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Apical Sealing Ability of Thermo Plasticized Gutta-Percha Technique Versus Lateral Condensation Gutta-Percha Technique: An In-Vitro Study

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ABSTRACT

Background: The primary objective of operative endodontics is total debridement of the pulp space and development of an impermeable fluid tight seal at the apex. OBTURATION, The three dimensional sealing of the entire root canal system is the last step in endodontic treatment. Two basic techniques are used in canal obturation, the cold lateral condensation technique and vertical compaction of warmed gutta-percha. Several other new techniques have been introduced in the recent past, which is the variation of these techniques. The aim of the present in-vitro study is to evaluate the apical sealing ability of thermo-plasticized Gutta-percha when compared to conventional cold lateral condensation Gutta-percha technique.

Methods and Methods: Thirty extracted maxillary central incisors and canines were selected. The selected samples were decoronated at the cemento-enamel junction. Chemo-mechanical debridement of the root canal was done. The prepared samples were randomly divided into three groups of fifteen samples each.

Group I: Root canals were obturated using thermo plasticized gutta-percha (E & Q Plus) obturating system and Zinc-oxide based sealer supplied along with the system.

Group II: Root canals were obturated using lateral condensation gutta-percha technique and Zinc-oxide Eugenol based sealer.

Group III: Used as a control.

Results: Conventional cold lateral condensation sealed the root canals significantly better than the thermo plasticized gutta-percha (E&Q Plus).

Keywords: Obturation; Lateral condensation; Gutta-percha.

INTRODUCTION

The primary objective of operative endodontics is total debridement of the pulp space and development of an impermeable fluid tight seal at the apex. OBTURATION, the three

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dimensional sealing of the entire root canal system is the last step in endodontic treatment. Gutta-percha has been known to dentistry over 100 years. Gutta-percha comes from sapodilla family, Malaysian trees, genera Payera or Palaquium. Chemically pure gutta-percha exists in two distinctly different crystalline forms, alpha and beta that can be converted into each other. In 1947, Hill developed the first gutta-percha root canal filling material known as HIILS STOPPING[1,2,3,4]. The preparation, which consisted principally of bleached gutta-percha and carbonate of lime and quartz, was patented in 1848 and introduced to dental profession.

In 1867, BOWMAN made claim (before the St Louis Dental Society) of the first use of gutta-percha for filling in an extracted first molar. References of the use of gutta-percha for root-canal obturation before the turn of twentieth century were few and vague. In 1883, PERRY claimed that he had been using a pointed gold wire, wrapped with some soft gutta-percha . It was in 1887, the SS White Company began to manufacture gutta-percha points. With the introduction of radiographs into the assessment of root canal obturations, it became painfully obvious that the canal was not cylindrical, as earlier imagined and that additional filling material was necessary to fill the observed voids. At first, hard setting dental cements were used, but these proved unsatisfactory[5]. It was also thought that the cement used should possess strong anti-septic action. Hence, the development of many phenolic or formalin type of paste cements[6]. The softening and dissolution of gutta-percha to serve as a cementing agent, through the use of rosins, was introduced by CALLAHAN in 1914. The sealers are to form a fluid tight seal at the apex by filling the minor intricacies between the solid material and the wall of the canal, and also by filling patent accessory canals and multiple foramina. Hence gutta-percha is always used in conjunction with sealer for the canal obturation[7].

Today most root canals are obturated using gutta-percha with a sealer. Two basic techniques are used in canal obturation, the cold lateral condensation technique and vertical compaction of warmed gutta-percha. Several other new techniques have been introduced in the recent past, which is the variation of these techniques [8].Though many techniques have been devised, cold lateral condensation is a proven classic technique.

Thermo plasticized gutta-percha technique was developed by Yee Et al [9,10]. Studies have shown that thermo plasticized gutta-percha technique is superior to other obturating methods. A close adaptation of the gutta-percha to the canal walls with only minimal voids present in the filling material was reported[11].

