Original Study

COMPARATIVE SEALING ABILITY OF INJECTABLE THERMOPLASTICISED GUTTA PERCHA, THERMOCOMPACTION AND LATERAL CONDENSATION – AN INVITRO STUDY

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ABSTRACT

Aims: The aim and objective of this study is to compare the sealing ability of Injectable thermoplasticised gutta percha, Thermocompaction and lateral condensation techniques.

Materials & Methods: Thirty four teeth with single roots were collected and disinfected. Access preparation, cleaning and shaping with step back technique were done. Teeth were then divided into 4 groups. Group I was obturated with Thermocompaction technique, Group II with Injectable thermoplasticised gutta percha technique, Group III with Lateral condensation and Group IV was left unfilled and as Positive control. All the teeth were then immersed in Rhodamine dye for 24 hours and then teeth were sectioned. The data obtained were subjected to statistical analysis using Anova and student's t test.

Results & Conclusion: Results showed significant difference between the groups.Presentstudy showed Injectable thermoplasticised gutta percha technique to have better apical seal than the other two techniques.

Key words: Fluorescent Microscope, Injectable thermoplasticised, Obturation, Thermocompaction.

Introduction

Successes of endodontic treatment depend on cleaning and shaping of root canal and adequately obturate the prepared root canal space.[1-3] Obturation has historically been achieved with gutta percha and a sealer. The root canal system has many variations in anatomy such as irregularly shaped canals, lateral and accessory canals, anastomoses between canals and a variety of fins. All this leads to a difficulty in preparing the canals to form conducive to complete obturation with filling materials. The various complexities and irregularities present in the root canal system. Close adaptation of the filling material to the canal walls has been considered for a good obturation technique.

Many techniques for obturating the root canal with gutta percha and sealer are present. Some of the techniques include lateral condensation, vertical condensation, sectional obturation, compaction, thermoplasticised and chemically plasticized gutta percha techniques. Complete obturation of the root canal system with a dimensionally stable material is one of the goals of conventional root canal therapy.

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 and their toxins and their flow into periapical tissues. Epley *et al*[1] and Schilder H[4] have 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 homogenous mass of gutta percha.

Long term success is due to three dimensional obturation of root canals in order to prevent ingress of bacteria and their toxins into periapical tissues.

Lateral condensation is one of the most widely used and practical method of obturation. It produces a cold welded, non-uniform mass of gutta percha cones in the canal without replication of canal and leaving space between gutta percha filled with sealer. Negotiating curved roots with pluggers can be difficult because of varied degrees of curvature. In such situations, thermoplasticised injection technique can be used to enhance gutta percha flowing into all the parts of the root canal. Thermoplasticised Injectable techniques were introduced to improve the homogeneity and surface adaptation of gutta percha.

The aim of this study was to compare the sealing ability of Injectable thermoplasticised gutta percha, Thermocompaction and lateral condensation techniques.

Materials and Methods

In this study 60 premolars extracted for periodontal reasons with single roots were selected. The teeth were cleaned by immersion in 5.2% sodium hypochlorite solution. Access cavity preparation was done and pulp tissue remnants were removed. Canal patencies were established with a number 15 file. Working length was determined.

The teeth were then cleaned and shaped using step-back technique. Roots were irrigated with 5.2% sodium hypochlorite before and after recapitulation till a size number 60 file. The teeth were randomly assigned into 4 groups before obturation. The groups consisted of 3 experimental obturating methods and 1 technique as control.

Before obturation all the root canals were flushed with ethyl alcohol and absorbent points were used to eliminate the moisture. Zinc oxide eugenol sealed was used as a sealer and applied into the root canal. Then obturation was carried out with Thermocompaction, Injectable thermoplasticised gutta percha technique and lateral condensation and teeth were divided into following groups.

- Group I – 15 Teeth obturated by Thermocompaction using McSpadden thermocompactors

- Group II- 15 teeth obturated by Injectable thermoplasticised gutta percha technique (Ultafil-Hygienic corp.)
- Group III – 15 teeth Obturated by Lateral Condensation
- Group IV – 15 teeth were prepared but left unfilled and used as positive control.

Group I – Thermocompaction

Fifteen teeth were obturated using McSpadden thermocompactors. It uses rotary friction between gutta percha and dentinal walls to produce heat which thermoplasticises the gutta percha and forces it apically sealing the apex and accessory canals.[5] The McSpadden thermocompactor resembles a reverse Hedstroem file mounted on a latch type slow speed contra-angle. The thermatic condenser is designed to plasticize gutta percha within the prepared root canal system and compacts the filling material laterally as well as vertically to obturate the radicular space.

