ORIGINAL RESEARCH PAPER

Volume-7 | Issue-8 | August-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

COMPARATIVE EVALUATION OF PERCENTAGE OF GUTTA-PERCHA FILLED CANAL AREA(PGCA) AFTER USING 2 ROTARY INSTRUMENTS AND 2 OBTURATION TECHNIQUES

Dental Science

Dr Prem Prakash Kar* Senior Lecturer, Department of Conservative Dentistry and Endodontics PMNM Dental College & Hospital, Bagalkot *Corresponding Author

Dr Sandhya A Khasnis Reader, Department of Conservative Dentistry and Endodontics PMNM Dental College & Hospital, Bagalkot

Dr K H Kidiyoor Private Practioner X ray dental clinic, Dharwad

ABSTRACT

AIM: To evaluate PGCA after using two different rotary instruments(K3 and Protaper) and two different obturation techniques(Lateral condensation and Thermafil)

MATERIALS AND METHODS: 80 freshly extracted maxillary central incisors were randomly divided into 4 groups, each consisting of 20 specimens based on instruments and obturation techniques. Group A1- Protaper/Lateral condensation(PLC); Group A2- Protaper/Thermafil(PT); Group B1- K3/Lateral Condensation(K3LC); Group B2- K3 / Thermafil(K3T). Transverse sections of filled root canal were made at 2,4,6 and 8mm respectively from apex. Digital images of sections were taken under stereomicroscope at 40 X magnification. PGCA of each section were calculated using image J 1.38 analyser software.

RESULTS: PT group showed significant highest PGCA followed by K3T group compared to other groups at all transverse section levels.

CONCLUSION: Thermafil showed superior filling quality than lateral condensation.

KEYWORDS

K3; Lateral Condensation; Pgca; Protaper; Thermafil

INTRODUCTION

According to Ingle, the most common cause of endodontic failure is incomplete obturation of the root canal.[1] Due to root canal anatomical variations such as irregularly shaped canals, lateral and accessory canals, anastomoses between canals and a variety of fins, it is difficult to prepare the canals to form conducive to complete obturation with filling materials.[2] The major objective of root canal treatment is to complement proper cleaning and shaping of the root canal system and three dimensional filling with a biologically inert and dimensionally stable material.[3]

Gutta-percha is commonly used obturating material with various techniques to enable the dentist accurately and thoroughly to obturate the root canal system. It is non-irritant and dimensionally stable. It is radiopaque, inert and can be removed from the root canal when required.[4]

Lateral condensation of gutta-percha is one of the most accepted canal obturation methods and is taught by many dental schools.[5] It also serves as the gold-standard against which new techniques are compared.[6] One major advantage of this technique is the ability to control the length of fill.[7] however this technique have various disadvantages like voids, spreader tracts, incomplete fusion of the gutta-percha cones, lack of surface adaptation is seen.[8]

The use of techniques utilizing thermoplasticized gutta-percha such as coated carrier systems(Thermafil) has gained popularity over time. It consists of plastic central carrier coated with a layer of alpha phase gutta-percha which can be softened by heat before insertion into the prepared root canal.Thermafil is more effective than lateral compaction in filling lateral canals. Thermafil system can produce a homogenous mass of gutta-percha unlike Lateral condensation.[9-12]

Sealer component should be kept to a minimum due to their dimensional instability and solubility over time.[13] It should be limited to a thin film and increasing the mass of the gutta-percha.[14]

The introduction of Nickel Titanium rotary instrumentation has made endodontics easier and faster than hand instrumentation, resulting in consistent and predictable root canal shaping.[15] It produces a more consistent, uniform, centered and round canal form.[16]

Protaper system (Dentsply, Maillefer, Baillaigues, Switzerland) comprises of 3 shaping & 5 finishing instruments. The Protaper files feature a triangular cross section that reduces the contact area between the file & dentin, and provide "minimally aggressive" cutting tip.[17]

