Evaluation of Efficiency of three NiTi Instruments in Removing Gutta Flow 2 from Root Canal during Re-treatment – An in vitro Study

Article *in* Indian Journal of Contemporary Dentistry · January 2016

DOI: 10.5958/2320-5962.2016.00026.7

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Evaluation of efficiency of three NiTi instruments in removing gutta flow 2 from root canal during retreatment –An in vitro study.

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ABSTRACT

Aim: To evaluate the efficiency of three rotary nickel titanium instruments and hand instrumentation in removing gutta flow 2 from root canals .

Methodology: 60 extracted human maxillary central and lateral incisors were instrumented with k-files and filled with guttaflow2 .The teeth were randomly divided into four experimental groups of 15 specimens each. Removal of gutta flow 2 was performed with the following devices and techniques : protaper Universal rotary retreatment system, R-Endo retreatment files, M two retreatment files and Hedstrom files.Time to reach working length and to eliminate filling material was also recorded. The specimens were rendered transparent for evaluation of the area of the remaining gutta flow 2 under stereomicroscope at 6x magnification.Photographs were taken for further analysis using computer image analysis program.The results were statistically analysed using ANOVA and Bonferroni test.

Results: The Protaper Universal retreatment system resulted in a smaller percentage of canal area covered by residual gutta flow 2 than in other groups, but a significant difference was found between Protaper and Mtwo group and between protaper and Hedstrom group($p < 0.001$). The mean operating time was minimum with Mtwo group (5.08±0.06 min) while it was found to be maximum with hand files (7.93± 1.03 min).

Conclusion: it was concluded that all test techniques left gutta flow 2 with in the root canal .The ProTaper Universal rotary retreatment system proved to be an efficient method of removing guttaflow 2 from maxillarycentral and lateral incisors.

Keywords: Gutta flow2, Rotary instruments.

Introduction

The key to successful endodontic treatment is to thoroughly debride the canal system of infected or necrotic pulp tissue and microorganisms ,and to completely seal the canal space,thus preventing the persistence of infection and /or re-infection of the pulp cavity.[1] Root canal therapy ,despite having high degree of success , may not lead to desired response ,and failure may occur.[2,3] When root canal therapy fails,treatment options include conventional retreatment ,periradicular surgery,or extraction.[3,4]

The non –surgical approach is the treatment of choice when access to the root canal is feasible and it is the most conservative method.[5]

The clinical success rate of endodontic retreatment has been estimated to vary between 50-90%.[6,7]The variability of the outcome in endodontic retreatment is related to patient's age and the type of teeth treated,[8]presence of alteration in natural course of the root canals ,[7]the possibility of removing the coronal restoration to access the pulp chamber[9] and possibility of repairing pathologic and iatrogenic defects.[10]Preoperative perforations ,apical periodontitis and quality of previous filling materials are the strong predictors for the outcome of endodontic retreatment .[10,11]

The main goal of orthograde retreatment is regaining access to the apical foramen by complete removal of root canal filling material thus facilitating sufficient cleaning and shaping of the complete root canal system and final obturation.[12]

One of the greatest technical difficulties faced by endodontists is the conventional root canal retreatment ,as the filling materials represent a mechanical barrier than can often require considerable time and effort to remove .[13]

Many techniques have been described for removal of gutta-percha.These include endodontic hand files combined with heat or chemical solvents,engine driven rotary files,ultrasonic instruments,heat carrying instruments ,paper points with chemicals and lasers.[14,15]Most recently flexible rotary nickel – titanium (NiTi) files have been introduced.

Various nickel titanium (NiTi) rotary endodontic instruments have been developed to facilitate cleaning and shaping of root canals.In order to improve safety preparation and to prepare more appropriate shapes,advanced instrument designs with non cutting tips,radial lands,varying tapers and rake angles, and changing pitch lengths have been developed .[16]

The aim of this study was to evaluate the efficiency of three rotary NiTi instruments ,the Protaper (Dentsply –Maillefer ,Ballaigus,Switzerland),Mtwo(Sweden & Martina,Padova,Italy),R-Endo (Micro-Mega,Besancon,France),in the removal of guttaflow2 during root canal retreatment in comparison with hand instruments using Hedstrom files (Dentsply Maillefer,Baillaigues,Switzerland).The time to reach the working length and to eliminate filling material was also recorded and evaluated.

Materials and Method:

Selection of teeth:

Sixty maxillary central and lateral incisors with mature root apices and single canal extracted for periodontal reasons were used.Teeth with root caries ,cracks on the root surface,curved roots and extremely calcified canals were excluded.Soft tissue and calculus were removed mechanically from the root surface.