A master cone was selected. After the sealer was placed, the master cone was seated to the working length. Then the McSpadden compactor, while it was rotating was placed in the canal and is advanced apically in one fluid movement to the predetermined depth until a resistance was felt. The speed of the compactor during rotation is between 8,000 to 15,000 rpm. Once the required speed was achieved, a "backing out" motion was felt produced by the gutta percha being forced ahead of the instrument. Then the compactor was slowly withdrawn while it was still rotating.[6]

Group II – Injectable thermoplasticised gutta percha

In this group the teeth were obturated using Ultrafil (Hygienic Corp.)- that is low temperature thermoplasticised Injectable gutta percha. The system consists of an injection syringe, cannulas with a 22 gauge needle attached and a portable 120-V heater with a pre-set temperature of 90^0 C. The root canals were irrigated, dried and coated with sealer. The low temperature injection syringe with the cannula attached was heated for 15 minutes which allowed the gutta percha to flow at around 70^0 C. the needle was then inserted 6 to 8 mm back from the working length of the canals and gutta percha was injected until it backed up into the pulp chamber. The excess gutta was removed with a warm instrument and access cavity was sealed with IRM.

Group III – Lateral condensation

In this group teeth were obturated with Lateral condensation technique. Root canals were irrigated and dried. A gutta percha master cone was selected and checked for Tug-back at the working length. After master cone selection, canals were coated with sealer. Master cone was fitted, then with a spreader space was created for additional cones and obturation was completed.

Group IV – Positive Control

In this group, teeth were used as control. The root canals were left unfilled except for a small cotton pellet which was placed into the coronal half of the canal to support the temporary filling.

Following obturation, all teeth were stored in humidity at 37^0 C for 48 hours to allow the sealer to set. The teeth were then allowed to dry at room temperature for 24 hours. The surfaces of the roots were then coated with 2 coats of nail polish except for the apical 2-3 mm.

The teeth were then suspended by a dental floss in a container containing 0.2% Rhodamine B dye for 24 hours in different beakers. Only the apical ends were immersed in the dye. After 24 hours the teeth were removed and rinsed with saline. The nail polish was removed from the roots and the teeth were again rinsed. The teeth were then sectioned bucco-lingually using a slow speed diamond disc and made into sections. The sections were then seen under the Leitz-Diaplan Fluorescent microscope under a magnification of 4X equipped with an excitation filter of 540 nm and a barrier filter 0f 590/600 nm. The Rhodamine B dye gives red/green fluorescence when excited at this wave length.

The extent of dye penetration was scored along the interface of the dentin and filling. Termination of the dye penetration was defined as that point where dye no longer penetrated the gutta percha, its interface with the dentin wall or the dentinal tubules.[7]

Results

After sectioning of teeth, they were observed under the Fluorescent microscope to evaluate the extent of dye penetration in the four groups. The extent of dye penetration was measured along the interface of the dentin and the filling. Linear measurements were made from the terminus of the root canal filling or from the point where gutta percha exited the apical foramen to the maximum coronal point of dye penetration.

Extent of dye penetration measured in each group is shown in table 1.

Samples	Group I	Group II	Group III	Group IV
1	1.96	0.63	1.96	5.36
2	1.58	1.89	0.63	6.31
3	3.41	3.91	2.52	5.30
4	2.59	2.05	3.63	5.36
5	2.33	2.05	3.64	5.52
6	2.52	1.96	1.70	5.35
7	1.58	1.83	0.95	5.36
8	2.65	0.25	2.15	5.39
9	1.10	1.42	3.15	5.35
10	0.79	2.21	1.58	5.70
11	2.33	2.33	2.52	5.81
12	1.58	2.01	2.35	5.35
13	2.33	2.10	2.33	5.90
14	1.58	2.05	2.35	5.60
15	2.35	2.33	2.33	5.35

Table 1: - Extent of Fluorescent dye penetration in Millimeters along root canal walls.

Table 2 shows the mean values and the standard deviation of each group. The values were then subjected to statistical analysis.

Variables	Samples	Mean	Standard deviation
Group I	15	2.0510	0.7986
Group II	15	1.7890	0.9795
Group III	15	2.2060	1.0698
Group IV	15	5.6375	0.4546

Table 2: - Mean and standard deviation of Dye penetration

Analysis of variance was used to determine whether there were significant differences in dye leakage among the groups .Differences between means for each group were tested using Student's't' test. (table 3)

Groups	Mean	Standard deviation	t-value	P-value	Significance
Group I	2.0510	0.7986	0.3867	>0.05	Not Significant
Group II	1.7890	0.9795			
Group I	2.0510	0.7986	0.3672	>0.05	Not Significant
Group III	2.2060	1.0698			
Group I	2.0510	0.7986	10.55	<0.05	Significant
Group IV	5.6375	0.4546			
Group II	1.7890	0.9795	0.6666	>0.05	Not Significant
Group III	2.2060	1.0698			
Group II	1.7890	0.9795	9.2726	<0.05	Significant
Group IV	5.6375	0.4546			
Group III	2.2060	1.0698	8.4195	<0.05	Significant
Group IV	5.6375	0.4546			

Table 3: - Student's 't' test

The analysis of variance indicates that there is significant difference between the groups (P<0.0001).

