Apical seal comparison of thermo plasticized gutta-percha technique and cold lateral condensation technique

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ABSTRACT

Aim: To assess the quality of root canal obturation and the degree of apical dye penetration in the root filled with lateral condensation , thermafil, EQ plus obturation technique.

Methodology: 50 extracted lower premolar with single roots were included in the study. All canals were prepared with step back preparation. Radiographs of the teeth were taken to determine the working length together with maximum degree of canal. The samples were divided into three experimental and two control groups. A total of 10 teeth were filled with Thermafill obturation, 10 with lateral condensation, 10 with EQ plus while four teeth remained unfilled kept as controls. Following obturation all access cavities were then sealed and the teeth immersed in dye for 48 h before being split longitudinally. Linear dye penetration via the apical foramen was then assessed using a Nikon SZ4045TR under 20 X magnification surface stereoscopic microscope

Result: Statistical analysis was evaluated using the Kruskal-Wallis test and the Mann-Whitney test for paired comparisons. There was no significant difference found between these three groups and the apical seal was similar in Cold lateral condensation, Thermafill system and EQ plus system.

Introduction

The final stage of endodontic therapy involves the complete sealing off of the the entire root canal system and its complex anatomic pathways with non irritating hermetic sealing agents. Total obturation of the canal space and perfect sealing of the apical foramen and its accessory canals at locations other than the root apex with an inert, dimensionally stable, and biologically compatible material are the goals for successful endodontic treatment.

"The three dimensional filling of the entire root canal system as close as possible to cementodentinal junction with minimal amounts of sealer which have been demonstrated to be biologically compatible are used in conjunction with the core filling material to establish an adequate seal".[1]

Chemically pure gutta-percha exists in two distinctly different crystalline forms that can be converted into each other. The "alpha" form comes directly from tree. Most commercial form is the "beta" crystalline form that has a melting point of 64^0C. This form is widely used in making gutta-percha points and is more flexible. The effect of heating on the volumetric changes of Gutta-percha is most important to dentistry. Gutta-percha expands slightly on heating; a desirable trait for an endodontic filling material. This physical property of gutta-percha manifests itself as an increased volume of material that can be compacted into root canal cavity.[2]

Cold lateral condensation technique most widely used and is kept as standard one.Gutta percha at room temperature is considered to be in the -phase. In this stage gutta percha is solid, compatible and elongatible. When heated to 42^0 to 49^0C, it undergoes a phase change to phase (alpha). In this phase it is runny, tacky, sticky, non compactable and non elongatible. The third or (gamma) phase occurs when the heating is raised from 56 to 62^0C. The properties are similar to the 2nd phase. The significance of these phases in addition to change in physical properties, is that the materials expand when heated from the to the phase from less than 1% to almost 3%; when cooled down to the phase, a shrinkage takes place, of similar percentiles, but the degree of shrinkage almost always is greater than the degree of expansion and may differ by as much as 2%. That means if gutta percha is heated above 42^0 to 49^0 C and then inserted into a prepared canal, a compaction procedure should be applied or some method must used to lessen the problem of shrinkage.

Thermafil, based on an original idea by Johnson (1978), consists of a carrier having handle and a shaft which is coated with a uniform layer of alpha-phase gutta-percha. This is heated in a flame until plasticized and then inserted into the prepared root canal, which is previously coated with a sealer. The coronal portion of the carrier is sectioned and removed, leaving the apical portion behind as part of the root filling. It is claimed by the manufacturers that the gutta-percha has been annealed by a proprietary process to achieve a more linear crystalline structure, resulting in unique physical properties. When heated, alpha-phase gutta-percha becomes exceedingly sticky and tacky and has excellent flow characteristics.

Materials and Methodology

Fifty single root human maxillary lower premolars (non-restored) with fully formed apices was immersed until use in 2% chlorhexidine solution. An X-ray image was obtained from a distance of 2 mm for verification purposes and for determining the curvature of the canals, based on the Schneider technique

Preparation of root canals

Access cavity was prepared with a tapered tungsten carbide bur. The working length was determined by inserting an #0.8 or #10 K-file into the canal until it was just visible at the apical foramen and then subtracting 1 mm. Cleaning and shaping was done using hand files in crown down technique and the master apical file size was 30 in all samples and the apical patency was maintained throughout the procedure using #10 k file. The canals were irrigated between the change of files with 2 ml of 2.5% sodium hypochlorite solution. The smear layer was then removed with a final flush of 10 ml of 17% EDTA, followed by 10 ml of 2.5% NaOCl.

Obturation of root canals

After canal instrumentation, all specimens were dried with paper point and zinc oxide eugenol sealer mixed according to manufacturer's instructions was placed with a counterclockwise motion into the root canals using Lentilospirals prior to obturation. 50 canals were then randomly divided into three groups and prepared as follows:

Group 1 (n=10): Thermafil thermoplasticized gutta-percha system. The Thermafil heater was allowed to reach its operating temperature and then the thermafil guttapercha point is placed in the heater to reach the optimum temperature for obturation. The gutta-percha point placed inside the canal allow to set for two minutes , the excess is sheared . Temporary coronal seal done with zincoxide eugenol.

Group 2 (n=10): Cold lateral condensation with 30 size ISO-standardized master cone. After placing zinc oxide eugenol in the canal, a size 30 gutta-percha cone was trimmed as necessary to give tugback at working length, and the master cone was then coated with sealer and placed into the canal at working length. Medium-fine accessory gutta-percha cones (Dents-ply Maillefer, Ballaigues, Switzerland) were then added. After the lateral condensation, gutta-percha cones were sectioned at canal orifice level using a heated instrument (GP heater, Maillefer, Ballaigues, Switzerland).