Initial root canal treatment:

Each tooth was decoronated at the cement enamel junction (CEJ) with a diamond disc to facilitate straight line access for instrumentation and obturation.Proper access was established and the apical patency was determined by inserting an ISO # 10 K-file until it appeared at the apical foramen. Working length was determined by placing a size 15K- file in to the canal until it appeared at the apical foramen;this length was measured and the working length was set 0.5mm short of this distance.A circumferential' staging platform ' was established near the canal orifice ,ensuring a uniform working length (WL) of 15mm in each tooth.

Cleaning and shaping were performed using a modified step back flare technique . The coronal third was flared with sizes 1-3 Gates glidden drills (Dentsply Maillefer).Canal preparation was carried out by the sequential use of k –files (Dentsply Maillefer,Ballaigues,Switzerland) up to size 30 at working length ; a step back procedure in 1mm increments to a file size 50 was then carried out. Upon withdrawal of each instrument , canals were irrigated alternatively with 5.25% sodium hypochlorite (NaOCL) and 17% ethylenediaminetetraacetic acid (EDTA).

Root canal obturation:

The root canal of each tooth was dried with paper points and obturated with guttaflow 2(coltene whaledent). The coronal access cavities of the specimens were sealed with temporary filling material (Cavit,DeTrey Dentsply). The quality of the root fillings was confirmed using postoperative radiographs.All teeth were stored at room temperature for 30 days to allow complete setting of the sealer.

Retreatment Techniques:

All the specimens were randomly divided into four experimental groups (n=4) with 15 specimens each for removal of guttta flow2 by using one of the following techniques:

Group A:Protaper Universal retreatment files

Group B:R-Endo retreatment files

Group C:Mtwo retreatment files

Group D:Hedstrom files

All instrumentation of the Protaper Universal retreatment files, R-Endo retreatment files and Mtwo retreatment files was performed using X-smart endodontic motor with 1:20 reduction gear handpiece (NiTi Control,Dentsply) operated at a constant speed of 500 rpm.

Group A: Protaper Universal retreatment files

The root canals were instrumented in a crown down sequence as recommended.ProTaper D1 file(size 30,0.09 taper,length 16mm) was used to remove filling material from the coronal portion of the root canal,where as the middle and apical third of the canals were instrumented using Protaper D2 (size 25,0.08 taper ,length 18mm) and Protaper D3 files (size 20,0.07 taper,length 22mm),respectively, using a brushing action with lateral pressing movements.ProTaper D3 file was taken to the working length.

Group B: R-Endo retreatment files

R-Endo retreatment files were used in a gentle in and out motion on the canal walls according to manufacturer's instruction.A manual file Rm was used to relocate the canal orifices ,then the Re (size 25,0.12 taper) instrument removed the first 2-3mm of the filling.R1 (size 25,0.08 taper) and R2 (size 25,0.06 taper) were used to one – third and two-thirds of the estimated working length respectively.Finally R3(size 25,0.04 taper) was used at the working length to complete the removal of filing material from the canal.

Group C: M two retreatment files

The M two retreatment files were also used according to the manufacturer's instructions .Removal of the root filling materials begun with the use of sizes 1-3 Gates Glidden drills in the coronal portion .The canals were instrumented in a simultaneous technique to the working length using Mtwo R2(size 25,.05 taper) in a brushing action with lateral pressing movement.Progression of the rotary files was performed by applying slight apical pressure and frequently removing the files to inspect the blade and clean the debris.

Group D: Hedstrom files

Removal of the root filling materials begun with the use of sizes1-3 Gates Glidden drills in the coronal portion.With xylene as a solvent,Hedstrom files (Dentsply Maillefer)sizes 30,25 and 20 were used in a circumferential motion to remove the root fillings from the middle and apical portions until the original working length had been reached.

Upon withdrawal of each instrument ,adherent debris was removed from the files and the canals were irrigated with 5.25% NaOCL and 17% EDTA .Retreatment was completed when no debris of Gutta flow 2 was visible on the surface of instruments and canal walls were smooth.

Evaluation

a)Remaining Guttaflow2

All specimens were rendered transparent according to the following technique described by Schirrmeister et al.[17]

The specimens were decalcified in 5% nitric acid for 72 hours,washed for 4 hours and dehydrated in increasing concentrations of alcohol (80%,for 12 hours ,90% for 1 hours and 99% for 3 hours). The roots were cleared subsequently using methysalicylate.

The guttflow 2 remnants on the canal walls were imaged on a black ground in mesio-distal (M-D) direction using a stereomicroscope at 6x magnification.Each canal was dividedin to coronal,middle and apical thirdsfrom the 'staging platform' to the terminus of the apical preparation.The area of Guttaflow2 remnants as well as the canal wall was measured using image analyzer software (DigiPro4.0).

b) Operating time

The operating time which elapsed from initial Guttaflow2 removal with the first instrument until reaching the original working length was recorded as T1.The time required to achieve satisfactory guttaflow2 removal after reaching the working length was recorded as T2. Total time for treatment was the sum of T1 and T2.

