Australian Journal of Basic and Applied Sciences, 5(3): 114-119, 2011
ISSN 1991-8178

Apically Extruded Debris During Removal of Realseal™ Using Two Re-treatment Rotary Systems

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Abstract: Aim: The aim of this study was to compare the quantity of the extruded debris during removal of laterally and vertically compacted RealSeal™ using two NiTi rotary re-treatment systems (ProTaper®re-treatment & R-Endo®) and Hedström files. Method: Eighty four extracted human premolar teeth were prepared using hand K-files with step down technique and randomly assigned into 2 groups (42 roots each) to fill with RealSeal™ using either cold lateral compaction or warm vertical compaction techniques. Each group was subgrouped into 3 groups and removal of the RealSeal was done by one of the following: Hedström files, ProTaper re-treatment system and R-Endo. Apically extruded debris was collected in pre weighted glass cuvette and the mean of the debris was statistically analyzed using Kruskal-Wallis test and Mann-Whitney test. **Result:** No significant difference was found between groups regarding obturation technique or type of files used during re-treatment $P > 0.05$. **Conclusion:** All the above used re-treatment methods were had the same effect on the amount of apically debris during re-treatment.

Key words: Apical debris, RealSeal, ProTaper, R-Endo, Endodontic re-treatment.

INTRODUCTION

Endodontic treatment is not always successful, and periapical inflammatory lesions might persist or develop postoperatively (Machtou P., C. Reti, 2003). When root canal therapy fails, treatment options include orthograde re-treatment, periradicular surgery, or extraction (Clin North Am, 1992). Orthograde re-treatment is considered the treatment of choice, unless patient preference or specific limitations within infected tooth indicate surgical approach (Friedman S., 2002), as it results in retention of millions of teeth (Roda S., B.H. Gettleman, 2006).

However, Removal of obturation material in conventional re-treatment may resulted in some problems such as the risk of straightening and perforation of the root canal, over enlargement of the apical area, instrument breakage and extrusion of filling material and debris through the apical foramen which may result in apical pathology or post-instrumentation pain (Hulsmann M., S. Stotz, 1997).

Most of the available techniques were produced apical debris and the different in quantities depends on the technique used (Al-Omari M.A.,1995).

Therefore, appropriate re-treatment technique should be selected to remove the pre existing filling material as completely as possible with minimum amount of apical extrusion.

Recently two NiTi rotary have been designed to remove obturation material from the root canal. ProTaper® Universal re-treatment system (DentsplyMaillefer, Ballaigues, Switzerland) and R-Endo® (Micro-Mega, Besancon, France) systems.The ProTaper® Universal re-treatment files are characterized by progressively increasing tapers, a convex triangular cross-section, and a modified guiding tip. The R-Endo® files are machined into a round blank and their cross-section is characterized by three equally spaced cutting edges; the instrument has neither radial lands nor an active tip.

ProTaper re-treatment system found to produce less amount of debris compared to hand instruments (Huang X., J. Ling, 2007) whereas other study (Somma F., 2008) found it most of debris were produced with ProTaper re-treatment system compared to manual instrument.

According to our knowledge, no studies hence now quantify the amount of debris using ProTaper re-treatment and R-Endo system during removal of RealSeal™.

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MATERIALS AND METHODS

Samples Selection:

Eighty four extracted single-rooted premolar teeth were collected. The teeth were disinfected in 0.5% chloramines T trihydrate solution for one week. The soft tissues and hard deposits were removed using the ultra sonic scaler. The teeth were then stored in distilled water at 4 C with changing the water regularly every week until used. Buccolingual and mesiodistal radigraghs were made in the same film using the lead shield to hide the half of the film not to be exposed. The teeth with single straight root canal, completely formed apex with patent foramina, no internal and/ or external resorption, no obstruction within canal system, and no pulp stones were selected. All teeth were decoronated with a separating disc (BEGO, Germany) at the level of 16 mm from the apex perpendicular to the long axis of the root canal to obtain a relatively standard root canal length.

Root Canal Preparation:

After removal of the pulp, the working length was established 1mm short of appearance at apical foramen with size 10 K-file. Root canal preparation was achieved with modified step-down technique (Goerig A.C., 1982). The coronal two-third was flared up with size 2-4 Gates-Glidden drills (Dentsply Maillefer). The apical third was then prepared with K-files (Dentsply Maillefer) to master apical file size 25 and step-back in 1mm increment to a file size 55. Apical patency was maintened with size 10 K-file. Canals were regularly irrigated between changes of files with 2ml of NaOCl. The final irrigation was done with 2ml of 17% EDTA followed by 2ml of distilled water to ensure complete removal of the NaOCl from the root canal.

Root Canal Obturation:

The samples were randomly assigned into two groups (45 samples each). After drying the canals with paper point each root canal was obyurated according to the assigned group using either cold lateral compaction (CLC) or warm continuous wave compaction (WCWC technique.

