticized gutta-percha techniques have been used widely as they improve the surface adaptability and homogeneity of the gutta-percha. [6] Obtura II (Obtura Spartan, IL) is a thermoplasticized injectable gutta-percha which has shown in several studies to have better homogeneity and adaptation to the three dimensional root canal system. [3, 6, 7]

Cold-flowable gutta-percha technique namely GuttaFlow (Coltene / Whaledent, Raiffeinsenstra, Germany) is a modification of the RSA RoekoSeal Automix (Roeko Dental Products, Langenau, Germany). It is a mixture of gutta-percha powder, poly-dimethylsiloxane and silver particles. GuttaFlow has good flowability, better seal and adaptability to the canal walls due to its inherent nature of slight expansion on setting. [8, 9] Although it has a homogeneous composition, after setting it presents small porous areas. [2, 3]

The aim of the present study is to compare the homogeneity of thermoplasticized injectable gutta-percha Obtura II and cold-flowable gutta-percha GuttaFlow after obturation.

MATERIALS AND METHODS:

Forty extracted human single-rooted mandibular premolar teeth with intact crowns were collected for the study and stored, disinfected and handled as per the recommendations and guidelines laid down by Occupational Safety and Health Administration (OSHA) and Centers for Disease Control and Prevention (CDC). Teeth that were collected had fully formed root apex without any evident fractures, calcifications or extreme canal curvatures. The teeth were divided into two groups of 20 teeth each, using stratified randomization.

Access cavities were prepared using Endoaccess burs (Dentsply Maillefer, North America) with a high speed airotor handpiece. The working length was defined to be 1 mm short of the apical foramen determined by inserting a size #15 K-file (Mani files, Japan) into the canal until the tip was visible at the apical foramen. Patency filing was accomplished by # 10 K-file. Canal preparation was done with ProTaper Next (Dentsply Maillefer, North America) files up to the size X3 with tip diameter 0.30mm and 07 taper. The canals were irrigated with 2ml 3% sodium hypochlorite (Prime dental, India) in between instrumentation and 10 ml 17% EDTA to remove the smear layer followed by a final rinse of 10 ml 3% sodium hypochlorite. The canals were dried with paper points before obturation.

Obturation:

Group A: Obtura II Group

The Obtura II system (Obtura Spartan, Fenton, Missouri, USA) was prepared according to the manufacturer's instructions (Obtura II Operator's manual). AH plus sealer was used. 23 guage needle was inserted into the canal short of the working length by 2-5 mm. The gutta-percha pellet was heated at 185^{0}C in the delivery system and injected into the canal. After the apical 5 mm was filled it was condensed with the plugger and the remaining canal was back filled in increments until the gutta-percha was observed at the canal orifice.

Group B: GuttaFlow Group

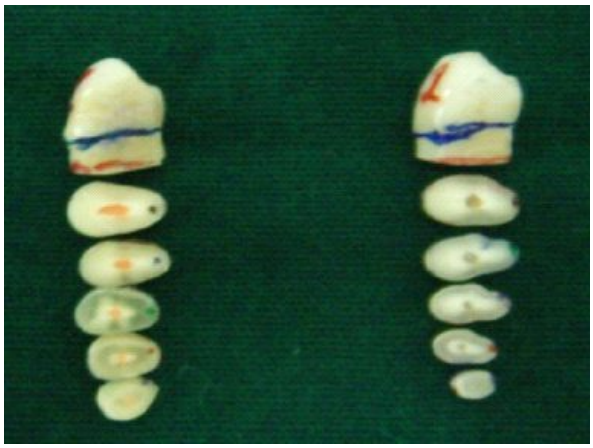
A standardized gutta-percha master-cone (Dentsply Maillefer, North America) was selected and checked for tugback in the canal. The master-cone was used along with GuttaFlow as per the recommendation of the manufacturer (GuttaFlow Operator's Manual). The GuttaFlow capsule was triturated for 30 seconds and loaded into the gun after attaching the cannula. The GuttaFlow was injected into the canal 3mm short of the working length. The master-cone was coated with GuttaFlow paste and inserted into the canal up to the working length. The butt end of the gutta-percha was seared with the red hot ball burnisher.