K3 system (Sybron Endo, Orange, USA) was introduced in 2002. These files are designed with a wide radial land, which is meant to make instrument more resistant to torsional and rotary stresses. It also features "radial land relief", which aids in protecting the file from "over engagement", in the canal; thus, less instrument separation or distortion occurs. This file features a variable core diameter designed to increase flexibility and it has a safe ended tip to decrease the incidence of ledging, perforation, and zipping.[18]

The objective of the study is to evaluate PGCA after using two different rotary instruments(K3 and Protaper) and two different obturation techniques(lateral condensation and thermafil).

MATERIALS AND METHODS

80 freshly extracted maxillary central incisors were collected from the Department of Oral & Maxillofacial Surgery, P.M.N.M Dental College and Hospital, Bagalkot.The teeth were stored in 10 % formalin until further use. Based on rotary instrumentation techniques and obturation techniques used, teeth were randomly divided into 4 groups, each consisting of 20 specimens.(Table 1) (Figure 1)

Table 1

GROUPS	INSTRUMENT	OBTURATION TECHNIQUE
Group A-1 (PLC)	Protaper	Lateral condensation
Group A-2 (PT)	Protaper	Thermafil
Group B-1 (K3 LC)	K3	Lateral condensation
Group B-2 (K3T)	K3	Thermafil

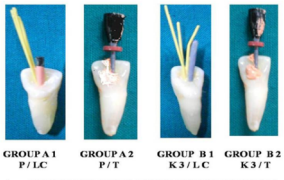

Figure 1 SAMPLES SHOWING OBTURATION TECHNIQUES

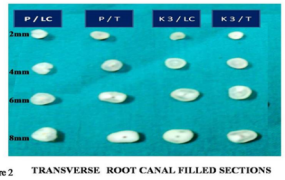

Figure 2 TRANSVERSE ROOT CANAL FILLED SECTIONS

ROOT CANAL PREPARATION

Access opening of teeth were done with No.4 round bur. The patency of canal was confirmed by inserting #15 K file into the root canals until it was visible at the apical foramen. The working length of each canal was calculated by deducting 1mm from this length. Root canals were prepared upto ISO size 40 using X- Smart Device with 16 : 1 gear reduction hand piece. The speed of rotation was maintained at 250 rpm.

Sequence followed for root canal instrumentation with Protaper were SX, S1, S2, F1, F2, F3, F4. Shaping using SX were done upto coronal 2/3rd with brushing motion. All other files were reached upto the working length. Sequence followed for root canal instrumentation with K3 were #15, #20, #25, # 30, # 35, #40. All files were having .06 taper.

The canals of all teeth samples were irrigated with 2ml of 3% NaOCl between instrumentation & irrigated with 17% EDTA for 60 second followed by 3% NaOCl after completion of the instrumentation. The canals were subsequently dried with # 40 paper point.

ROOT CANAL OBTURATION

Lateral condensation

#F4 master cone in case of Protaper instrumented samples and # 40 0.06 taper master cone in case of K3 instrumented samples was fitted into the root canal at the working length and was checked for tug back. AH Plus sealer was mixed according to the manufacturer's instruction & was placed twice into each root canal. Master cone was coated with AH plus sealer, was moved up and down in the canal for 20 seconds to deliver sealer into the canal and placed into the canal until WL. Lateral condensation achieved by using accessory cones & spreader. After obturation excess gutta-percha was removed with hot plugger.

Thermoplasticized obturation

Size of each canal was checked with # 40 Thermafil verifier. Accordingly the same size Thermafil plus obturator was chosen, heated in Thermaprep oven for 41 sec as per manufacturer. AH Plus sealer was mixed according to the manufacturer's instruction & was placed twice into each root canal with a 40 size spreader, subsequently moving it up and down in the canal for 20 seconds to deliver sealer into the canal. Then the obturator was slowly placed at the working length in a single motion. After the gutta-percha was cooled the plastic carrier left in the canal was cut with inverted cone bur. The gutta-percha around the carrier was vertically condensed with a hot plugger.