Clc Group:

A size 25 master cone was fitted in each canal with tug-back at the working length. RealSeal™ self etching Primer was introduced into the root canal with a supersaturated paper point and access primer was removed with a new paper point to condition the canal. The RealSeal sealer was applied with paper point and then slightly with master cone. The root canals were laterally condensed with accessory cones using F-M finger spreader (Kerr/SybronEndo). The system B side of the Elements ™ Obturation Unit (SybronEndo, Orange, USA) was used to sear off the cores at the canal orifice.

Wcwc Group:

A fine-medium size non-standarized RealSeal™ core was fitted into the root canal until tug-back at the working length. After conditioning the canal and applying the sealer. . The selected RealSeal™ core was coated lightly with sealer and inserted to the working length and then down packed with the selected Buchanan plugger using the System B side of the Elements™ Obturation Unit (SybronEndo, Orange, USA). Backfill of the canal was achieved by warm vertical compaction of the injected RealSeal™ (Elements RealSeal™ Obturation Cartridge, SybronEndo, Orange, USA) using the Extruder side of the Elements™ Obturation Unit which was set at 150 C.

The coronal surface of all samples was light cured (Spectrum™ 800.Dentsply, Caulk, USA) for 40 seconds to produce an immediate coronal seal. After canal obturation, each sample was removed from its mounting. Radiographs were taken from the buccal and mesial aspect to assess the quality of the root canal filling. The filling was considered satisfactory if it appeared to be dense without voids present and if it extended within 1mm from the root end. The canal coronal to the root filling was restored with IRM (Dentsplay International Inc., Caulk, Milford, USA). All samples were then kept at 37 C for 8 weeks in 100% humidity in anaerobic enviroment using AnaeroPack®Anaero (Mitsubishi Gas Chemical Co., INC. Tokyo, Japan) to achieve complete seating of the sealer.

Collection of Debris and Re-treatment Techniques:

After regaining access by removal of temporary filling, the Gates-Glidden drill was used to remove 2-3mm of the obturation material to confine the length of the obturation material to 12 mm for each sample and to create a reservoir to the solvent during re-treatment procedures. The samples in two groups were subdivided and coded into six groups (three subgroups in each group) with 15 samples each.

All samples were secured for re-treatment and debris collection using a modification of technique described previously (Myers G.L., 1991) .The teeth were fixed in a pre-cut hole in a rubber stopper leaving the apical 6 mm exposed. A 4 ml quartz cuvette with Teflon led (Micro,....) was pre-weighted with a precision of +/- 0.0001 g using a microbalance (Acculab,Sartorious group,Germany) and used to collect the apically extruded debris and irrigation .This cuvette was placed in a glass vial (30 ml) then the rubber stopper was fitted tightly into the opening of the glass container in way that the apex of the tooth was fitted in a quartz cuvette. A 23-gauge disposable needle was placed alongside the stopper to equalize the air pressure inside and outside the glass container.

The re-treatment was achieved using 2 drops of chloroform solvent were incremental delivered to each sample using disposable syringe, and one of the following techniques:

Group1 & 4 (Control Groups):

Re-treatment with Hedstrom hand files (SybrnoEndo, Orange, USA). . A sequence of hand files from #55coronal to #25 apical was used in a crown-down technique in a circumferential quarter-turn push-pull filing motion.

All instruments of the ProTaper and R-Endo was performed using using rotary engine driven motor X-Smart™ (Dentsply Maillefer, Ballaigues, Switzerland) with constant speed of 500.p.m, torque control of 2NCm $^{-1}$, and a 16:1 reduction gear contra angle hand piece.

Group2 & 5 (Experimental Groups):

Re-treatment with Pro-Taper re-treatment rotary files (Dentsply Maillefer, Ballaigues, Switzerland) was done as recommended by manufacturer in crown-down technique and brushing motion circumferentially. D1 file was used to remove the obturattion material from coronal third. D2 file was used to remove the obturation material from the middle third. D3file was used to remove the material from the apical third and achieved working length.

Group3 & 6: (Experimental Groups):

Re-treatment with R-Endo re-treatment rotary files (MicroMega, Besancon, France) was done as recommended by manufacturer in crown-down technique and push-and-retain motion circumferentially. R1, R2 and R3 were used respectively to remove the root filling material from the coronal, middle and apical thirds. R3 was taken to the working length.

The removal of the obturation material was considered complete when the working length was reached, no material was observed between the flutes of the files, and the walls of the canal were smooth and free of visible debris.

During the re-treatment, distilled water used as irrigation as it has no effect on the weight of debris (11) and it was confined to 14 ml for each tooth. All instruments were used to prepare 5 root canals and then discarded.

Assessment the Amount of Apically Extruded Debris:

When the retraetmnt was considered complete, the samples were taken out the container. Subsequently, the quartz cuvette were taken and dryed in the hot oven (..) under 150C° for 20-30 minutes. After that the cuvette was left to cool in the room temperature and then reweighed using the microbalance with precision of+/- 0.0001 g to calculate the amount of apical extruded debris. This calculation was achieved by subtracting the weight of the cuvette (before re-treatment) from the combined weight of the cuvette and debris (after re-treatment).