According to the Student's't' test, when group I was compared with group II and group III, it had a P value of >0.005, the results were not statistically significant whereas it was statistically significant when compared with group IV and had a P value of <0.05. Group II compared with Group III, the results were not statistically significant and had a P value of >0.05, whereas it was statistically significant when compared with group IV and had a p-value of <0.05.Group III compared with Group IV, the results were statistically significant and had a P value of <0.05.

Discussion

Complete obturation of the entire root canal system and achievement of a fluid tight apical seal with an inert filling material is one of the major objectives of endodontic treatment. Dow and Ingle have demonstrated that nearly 60% of endodontic failures are due to incomplete obturation.[8,9] Naidorf states that improper obturation permits tissue fluids to enter spaces in root canals, which subsequently can become infected. Seltzer emphasizes that exchange of metabolites occurs constantly between the root canal and saliva. Thus, an open root canal is a pathway that can introduce metabolic products to the periapical tissues.[10]

Apical leakage leads to failure of endodontic treatment. Microorganisms present inside the canals remain active in the tubules even after cleaning and shaping. Thus apical sealing is desirable to prevent the remaining bacteria and their endotoxins from reaching the root apex.[11]

In this study the sealing ability of Injectable thermoplasticised gutta percha, Thermocompaction and lateral condensation techniques has been done. A Fluorescent dye, 0.2% Rhodamine B was used. 3 groups of teeth with a positive control were used. Injectable thermoplasticised gutta percha used in this study was at 70^0C. (figure 1)

Figure 1: - Injectable thermoplasticised obturation showing dye leakage

The thermocompactor uses rotary friction between gutta percha and dentinal walls to produce heat which thermoplasticises the gutta percha and forces it apically i.e. the plasticized gutta percha is pushed laterally because of the thread pattern of the instrument. (figure 2)

Figure 2: - Thermocompaction showing dye leakage

Lateral condensation was used as a standard for comparison as it is one of the widely used techniques. (figure 3) Positive controls used in this study demonstrated that dye penetration was able to disclose all voids within the root

canal system since there was dye penetration throughout the entire canal length. (figure 4)

Figure 3: - Lateral Condensation showing dye leakage

Figure 4: - Positive control

The results of this study showed that the mean leakage of Injectable thermoplasticised gutta perch was lesser in comparison with thermocompactedguttapercha and laterally condensed gutta percha and it was not statistically significant between the three groups.[12] No statistical difference in leakage between Injectable thermoplasticised gutta percha and lateral condensation in studies done by Yee *et al* [13], Micanowicz *et al*[14,15,16], ElDeeb ME[17], Greene *et al* [18].

An SEM study showed the root canal fillings resulting from injection of thermoplasticised gutta percha showed close adaptation to the dentin walls with only occasional voids whereas fillings produced by lateral condensation technique showed poor adaptation to the dentin walls. A consistent observation was that the intricacies of the root canal space were reproduced in impression like manner by Injectable thermoplasticised gutta percha filling with few voids. In case of lateral condensation, it was found to be reasonably well adapted at the apical and coronal parts and showed longitudinal voids in midroot section. Kersten and others reported that with lateral condensation, excessive amounts of root canal sealer and open spaces between the gutta percha cones were observed.[19]

Lateral and accessory canals were filled with Injectable thermoplasticised gutta percha and Thermocompaction. Though Thermocompaction showed less leakage than lateral condensation, it has drawbacks like no control over the speed, compactor acts like a corkscrew and can go beyond the apex and overextension was also seen.[20] Even though there are various techniques for obturating the root canal, lateral condensation has been widely used. Brayton et. al reported that lateral condensation produced irregularities in the final mass of gutta percha and also it did not produce canal fins, the surface of the material was frequently rough and pitted and that there was an inadequate dispersion of sealer. [21]

Conclusion

In the present study Microscopic evaluation was done to analyze apical dye leakage of three different obturating techniques using Rhodamine dye .Within the limits of the study it can be concluded that the mean leakage of Injectable thermoplasticised gutta percha was lesser than the other two techniques. Injection of low temperature thermoplasticised gutta percha produces a good obturation and a good apical seal.

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