DETERMINING THE PERCENTAGE OF GUTTA-PERCHA FILLED CANAL AREA (PGCA) :

All teeth were stored in water for 1 week. Each tooth was horizontally sectioned at 2, 4, 6, and 8 mm from the apical foramen.(Figure 2) The specimen was pushed toward the double faced diamond disk by using light pressure, with constantly refreshed water bathing(cooling) the teeth. Slices were then viewed through a Stereomicroscope at a magnification of 40 X. Digital images were taken with Nikon Coolpix camera(Figure 3). With Image J 1.38 analyser software programme , the cross-sectional area of root canal and area of gutta-percha filled canal area were manually outlined (figure 4(a)) and from these values PGCA was measured for each transverse root canal filled section (figure 4(b)).

Figure 3 DIGTAL IMAGES OF TRANSVERSE ROOT CANAL FILLED SECTIONS TAKEN UNDER STEREOMICROSCOPE

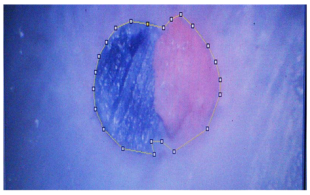

Figure 4. (a) GUTTA-PERCHA FILLED CANAL AREA OUTLINED USING IMAGE ANALSER SOFTWARE

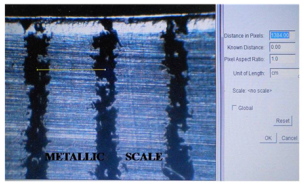

Figure 4. (b) CALIBRATION DONE USING IMAGE ANALYSER SOFTWARE

RESULTS

There was statistical significant difference in PGCA between groups and within the groups at all levels of transverse root canal filled sections. (Graph 1,Table 2)

Protaper Thermafil & K 3/ Thermafil was having significant higher PGCA than rest of the groups at all levels of transverse root canal filled sections(2, 4, 6, & 8mm) from the apical foramen. Protaper / Thermafil group was having significantly higher PGCA than K3 / Thermafil at 2 & 4mm levels of transverse root canal filled sections. K3 / Lateral condensation group was having significant higher PGCA than Protaper / Lateral condensation at 2 & 6mm levels of transverse root canal filled sections from apical foramen. (Table 3)

Graph 1: Comparision Of Pgca Among Four Groups At Various Levels Of Transverse Root Canal Filled Sections

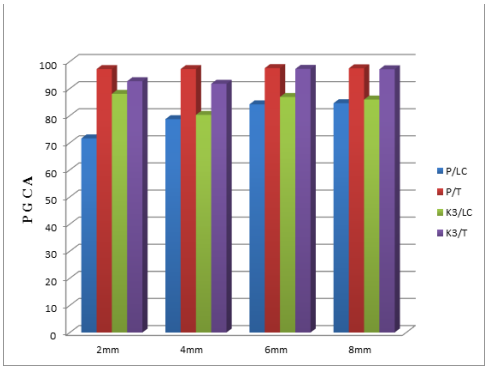

Table 2: Comparision Of Pgca Among Four Groups At Various Levels Of Transverse Root Canal Filled Sections By Using One Way Anova

2mm level	Sum of Squares	df	Mean Square	F	Significance
Between Groups	7478.634	3	2492.878	106.454	.000
Within Groups	1779.721	76	23.417		
Total	9258.355	79			
4mm level					
Between Groups	7478.634	3	2492.878	106.454	.000
Within Groups	1779.721	76	23.417		
Total	9258.355	79			
6mm level					
Between Groups	2895.747	3	965.249	89.722	.000
Within Groups	817.623	76	10.758		
Total	3713.370	79			
8mm level					
Between Groups	2910.913	3	970.304	38.090	.000
Within Groups	1936.035	76	25.474		
Total	4846.948	79			