The aim of the present in-vitro study is to evaluate the apical sealing ability of thermo-plasticized. Gutta-percha when compared to conventional cold lateral condensation Gutta-percha technique.

MATERIALS AND METHODS

Thirty extracted maxillary central incisors and canines were selected; superficial debris was removed from roots with ultra-sonic unit and stored in saline until it was used for the study.

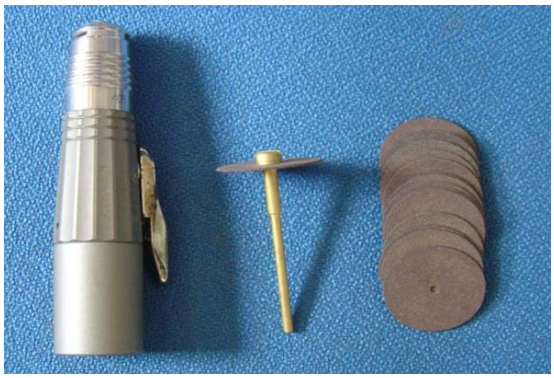

Fig 1. Selected samples were decoronated at the cemento-enamel junction using carborundum discs[12].

Fig 2: Thermo plasticized gutta-percha (E&Q Plus) system[12,13] .

Chemo- mechanical debridement of the root canal was done by removal of the pulp and working length determined using # 15 K file, thereby adjusting the rubber stopper 1mm short of the apical foramen. Canals were instrumented using filing action up to # 40 K file 1 mm short of apical foramen followed by middle and coronal flaring using step back technique[14]. Copious irrigation was used through out the procedure with 27-gauze leur-lock syringe. The root canals were dried with paper points and checked for patency.

Fig 3: Samples in the boxes.

Group I: In this group, the canals were dried with paper points and then coated with sealer using k-file. Master cone was selected, and checked for tug back. It is then coated with sealer and placed in the canal. An E& Q pen tip that goes within 5-7 mm short of the working distance is selected. The temperature of E&Q pen tip is set to 250 °C and is activated by touching the switch on hand piece. The coronal excess of the cone is seared off and the heated gutta-percha cone is now down packed for about 2-3 seconds. Now the back filling is done with E & Q Plus gun with a 23-gauge needle tip[14,15,16]. The needle tip of the gun is inserted as far as it will go into the canal space with out binding, then the trigger is activated. The injected gutta mass is allowed to push the tip out of the canal and then the gutta-percha is again condensed with an appropriate sized plugger[17].

Group II: In this group, the canals were dried with paper points and coated with sealer using k-file. Master cone was selected, checked for tug back and coated with sealer, placed in the canal. Lateral condensation was commenced using a finger spreader[18].

The Group III: In this group, canals were dried with paper points, left un-obturated and were used as control void left by the spreader was filled with an accessory gutta-percha point of identical size. After the entire canal was filled, the excess gutta-percha was removed with the hot instrument and condensed vertically.

The samples were dried and the root surface coated with two layers of nail varnish leaving the apical 2-3 mm. Samples were placed in India ink and stored at room temperature for 48hrs after which they were thoroughly washed under tap water and dried[19].

The roots were split longitudinally with diamond disc and were checked for dye leakage using stereomicroscope. Data was analyzed statistically[20].

RESULTS

Thirty maxillary central incisors and canines were used as specimens to evaluate the apical seal of root canals obturated using two different techniques i.e. the thermo plasticized gutta-percha technique (E&Q Plus) and the conventional cold lateral condensation technique[21].

The samples were divided into three groups of fifteen each.

Group I: Obturated by thermo plasticized gutta-percha technique with Zinc oxide based sealer supplied along with the system.

Group II: Obturated using the conventional cold lateral condensation technique using a Zinc-Oxide Eugenol based sealer.

Group III: Used as a control.

