International Journal of Advanced Multidisciplinary Research (IJAMR)
ISSN: 2393-8870
www.ijarm.com
Volume 3, Issue 6 -2016

Original Research Article

SOI: http://s-o-i.org/1.15/ijarm-2016-3-6-1

Comparative evaluation of apical microleakage of three different obturating material using stereomicroscopy.

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Keywords

Dye penetration, gutta flow, microleakage, thermafill.

Abstract

Aims: The aim of this study is to assess the microleakage of three root canal filling materials using a dye penetration method and comparison of the differences in microleakage of each obturating material. **Methods and Materials**: Thirty human first premolars with intact roots, extracted for orthodontic purpose, were selected for the study. Root canal treatment was done in all the specimens and randomly divided into three groups (ten teeth in each group) and obturated with three different obturating materials (i.e. Themafill, ProPoints and GuttaFlow). All the specimens were subjected to thermocycling and then stored in 100% humidity at 37ºC for 48 hours. Microleakage was measured using dye penetration technique using stereomicroscope. **Static analysis**: Done by using tukey test and ANOVA. **Result**: The amount of microleakage was minimum with Thermafil (0.01-0.12 mm) as compared to GuttaFlow (0.11-0.23 mm) and ProPoint (0.17-0.30 mm). On comparison of mean microleakage between the groups Thermafill has got minimum ($p<0.001$). **Conclusion**: Study concluded that Thermafill is the better material for obturation as it exhibits minimum microleakage than ProPoint and Guttaflow.

Introduction

Clinical success of endodontic therapy dependent on proper access, cleaning, shaping, disinfection and sealing of root canals. Three dimensional sealing ability of obturating material leads to decrease the risk of apical microleakage & hence increases the success rate of endodontic treatment[1].

Johnson (1978) introduced concept of carrier based thermoplasticized gutta-percha obturation technique involving the obturation of the root canal with heated alpha phase guttapercha on a carrier[2]. The root canal filling paste called GuttaFlow (Colténe/Whaledent, Altstätten, Switzerland) is a mixture of gutta-percha powder, poly-dimethylsiloxane and silver particles with a particle size of less than 30 micron, and sealer in its mass. Its capacity to expand slightly on setting and its increased flowability allow for good adaptation to the root canal walls and to the gutta-percha[3]. ProPoints have a two component design, with a central core to provide good handling characteristics and a hydrophilic polymer coating, which radially expands to seal the canal when hydrated in the root canal. This gentle expansion occurs within the first 4 hours after placing the point into the canal[4].

Methods

The present study was carried out in the Department of Conservative Dentistry and Endodontics. The standardization of the whole procedure for all the groups is maintained as it was performed by a single operator. In the present study freshly extracted thirty permanent first premolars were collected. Root canals of all the specimens were debrided and with radiovisiography and k-files of size #10 (Dentsply) was used to determine the patency and working length (maintained 1mm short of radiographic apex). Initial hand filing was done till #25 k-file. Coronal preflaring was done using gates glidden drills (Dentsply). Final apical preparation was done by crown down technique using Hyflex CM (coltene/ Whaledent, USA), till 4% 30. Glyde File Prep (Dentsply, Maillefer) & 3% NaOCl (Pyrex) were used in the chemomechanical preparation of all the specimens as chelator and irrigant respectively. Prepared specimens were stored in distilled water till the obturation was carried out. The specimens were then randomly divided into 3 groups where ten teeth in each group as per the obturating materials:

1. Group I: Thermafil with AH Plus Sealer
2. Group II: ProPoints
3. Group III: GuttaFlow

Then obturation was done according to their manufacturer's instructions.

Coronally 2mm of gutta-percha was removed from the canal and cervically sealed with Glass Ionomer Cement. All the specimens were placed in incubator for 48hrs at 37^0C and 100% humidity for thermocycling. After thermocycling procedure, root surfaces of all the specimens were coated with three coats of GC Fuji Varnish (GC, Tokyo) leaving the apical 2mm and specimens were immersed in methylene blue dye for 48 hrs at 37^0C. Specimens were washed with water and dried. Longitudinal sections were then prepared using sectioning disc and are examined under stereomicroscope to determine apical microleakage. Stereomicroscopic evaluation was done with a Wild Heerbrugg stereomicroscope under 6.5X magnification surface using Leica application software to determine the presence or absence of dye.