$p < 0.05$

Table 3 : Pair Wise Comparision Of Pgca Among Four Groups At Various Levels Of Transverse Root Canal Filled Sections By Tukey Kramer Multiple Post-hoc Test

2mm level	P/LC	P/T	K3/LC	K3/T	6mm level	P/LC	P/T	K3/LC	K3/T
Mean	71.61	97.20	88.04	92.72	Mean	84.16	97.56	86.91	97.26
P/LC	-				P/LC	-			
P/T	.000	-			P/T	.000	-		
K3/LC	.000	.000	-		K3/LC	.048	.000	-	
K3/T	.000	.023	.016	-	K3/T	.000	.991	.000	-
4mm level	P/LC	P/T	K3/LC	K3/T	8mm level	P/LC	P/T	K3/LC	K3/T
Mean	78.70	97.19	80.29	91.76	Mean	84.610	97.497	85.971	97.131
P/LC	-				P/LC	-			
P/T	.000	-			P/T	.000	-		
K3/LC	.840	.000	-		K3/LC	.829	.000	-	
K3/T	.000	.029	.000	-	K3/T	.000	.996	.000	-

p < 0.05

DISCUSSION

Successful root canal treatment is critically dependent on thorough cleaning & shaping of root canal space and on three dimensional filling of entire root canal space creating an hermetic seal to prevent the movement of tissue fluids, bacteria or bacterial by-products through the filled canal.[3,9]

Prepared root canals are usually obturated with solid core material and a sealer.The sealer can fill in imperfections, thus improving the filling capacity of the gutta-percha. However sealers are subjected to shrinkage and solubility resulting in poor long term seal and leakage. Consequently the goal of various filling techniques is to maximize the amount of gutta-percha applied and minimize the amount of sealer.[13,14]

In the present study maxillary central incisor teeth were selected rather than single rooted teeth to attain standardization in canal anatomy.[1]

Rotary instrumentation with NiTi files was done in the present study as it creates smooth, funnel shapes, with minimal risk of ledging or transporting and is also time saving. [16]In the present study both Protaper and K3 instrumented teeth the apical preparation was kept constant (ISO # 40) in order to attain standardization. This is in accordance to Prashanth et al. [19]In the present study a combination of Sodium Hypochlorite (2.5-5%) & EDTA (10-17%) was used to effectively remove organic and inorganic debris. [2,20]

In the present study gutta-percha was used as core material since it satisfies the majority of criteria of an ideal filling material suggested by Grossman.[21]AH Plus sealer was used in the study since it showed smallest weight loss in water and artificial saliva with different pH values when compared with calcium hydroxide and zinc oxide based sealers. AH Plus is an epoxy resin-based sealer and provides a tight seal of the root canal system. [22]

PGCA is defined as the ratio between the area of gutta-percha in the filling relative to the total cross-sectional area of the prepared canal . In this study PGCA was used to evaluate quality of root filling of transverse root canal filled sections at 2,4,6 & 8mm because of its simplicity, ease to perform and relatively inexpensive.[23-27]

In the present study double faced rotating saw diamond disc was used to make transverse sections of filled roots canals under constant water irrigation to prevent overheating which is in accordance to N Gencoglu et al.[28]

In the present study stereomicroscope was used to take digital images under 40 X magnification which is in accordance to Manal Fareal et al. & R Smitha et al.[29,30] In the present study Image J 1.38 /Image Analyser Software Program was used to analyse digital images taken under stereomicroscope. A metallic scale was placed under the platform of stereomicroscope and photograph was taken at 40 X magnification. The scale was calibrated using Image J 1.38 /Image Analyser Software Program. It was calibrated as 1 mm= 1.38 pixels. Then based on this calibration cross-sectional area of the canal and gutta-percha was manually outlined & percentage of gutta- percha filledcanal area was calculated for each transverse root sections.