The specimens were then viewed under stereomicroscope with (16x) magnification for the dye penetration from the apical end and the values are subjected to statistical analysis. Analysis was done using Chi- Square test and the percentage with and with out the dye leakage of each group was calculated and tabulated with

the ranking in decreasing order of their efficiency[22].

Grou	Rank	Sampl	No	Percent	With	Percent
GRO	1	10	6	60	4	40
GRO	2	10	2	20	8	80
GRO UP III	3	10	0	0.0	10	100.0

The |[2] value obtained for dye penetration was 8.33% and P-value of (<0.05); hence; it was concluded that there is a statistically significant difference among the groups.

Comparison	?2	P value
Group I Vs Group II	8.33	< 0.05

Group I (thermo plasticized gutta-percha) was compared with Group II (conventional cold lateral condensation technique) and the P-value obtained was <0.05, concluding a statistically significant difference amongst the two groups. Group III was however a positive control showing complete leakage.

DISCUSSION

Obturation, the three dimensional sealing of the entire root canal system is the last step in endodontic treatment. The seal has to be perfect to protect the treated surface because, while incomplete removal of etiological factors is a major cause of endodontic failure, according to Ingle, 60% of failures can be attributed to apical percolation due to inadequate obturation . It has been shown using canal sampling and culturing techniques that microorganisms remain in the canal after biomechanical preparation and medication, albeit in reduced numbers and type. These results should be viewed with the knowledge that a negative culture does not mean an absence of microorganisms in the root canal system[23].

These findings taken collectively would appear to suggest the following role of obturation.

1. To help prevent microbial recolonization of the closed root canal system by growth of those microorganisms that escapes the biomechanical preparation and medication procedure.

2. To prevent the entry of new microorganisms in root canal system from the oral environment.

3. To prevent egress of microorganisms and their products from root canal system to the periradicular tissues, that is to incarcerate remaining bacteria and their products in the root canal system[24].

Successful root canal therapy requires a complete obturation of the root canal system with non-irritating biomaterials. Thus it is necessary to use materials that will be able to create a fluid impermeable seal between the root canal system and the periapical tissues. The most popularly used material is the Gutta-percha, which has enjoyed acceptance as a dental material for more than 100 years. Marshall and Massler showed by way of isotopes that in a root canal procedure, Gutta-percha gives the best apical seal among the commonly used canal filling techniques.

Four basic techniques exist for the obturation of the root canal system with gutta-percha and sealer.

1. The cold compaction of gutta-percha.

2. The compaction of gutta-percha that has been heat softened in the canal and cold

compacted.

3. The compaction of gutta-percha that has been thermo plasticized, injected into the system and cold compacted.

4. The compaction of gutta-percha that has been placed in the canal and softened through mechanical means.

In this study, the time tested cold lateral compaction of gutta-percha and a not much investigated “E & Q plus system” technique has been evaluated. The thermo plasticized gutta-percha E&Q Plus system consists of two-step procedure. The first step uses 250 ◦ C to severe the master cone and the second step involve backfilling of the remaining canal space using gutta-percha heated upto 160-200°C. Sealability

of these two techniques was studied with dye leakage. Leakage studies contribute a major part of contemporary endodontic research. Dye penetration studies are a pragmatic and useful way of comparing new obturation techniques and materials with a known standards[25]. In this study, specimens were passively soaked in India ink; the method is simple and has been used in large number of studies. Tracers other than India ink have been used, such as methylene blue, basic fuschin etc. The merits of micro leakage studies have been discussed extensively and despite their drawbacks remain a useful way of relatively quickly comparing new obturation techniques against a known standard (Lateral condensation) . Black India ink was used as a leakage marker in this study for its ready visibility under visible light. Use of Black India ink have been reported to be efficient in many studies evaluating apical leakage after obturation[26] .

Leakage into root canal can occur through four possible routes.

1. Through the apical foramen, between the roots filling material and the root canal wall.

2. Through the apical foramen by infusion into the material.

3. From the outside of tooth through exposed cementum, accessory canals, secondary canals, through micro cracks in the root or defects in the coating surfaces.