Statistical Analysis

Analysis of variance (ANOVA) was used to analyse the differences in the percentage of

Guttaflow 2 remnants covered area amongst the four groups.One –way ANOVA was applied to compare the operating time amongst the four groups.Bonferroni test was performed as the post hoc multiple comparison method.

Results

a)Remnants of material

All instruments left filling material inside the root canal .The specimens retreated with the Protaper left less filling material insie the root canalsthan other groups but significance difference was found between Protaper and Mtwo and protaper and Hedstrom files (<0.001).(Table 1)

The comparison of Guttaflow 2 remnants at different levels among four groups using Bonferroni Method test showed that difference in different levels was found to be maximum between coronal and apical levels (4.062) while it was minimum between coronal and middle levels (1.751).(Graph I and Graph II).

Table I – Area fraction of root canal wall covered by Guttaflow2 remnants after retreatment

		Coronal		**Middle**		**Apical**	
S. No.	**Group**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
1.	A(protaper)	3.24	1.29	5.17	1.81	7.51	2.51
2.	B(R-Endo)	3.46	1.06	5.15	1.58	7.54	2.04
3.	C(M-Two)	4.42	1.19	6.60	1.34	11.01	2.33
4.	D(H-File)	6.40	3.35	7.61	2.26	11.31	3.00
"F"		8.054		6.732		10.651	
"p"		< 0.001		0.001		<0.001	

SD - Standard Deviation

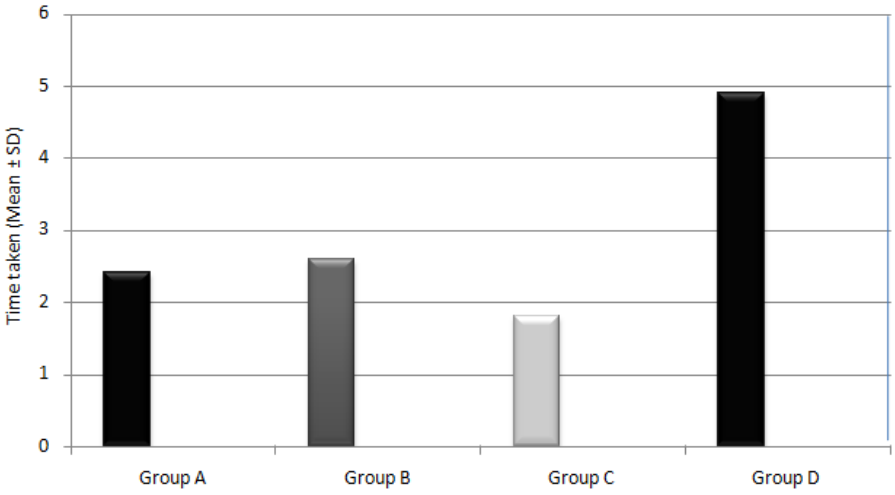
F - Analysis of Variance (ANOVA)

P – level of significance

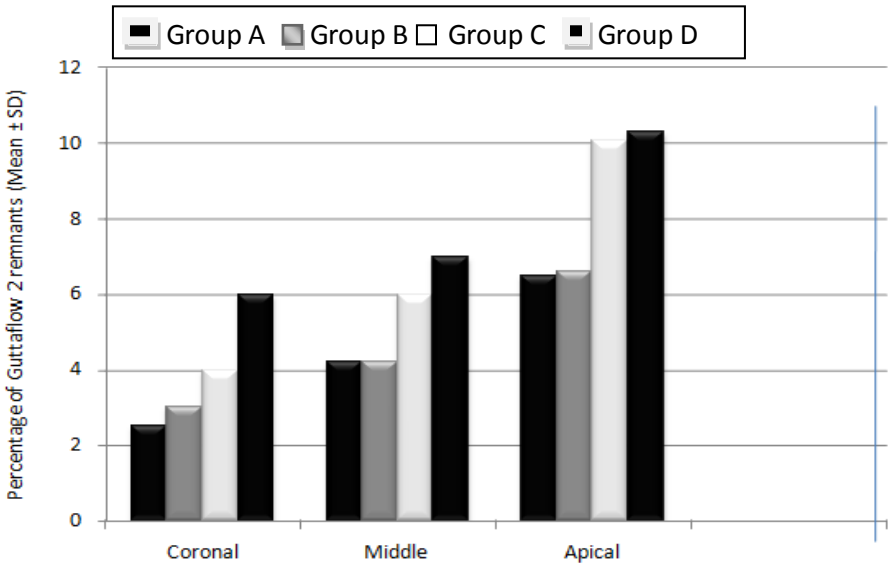
Table II – Time taken for complete procedure in different groups.