Access cavities were then sealed with Cavit (3M ESPE, US) and the teeth were stored at 37° C and 100% relative humidity for 7 days.

Sectioning:

Sectioning was done with double-ended diamond disks at low speed, with water cooling. Each tooth root was sectioned at five levels (Figure 1).

Figure 1: Sectioning of teeth.



Level 1 was at the apical end of the working length and other four levels were determined according to the individual root length. In general the thickness of the section was 1 – 2.5 mm. The coronal surfaces of the sections were labeled, digitally photographed, and measured at ×40 magnification, using a Stereomicroscope (Magnus) [Figure 2, 3].

Figure 2: Stereomicroscopic Photographs at 5 levels for Group A- Thermoplasticized injectable gutta-percha Obtura II.

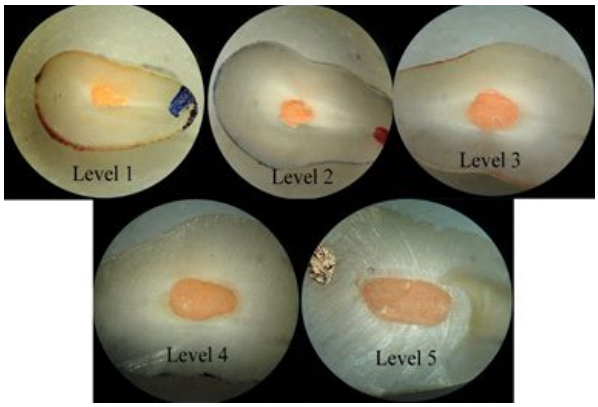
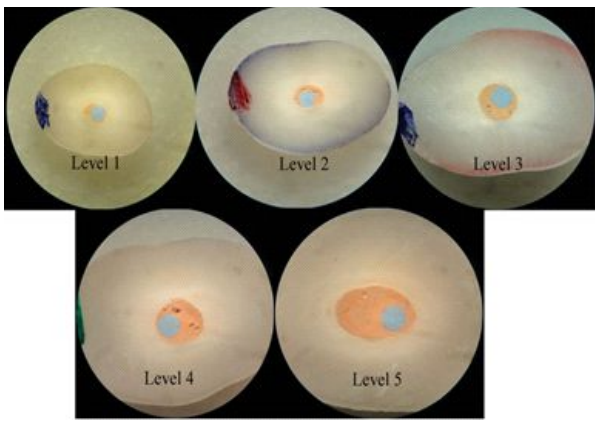


Figure 3: Stereomicroscopic Photographs at 5 levels for Group B- Cold-flowable gutta-percha, GuttaFlow.



The number, location and the area of voids (AV) were noted to determine the homogeneity of the obturating material using Image J Analysis software.

RESULTS:

The number of voids were more in the Group B –GuttaFlow (56%) when compared to Group A- Obtura II (15%) [Table 1].

Table 1: Mean, standard deviation, and 95% CI of the area of voids in the two study groups

					95% Confidence Interval for Mean	
Group	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
A	15	1.0167	.88478	.22845	.5267	1.5066
B	56	3.0093	3.41765	.45670	2.0940	3.9245

The area of the voids in the GuttaFlow was small and were seen mostly in the core of the material than the periphery, whereas the area of the voids in Obtura II was large but were seen equally in the core and at the periphery [Table 2, 3].

Table 2: Obtura II Group

Samples	Level 1		Level 2		Level 3		Level 4		Level 5	
	AV (%)	Location	AV (%)	Location	AV (%)	Location	AV (%)	Location	AV (%)	Location
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0.68	C	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0.72	C	0	0	0	0	0	0
7	0	0	0	0	0	0	1.48	C	0.09	P
8	0	0	0.6	P	0	0	0.37	C	0	0
9	0	0	2.82	P	0	0	0	0	0	0
10	0	0	0	0	2.48	C	0	0	0.39	C
11	0	0	1.59	C	0	0	0	0	0	0
12	0	0	0	0	0	0	0.18	P	0.35	P
13	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0
15	0	0	2.25	P	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0
17	0	0	0.68	C	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0.57	P
20	0	0	0	0	0	0	0	0	0	0