4. Through the coronal access cavity.

Care was taken to see in this study that the teeth selected had no cracks and all the experimental specimens were thoroughly coated with nail varnish to seal the entire surface except the apical 2-3 mm from the foramen. Any accessory canals within this area were expected to be sealed off by the sealer cement in the Group II and by the gutta-percha and sealer in Group I.

The aim of this study was to compare the apical sealing ability of thermo plasticized gutta-percha (E&Q Plus) technique with conventional cold lateral condensation gutta-percha technique[27].

Results of the present study showed leakage in 8 samples of Group I, 4 samples in Group II and in all the samples of Group III (Control), indicating that the lateral condensation technique sealed the root canals better than the thermo plasticized gutta-percha technique (E&Q Plus). The mean dye leakage percentage of Group I, Group II and Group III were 80%, 40%, and 100% respectively. Table 1 shows the percentage values and ranking in decreasing order. Similar leakage studies comparing cold lateral compaction compared with thermo plasticized injectable gutta-percha technique showed lateral condensation better than injectable gutta-percha. In a study of Larz Spanberg, lateral condensation of gutta-percha was better than thermo-mechanical compaction radio graphically from both facial and proximal views[28]. Though some of these studies have shown cold lateral compaction superior, there are also studies that showed warm techniques superior.

No previous study is available comparing cold lateral condensation with E & Q Plus system. In the present study, there was a statistically significant difference between the two obturated groups. superior seal4. The presence or absence of smear layer in endodontics has been controversial. Many studies have shown that smear layer did not alter the sealability of obturation technique. At the same time studies have also shown that the removal of smear layer had improved sealability of Warm gutta-percha. The effect of removing smear layer was more pronounced for thermo plasticized gutta-percha than for laterally condensed gutta-percha. In this study no attempt was made to remove the smear layer and may also have attributed to the increased leakage observed.

In Group II, lateral condensation was chosen as the standard for comparison with thermo plasticized gutta-percha, because it is still the most widely used method. The conventional lateral condensation was carried out with a Zinc oxide Eugenol based sealer. Few specimens did show leakage in this group as well. Reasons could again be attributed to the sealer or improper compaction of gutta-percha in samples showing leakage. Root canal sealer is used with cold gutta-percha technique not only

to lute the points, but also to allow for filling of accessory anatomy. The stated disadvantage of cold lateral condensation is that, at no time is a homogenous mass of gutta-percha developed as said by Schilder and Brayton et al and cited. The final filling is composed of a large number of gutta-percha cones tightly pressed together and joined by frictional grip and cementing substance. Yet in the present study, the percentage of teeth obturated with this technique showed absolute sealability in 10 out of the 15 specimens. This is in concurrence with the result obtained by many workers .

Leakage evaluation is done using various quantitative and qualitative analysis such as measurement of length of penetration of dye, volumetric leakage using spectrometric analysis etc. But in this study only the all or none principle is considered and evaluated. The reason is that even 1mm length of canal space can harbor sufficient microbes that can result in failure of endodontic treatment. Other workers have done similar evaluation too. The results are subjected to various analyses for significance such as Chi-square test, Fishers test, Mann-whitney U-test, ANOVA tests. In this study the data were subjected to Chi-square analysis[29].

The present study was conducted to evaluate the apical sealing ability of the thermo plasticized gutta-percha when compared to that of cold lateral condensation technique.

CONCLUSION

The following conclusions can be drawn. Conventional cold lateral condensation sealed the root canals significantly better than the thermo plasticized gutta-percha (E&Q Plus). Even in the samples of cold lateral condensation with leakage, the dye penetration was less than in the samples of thermo plasticized gutta-percha[30].

Hence, under the conditions of present study, the mean value of apical dye penetration of thermo plasticized gutta-percha was significantly higher than cold lateral condensation. However, the clinical relevance of the results of this laboratory studies should be interpreted with caution.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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