S. No.	**Group**	**No. of samples**	**Mean time taken**	**Range**		**Max**	**"F"**	**"p"**
				SD	**Min**			
1.	A(Protaper)	15	6.10	1.00	3.58	7.45	21.350	<0.001
2.	B(R-Endo)	15	6.41	1.21	4.07	8.81		
3.	C(M-Two)	15	5.08	0.64	3.49	5.72		
4.	D(H-File)	15	7.93	1.03	6.70	10.59		

Graph 1 – Bar graph showing Gutta flow 2 remnants after retreatment at coronal,middle and apical level among four groups.



Graph II- Bar graph showing mean time for retreatment .



Solvents which are recommended for endodontic retreatment which includes eucalyptol,halothane,methyl chloroform,chloroform,turpentine.[14]Xylene slowly dissolves the gutta-percha,thus allowing better control and removal of softened gutta-percha rather than liquefied gutta percha. Although chloroform has been used.

b)Operating time

The mean time taken for complete procedure was found to be minimum in group c (5.08±0.64 min) while it was found to be maximum in group D (7.93±1.03 min). (Table II) .

Discussion

The primary reason for a negative outcome following the root canal treatment is the persistence of bacteria with in the intricacies of the root canal system.[18] Complete removal of pre-existing filling material from canals is a prerequisite for successful nonsurgical root canal treatment .[19]This procedure can uncover residual necrotic tissues or bacteria that may be responsible for persistent periapical inflammation and allow further cleaning and refilling of the root canal system.[20]

Different methodologies have been reported to evaluate the amount of filling material remaining inside the canal after retreatment procedure . It can be assessed radiographically [21],roots can be split longitudinally and remaining gutta flow 2 were measured linearly or using scoring system[22] or making the teeth transparent[17].In addition computer tomography [23] and operating microscopes [20] have also been used for this purpose. Ideally , three-dimensional visualization of the root canal system would provide a better understanding of the distribution of the debris after retreatment .[16,24]

In the present study xylene was selected from a variety of different shown to be most effective gutta percha solvent when compared with other solvents but its use is controversial.[20]It has been reported to be locally toxic when in contact with periradicular tissues.Additionally it is hepatotoxic and nephrotoxic and is classified as a carcinogenen.[22]

Different methods have been applied to remove root canal canal filling material from canals.These include use of hand files,ultrasonic files,engine driven instruments and lasers.[3,14,15] Conventionally ,the removal of gutta percha using hand files with or without solvent can be a tedious and time consuming process ,especially when the root filling material is well condensed.[16]

In the current study ,all retreatment techniques left Gutta flow 2 remnants with in the root canal. This finding confirms previous results reported by numerous investigators using different retreatment instruments , techniques and solvents .[3,13,16] Furthermore ,the present investigation showed that rotary NiTi instruments, the Protaper instrumentation was significantly more effective than Mtwo and Hedstrom group in terms of residual material,where as no statistical difference was found amongst the Protaper and R-Endo instrumentation group.

De Carvalho Maciel and Zaccaro Scelza[21] found that Protaper was more effective in removal of filling material from root canal walls than manual instrumentation.By contrast ,Schirrmeister et al.[19] found similar amount of residual Guttaflow 2 after Protaper and manual instrumentation.

In the present study the better performance of Protaper Universal retreatment instruments may be due to their specific flute design . The file not only cut gutta-percha but also the superficial layer of dentin during root filling removal.Others features are progressive tapers of D1,D2,D3files which make it possible to shape specific sections of a root canal with one file and variable tip diameter which allow the files specific cutting action in defined areas of the canal, without stressing the instrument in other section.The flute design and rotary motion cut the large amount of gutta percha in spiral around the instrument and direct it towards the orifices.

The manufacturer of R-Endo instruments claims that instrument is designed especially for retreatment as are machined in to a round blank and they have a triangular cross section with three equally spaced cutting edges.Tasdemir et al reported that ProTaper ,R-Endo and manual instrumentation groups have similar

effectiveness in removing filling material in straight root canals.[16]

In the present study significant difference was found between ProTaper group and Mtwo ,this in accordance to the study done by Tasdemir et al.[16]

Conclusion

With in the parameters of this study ,the following conclusion may be drawn:

Protaper Universal retreatment files and R-Endo retreatment files left significantly less Guttaflow2 than Mtwo system and Hedstrom files.Retreatment with Mtwo system NiTi rotary systems was significantly faster than manual instrumentation in the removal of Guttaflow2.

Acknowledgment: None.

Conflict of interest:None.

Source of support:None.

Ethical Clearance: Not applicable.

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