In the present study lateral condensation technique was used rather than single cone technique in order to maximize the PGCA. Thermafil was chosen for the study as it results in good surface adaptation and homogenous mass of gutta-percha.

The objective of the present study was to evaluate PGCA after using two different rotary instruments(K3 and Protaper) and two different obturation techniques(Lateral condensation and Thermafil)

In the present study PT & K3T groups showed significantly higher PGCA than other groups at all levels of transverse root canal filled sections. Thermafil obturation resulted in significantly higher PGCA than lateral condensation. The results are in accordance with previous studies(K Gulsahi et al and De-Deus et al).[31-33] this result may be attributed to alpha phase present in the Thermafil, leading to highly condensed and homogenous gutta-percha mass. The plastic carrier which acts as plunger, would have forced the thermoplasticized gutta-percha into the lateral walls of the canal.

In the present study PTgroup showed significant higher PGCA than K3T at 2 & 4mm levels of transverse sections. In Protaper system, coronal 2/3rd of the canal was first preenlarged followed by preparing its apical 1/3rd which is according to Clifford J Ruddle, so cleaning of apical third significantly enhanced. [34]

K3LC group was having significant higher PGCA than PLC at 2 & 6mm levels of transverse root canal filled sections. It may due to close adaptation of .06 taper # 40 GP with the k3 prepared canal wall compared to adaptation of F4 Protaper GP cone with the Protaper prepared canal wall. It also may be due to anatomic variability of teeth.

Further, more research and studies are required for the evaluation of PGCA using different rotary instruments and different obturation techniques and to apply them in regular clinical use and enlighten the fraternity.

CONCLUSION

Within the limitations of this in vitro study Thermafil obturation was better in quality and less time taking than Lateral condensation. In thermafil obturated canals, Protaper instrumented samples shown better filling quality than K3 instrumented samples. In laterally condensed canals, K3 instrumented samples shown better filling quality than Protaper instrumented samples.

References

1. Ingle JI, Backland LK, Brveridge EE, Glick DH, Hoskinson AE. Modern endodontic therapy. Endodontics. 5th edtn. Philadelphia: Lea & Febiger 2002:1-23
2. Branstorm M, Smear Layer: Pathological and treatment considerations. Oper Dent Suppl 1984;3:35-42
3. Hulsmann M, Peters OA, Dummer PMH. Mechanical preparation of root canals: shaping goals, techniques and means. Endod Topics 2005;10:30-76.
4. Charles M. Friedman, James L. Sandrik, Michael A. Heuer, and Gustav W. Rapp. Composition and mechanical properties of gutta-percha endodontic points. J Dent Res 1975;54:921.
5. Cailleteau JG, Mullaney TP. Prevalance of teaching apical patency and various instrumentation and obturation techniques in United States dental schools. J Endod 1997;23:394-6.
6. Gordon MP, Love RM, Chandler NP. An evaluation of .06 tapered gutta-percha cones for filling of .06 taper prepared curved root canals. Int Endod J 2005;38:87-96.
7. Schaefers E, Olthoff G. Effect of three different sealers on the sealing ability of thermafil obturators and cold laterally compacted gutta-percha. J Endod 2002;28:12-8.
8. Brayton SM, Davis SR, Goldman M. Gutta-percha root canal fillings. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1973;35:226-31.
9. Schilder H. Filling of root canals in three dimensions. Dent Clin North Am 1967;12: 723-44.
10. Johnson B. A new gutta-percha technique. J Endod1978;4:184-8.
11. Reader CM, Himel VT, Germain LP, Hoen MM. Effect of three filling techniques on the filling of lateral canals and the main canal. J Endod 1993;19:404-8.
12. Gencoglu N, Samani S, Gunday M. Dentinal wall adaptation of thermoplasticized gutta-percha in the absence or presence of smear layer: a scanning electron microscopic study. J Endod 1993a, 558-62.
13. Peters DD. Two year in-vitro solubility evaluation of four gutta-percha sealer obturation techniques. J Endod 1986;12:139-45.
14. Kontakiotis EG, Wu MK, Wesselink PR. Effect of sealer thickness on long term sealing ability: a 2- year follow-up study. Int Endod J 1997;30:307-12.
15. Glickman GN, Koch KA. 21st century endodontics. J Am Dent Assoc 2000 Jun;131: 39S-46S.
16. Glosson CR, Haller RH, Dove SB, Del Rio CE. A comparison of root canal preparations using NiTi hand, NiTi engine driven and K-Flex endodontic instruments. J Endod 1995;21:146-51
17. http:// store.tulsadental.com/lit/pdfs/Protaper _ Universal_ DFU_Manual.pdf. Protaper directions for use.
18. Ankrum MT, Hartwell GR, Truitt JE. K3 Endo, Protaper, and Profile systems: breakage and distortion in severely curved roots of molars. J Endod 2004;30:234-7.
19. Prashanth BR, V Shivanna. Analysis of percentage of gutta-percha filled area using single cone, continuous wave of compaction, thermafil & obtura II in 0.06 taper prepared root canals. Endodontology 2008:22-28.
20. Villegas JC, Yoshioka T, Kobayashi C. Obturation of accessory canals after four different final irrigation regimens. J Endod 2002;28(3):220-3