Group 3 (n=10): EQ plus system was used. Zinc oxide eugenol sealer was coated in the canal,a 30 size master cone placed in the canaland the remaining canal was filled using back flow gun. Finally coronal seal done with zinc oxide eugenol

Positive controls (n=10): The root canals were prepared but were not root-filled in order to demonstrate microleakage along the entire length of the canal.

Negative controls (n=10): The root canals were not prepared and completely covered with two layers of nail polish varnish.

Apical dye penetration

After the filling, the canals were stored in 100% humidity at 37ºC for 72 hours to allow the sealer to set. Then, the canals were dried and coated with three layers of nail polish covering the whole tooth, including the access restoration but not the apical 2 mm of the root. The specimens were then immersed in India ink for seven days at 37ºC. After this time, the roots were washed in water and the nail polish and India ink were carefully removed with surgery blade. Transversal sections at the level of apical third, middle third and coronal thirds were made in using diamond disc on straight hand piece to evaluate apical dye penetration.

The resulting sections were examined with a Nikon SZ4045TR under 20 X magnification surface stereoscopic microscope to determine the presence or absence of dye.

Statistical analysis

Global comparisons were made by using the Kruskal-Wallis test and the Mann-Whitney test for paired comparisons. p-value of 0.05 was regarded as significant.

Results

Obturation technique	Microlekage		
	No:	S.D	($X \pm S$)
Thermafill (Group 1)	10	.4882	.4000 .4882
Cold lateral condensation (Group 2)	10	.3500	.2250 .3500
EQ plus (Group 3)	10	.4787	.3750 .4787

The positive control shows microlekage after one day.
The negative control did not leak for entire observation period.
The global comparison showed no significant differences in mean microlekage among three groups.

Discussion

Whole extracted human teeth were used in this study to improve the reliability of the investigation by simulating the clinical situation. The smear layer was removed because many studies have suggested that thermoplasticized gutta-percha adapts better to the prepared dentine in its absence. Root canal sealer was used because it improves the sealing ability of gutta-percha as a root-filling material, both in clinical practice and experimental research, regardless of the technique used. In this study, we compared the microleakage in three obturation techniques namely lateral condensation, Thermafil and EQ plus..

In thermafill, the core content occupies more space than the gutta-percha and the retriveability and post placement in the canal was also difficult. The most important disadvantage of Thermafill and EQ Plus system is that the gutta-percha goes beyond the apex and also the heat may affect the periodontium. Hence, care should be taken while canal preparation and Obturation. The improved flow characteristics of thermoplasticized gutta-percha are directly related to one of the main disadvantages of such techniques; that is extrusion of material beyond the apical limits of the root canal space. Also, vertical compaction of thermoplasticized gutta-percha is recommended to counteract the cooling contraction of the material and this presumably increases the probability of extrusion.[3]

Despite certain reservations, studies of microleakage of tracer substances remains a useful way of comparing new obturation techniques with a known standard .[4] De Moor & De Boever found that there was better apical seal with cold lateral condensation than thermoplasticized [5] while Wu et al. suggested that there is no significant difference between cold lateral and warm vertical compaction.[4] Vizgirda et al. in their study found there is no significant differences between the cold lateral condensation method and the high-temperature thermoplasticized gutta-percha technique.[6]

On statistical evaluation the mean value for these groups showed no much significant difference among the groups but studies by McMurtrey LG et al.[7] and Gilhooly RM [3] found them to be comparable or better than lateral condensation in terms of apical dye penetration and radiographic density

Siqueira et al. found that only the Thermafil system was able to fill oval canals in a suitable manner.[8] Studies using bacterial cultures or saliva have been used widely to test the leakage resistance of endodontic materials because it might be more meaningful and provides more precise and reproducible data. Such tests may be considered to have more biological significance than dye leakage tests, but in our study we used methylene blue dye penetration test.[8]

Conclusion

In this study there was no significant difference found between these three groups. The apical seal was found to be similar in Cold lateral condensation, Thermafill system and EQ plus system

References

1. Cohen, Burns. Pathways of the Pulp. 8th ed. Missouri: Mosby; 2002. p. 457-92.
2. Weine F.S. Endodontic Therapy. 4th ed. St. Louis : Mosby ; 1989. p 154-7.
3. Gilhooly RM, Hayes SJ, Bryant ST, Dummer PM. Comparison of cold lateral condensation and a warm multiphase gutta-percha technique for obturating curved root canals. Int Endod J. 2000 Sep;33(5):415-20.
4. Souza EM, Wu MK, van der Sluis LW, Leonardo RT, Bonetti-Filho I, Wesselink PR. Effect of filling technique and root canal area on the percentage of gutta-percha in laterally compacted root fillings. Int Endod J. 2009 Aug; 42(8):719-26. Epub 2009 May 8.
5. De Moorm, De Boever . The sealing ability of an epoxy resin root canal sealer used with five gutta-percha obturation techniques. Endod Dent Traumatol. 2000; 16(6):291-7.
6. Vizgirda PJ, Liewehr FR, Patton WR, McPherson JC, Buxton TB.. A comparison of laterally condensed gutta-percha, thermoplasticized gutta-percha, and mineral trioxide aggregate as root canal filling materials. J Endod. 2004;30(2):103-6.
7. McMurtrey LG, Krell KV, Wilcox LR. A comparison between Thermafil and lateral condensation in highly curved canals. J Endod. 1992;18(2):68-71.
8. Siqueira JF Jr, Rôças IN, Abad EC, Castro AJ, Gahyva SM, Favieri A. Ability of three root-end filling materials to prevent bacterial leakage. J Endod. 200;27(11):673-5.

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