P= periphery & No. of voids - 7, C= Core & No. of voids- 8

Table 3: GuttaFlow Group

Samples	Level 1		Level 2		Level 3		Level 4		Level 5	
	AV (%)	Location	AV (%)	Location	AV (%)	Location	AV (%)	Location	AV (%)	Location
1	0	0	2.55	C	0.31	C	0.39	C	0	0
2	0	0	0.65	C	0.45	C	4.88	P&C	2.89	P&C
3	0	0	1.01	P&C	9.65	P&C	8.5	P&C	0.95	C
4	0	0	3.29	C	3.98	C	1.01	C	1.87	C
5	0	0	0	0	0	0	0	0	0.33	C
6	15.55	C	0	0	0.56	C	0.75	C	1.14	C
7	1.09	C	0.34	C	0	0	0	0	14.83	C
8	0	0	0	0	1.71	P&C	4.99	C	1.09	C
9	0	0	0	0	1.23	P	0	0	0	0
10	0	0	0	0	0.46	C	6.49	C	3.69	C
11	0	0	1.33	C	1.11	C	2.16	C	0.33	C
12	0	0	2.37	C	1.87	C	0	0	2.35	C
13	0	0	0	0	3.56	C	2.75	C	1.94	C
14	0	0	0	0	1.82	C	2.16	C	1.15	C
15	0	0	1.96	C	0	0	5.65	P&C	12.38	C

16	1.68	C	2.72	C	8.26	C	3.46	C	1.6	C
17	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	1.18	C
19	0	C	3.15	C	0	0	0	0	0.39	C
20	0	0	0	0	0	0	2.55	C	2.01	C

P= periphery & No. of voids - 8, C= Core & No. of voids- 56

DISCUSSION:

Success of the endodontic therapy depends upon the meticulous cleaning and shaping and a three-dimensional homogenous obturation with proper seal apically, coronally and laterally. The voids or crevices that may occur during the obturation of the canal may interconnect with each other and may open up either apically or coronally. These voids may act as empty recess or dead spaces which may in turn lead to reinfection and percolation of bacterial substrates and act as reservoirs of irritants leading to failure of the endodontic treatment.

The thermoplasticized injectable obturation techniques was introduced in 1967 by Schilder to improve the homogeneity and surface adaptation of the gutta-percha. [10] In the present study Group A obturated with thermoplasticized injectable gutta-percha technique showed better adaptation and homogeneity in the canal with fewer voids which is in accordance with the other studies. [3, 11-13]

GuttaFlow is composed of gutta-percha powder in a silicone based sealer (polydimethylsiloxane). It is categorized as silicone sealer i.e. it can be used with or without core material. Evidence suggests that the material fills canal irregularities with consistency. [14] The manufacturer emphasize over better sealing and good adaptability because of its flowable nature and expansion slightly (0.2%) on setting. [2] However, GuttaFlow belongs to the category of root canal filling pastes, which has a high risk of void formation and over filling. In the present study Group B obturated with GuttaFlow showed more number of voids in core and less at the periphery indicating a better adaptability to the canal walls but, compromised on the homogeneity. The results for the Group B are in accordance with the studies done previously. [2, 3, 15-17]

The present study was carried out in an in vitro setup on the extracted teeth and further in vivo studies are necessary to quantify the results. Moreover the teeth selected had straight canals so, the applicability of these techniques in curved and narrow canals need to be studied before accepting these techniques for routine obturation. Further studies are also required to see the correlation between the voids and the bacterial penetration and their growth affecting the treatment outcomes.

CONCLUSION:

Based on the observations of this study it can be concluded that the thermoplasticized injectable gutta-percha, Obtura II and cold-flowable gutta-percha, GuttaFlow showed acceptable adaptation to the canal walls but Obtura II has more homogeneity when compared to GuttaFlow as it contained less number of voids in the core of the material. GuttaFlow due the more voids in the core of the material showed less homogeneity.

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