21. S Chandra and Gopi Krishna. Grossman Endodontic Practice 12th edtn. Wolters Kluwer 2010;278-279.
22. Schafer E, Zandbiglari T. Solubility of root canal sealers in water and arficial saliva. Int Endod J 2003;36:660-669.
23. Wu MK, De Gee AJ, Wesselink PR, Moorer WR. Fluid Transport and bacterial penetration along root canal fillings. Int Endod J 1993;26:203-8.
24. Wu MK, De Gee AJ, Wesselink PR. Fluid transport and dye penetration along root canal fillings. Int Endod J 1994;27:233-8
25. Wu MK, Kontakiotis Eg, Wesselink PR. Decoloration of 1% methylene blue solution in contact with dental filling materials. J Dent;26:585-9.
26. CN Ardila, MK Wu & PR Wesselink. Percentage of filled canal area in mandibilar molars after conventional root- canal instrumentation and after a noninstrumentation technique(NIT). Int Endod J 2003;36:591-598.
27. T Tasdemir, C Yesilyurt. Evaluation of apical filling after root canal filling by 2 different techniques. J Can Dent Assoc 2009;75:201-201d.
28. N Gencoglu, Y Garip and S Samani. Comparison of different gutta-percha root filling techniques: Thermafil, Quick-Fill, System B, and lateral condensation. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;93:333-6.
29. R Smitha, N Bharadwaj. Density of gutta-percha fill using four different cone placement methods for obturation –An in-vitro study. J Indian Dent Assoc 2011;5(1):15-18.
30. M Fareal, A Rani, A Husein. Evaluation of Gutta-Percha areas in root canals after filling by two different obturation techniques. Aust J Basic App Sci 2011;5(8):631-636.
31. K Gulsahi, ZC Cehreli, T Kuraner. Sealer area associated with cold lateral condensation of gutta-percha and warm coated carrier filling systems in canals prepared with various rotary NiTi systems. Int Endod J 2007;40:275-281.
32. GD Deus, ED Gurgel-Filho, KM Magalhaes & T Coutinho-Filho. A laboratory analysis of gutta-percha- filled area obtained using Thermafil, System B and lateral condensation. Int Endod J 2006;39:378-383.
33. GD Deus, M Ferreira, G Filho. Comparison of the percentage of gutta-percha-filled area obtained by Thermafil and System B. Aust Endod J 2007:55-61.
34. C J Ruddle. The Protaper technique. Endodontic Topics 2005;10:187-190.