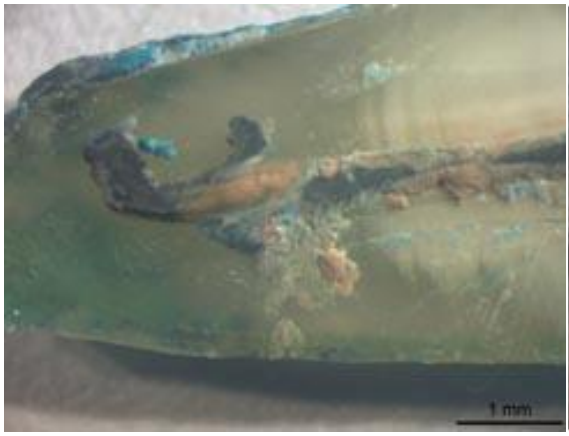

Fig. 1. Thermafil obturation

Fig.2. ProPoint obturation

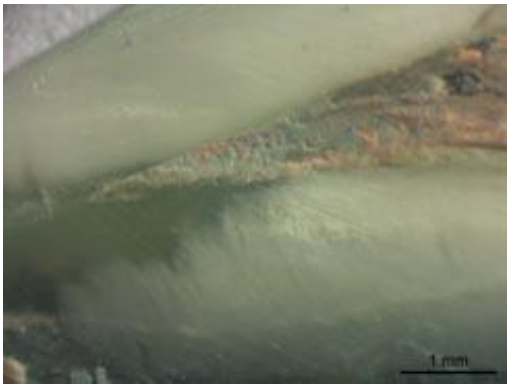

Fig.3. GuttaFlow obturation

Statistics

Data were summarized as Mean ± SD (standard deviation). Groups were compared by one way analysis of variance (ANOVA) and the significance of mean difference between the groups was done by Tukey's post hoc test. Mean microleakage of three groups were compared which was$p<0.001$- as compared to Thermafill.

Results

The amount of microleakage was minimum with Thermafil (0.01-0.12 mm) as compared to ProPoint (0.17-0.30 mm) and Guttaflow (0.11-0.23 mm).

Table 1 Comparison of Microleakage

THERMAFIL	PRO POINT	GUTTAFLOW	F value	P value
0.050±0.029 (0.01-0.12)	0.230±0.035 (0.17-0.30)	0.173±0.039 (0.11-0.23)	212.60	<0.001

Numbers in parenthesis indicates the range(min-max)

On comparision of mean microleakage between the groups Thermafill has got minimummicroleakage ($P<0.001$).

Table 2 Comparison of Microleakage of groups Thermafill

Comparison	Mean Diff.	q	P value	95% CI of diff
THERMAFIL vs PRO POINT	-0.18	28.54	p<0.001	-0.2018 to – 0.1590
THERMAFIL vs GUTTAFLOW	-0.12	19.46	p<0.001	-0.1444 to – 0.1016
PRO POINT vs GUTTAFLOW	0.06	9.08	p<0.001	-0.03604 to – 0.07876

Discussion

A three dimensional obturation is critical for endodontic success. Microleakage remains to be the most crucial cause of endodontic failure, it is defined as the 'passage of bacteria, fluids, and chemical substances between the root structure and filling material of any type'. Microleakage mainly occurs because of the microscopic gaps which are present at the interface of the filling material and the tooth[5]. In root canal many variables are responsible such as root filling technique, chemical properties of the sealer and the infectious state of the canal.

Various methods have been used to assess the quality of root canal seal like dye penetration test, fluorometric, vacuum studies, bacterial leakage test, radio tracer penetration test, fluid-transport model and electrochemical methods. The basic problem is that the amount of leakage cannot be observed by these methods to an in vivo situation[6].

Microleakage resistance of endodontic materials can be studied using bacterial cultures or saliva because it provides more precise and reproducible data [7]. Such tests may be considered to have more biological significance as they reflect more closely the clinical situation than the dye penetration especially, when human saliva is used as a bacterial source.

The Thermafil technique involves the obturation of the root canal with heated alpha phase guttapercha on a carrier. In the Thermafil system, the majority of the canal space is filled with the plastic core there by reducing the volume of gutta-percha undergoing setting contraction[8].This reduction in shrinkage could have increased the seal at the gutta-percha- sealant interface, there by contributing to decreased leakage. This would have been one of the reasons for Thermafil to leak less.The plastic carrier in Thermafil could also act as plunger, which effectively forces the thermoplasticized guttapercha into the lateral walls of the canal. This condensation of the thermoplasticized guttapercha into the patent dentinal tubules might also have contributed to the superior seal exhibited by the Thermafil in Group.1

Although GuttaFlow is known to expand slightly while setting, it showed gaps and voids. That might be explained by the filling technique used. The use of a single-cone filling technique is often considered inferior to the more sophisticated 3D compaction techniques, because the volume of sealer is high relative to the volume of the cone, which promotes void formation and reduces the quality of the seal. A high frequency of the voids at all measurement levels in the Guttaflow group, although smaller in area, could increase the possibility of communication between these voids and the apical and coronal ends of the root canal filling[9].

The ProPoint is a cross-linked copolymer of acrylonitrile and vinylpyrrolidone, which has been polymerized and cross-linked using allyl methacrylate and a thermal initiator. The lateral expansion of ProPointis claimed to occur non-uniformly, with the expandability depending on the extent to which the hydrophilic polymer is pre-stressed (i.e. contact with a canal wall will reduce the rate or extent of polymer expansion). One of the prime reasons for increased microleakage in ProPoints would be due to limited moisture availability from intraradicular dentine for the expansion of the polymer. Furthermore, the canal was blot-dried with paper points before the sealer was applied[10].

Conclusion

Study concluded that Thermafil is a better material for obturation as it exhibits minimum microleakage than ProPoint and GuttaFlow. However, the findings of this study may need further validation on larger sample size.

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How to cite this article:
B.Rajkumar, Preeti Shukla, Garima Popli, Vishesh Gupta, Akanksha Bhatt. (2016). Comparative evaluation of apical microleakage of three different obturating material using stereomicroscopy. Int. J. Adv. Multidiscip. Res. 3(6): 1-4.