Statistical Analysis:

The mean of the amount of apical extruded debris for each group was analysed using T-test for the obturation techniques. For the types of files Kruskal-Wallis test was used. The p-value was set at 0.05

Result:

The mean of apically extruded debris regarding the obturation techniques and type of the files will be summarized in table 1 and 2

Detectable amount of the apically extruded debris was assessed during removal of Realseal™. The average of apical extruded debris ranged between 0.000-0.07 g. The quantities of debris were varied between groups especially depends on types of files (see index) but these variance were not significantly difference (P>0.05) regardless obturation technique and types of files. The result demonstrated, with only few exceptions, the amount of apically debris for samples didn't exceed 0.07 g for each sample.

Discussion:

Infected dentinal chips or debris during cleaning and shaping of the root canal found to be a cause of the post-operative pain and failure of the endodontic treatment (Nair P.N., 2004). Similarly the extruded debris of the root filling material during conventional re-treatment could be give bad prognosis to the case by interfering with healing of pre-existing periapical lesion or initiating new periapical lesions.

This study confirmed the other vitro studies (Betti L.V., 2001; Imura N., Kato A.S., 2000; Saad A.Y., 2007) in that all available techniques used during endodontic re-treatment produced detectable amount of debris.

In the current study, no significant difference was found between the quantities of the apical extruded debris during re-treatment using different types of files. This is in agreement with other vitro studies (Betti L.V., 2001; Imura N., Kato A.S., 2000; Saad A.Y., 2007).

Huang and his colleagues (2007) have been concluded that using ProTaper Universal re-treatment system was significantly resulted in less extruded compared to manual manual files (Hedstrom and K-flex). This disagreement may referred to using of step-back technique with hand instruments where as we used crown-down technique and it is found in review that using of step-back technique resulted in most quantity of debris compared to other techniques(Al-Omari M.A., 1995). In addition to In Huang et al. (2007) study they followed removal of the root canal filling (GP) by re-instrumentation of the canal with either ProTaper rotary files or K-flex manual files. For this study removal of the root canal filling (RealSeal™) was done without re-preparation of the canal.

Other researchers (Somma F., 2008) concluded that using of rotary files (ProTaper re-treatment and Mtwo R) produced significantly more debris than manual technique (Hedstrom). This disagreement may be referred to using rotary files with apical pressure which may lead to force more debris apically than manual files. Additionally, scoring method was used to assess the amount of debris which may less sensitive than quantitatively evaluation to debris that used in this study.

The obturation techniques have no significant effect on the quantities of the apically extruded debris during re-treatment. No comparable data could be found in literature for the effect of obturation techniques on the amount of apically extruded debris. Different method in review has been done to evaluate the apically extruded debris such as, semiquantitively using scoring system which may be less sensitive in detecting the minor difference between different techniques (Hülsmann M., 2004) Quantitatively assessed of tiny amounts of debris using very sensitive microbalance could find significant difference between various technique (Huang X., J. Ling, 2007; Saad A.Y., 2007).

Quantitatively evaluation of apically extruded debris has been done in either wet debris combined with irrigation (Huang X., J. Ling, 2007; Saad A.Y., 2007). or dry debris with no irrigation (Huang X., J. Ling, 2007; Myers G.L., 1991) was done. In this study quantitatively evaluation for the amount of dry apically extruded debris was done for the following reasons:

To reduce the discrepancy between measurements due to presence of irrigation which may extruded in high or low measurable amount from the apical foramen especially if the apical perforation was happened. In vitro studies the apex of the teeth hanging in the air unlike the vivo situation in which teeth are surrounded by per apical tissues which could help to restrict apical extrusion of the irrigation.

Table 1: Apical extruded debris depends on obturation technique

Variable	CLC techniquen=45 Mean(SD)	WVWC techniquen=45 Mean(SD)	Mean differ.(95% Cl)	T statistic (df)	P value
Apically extruded debris (g)	.003 (.013)	.002 (.010)	.002	.884(88)	.379

a -equal variance assumed (Levene's test P=0.096)
b- P value > .05 (independent t-test was used)

Table 2: Apical extruded debris depends on type of files

Variable	Hedstrom n=30 Median (IQR)	ProTaper n=30 Median (IQR)	R-Endon=30 Median (IQR)	X^2 statistic(df)	P value
Apically extruded debris (g)	.0004 (.0165)	0.004 (.0004)	.0003 (.0009)	2.468(2)	.291

a-Kruskal-Wallis Test
b-P >.05

Table 1: Comparison in apical extruded debris between CLC & WVWC techniques

Groups	n	Debris (g)Mean (SD)	Range	P value
CLC technique	45	0.003 (0.013)	0.000-0.0703	0.379*
WVWC technique	45	0.002 (0.010)	0.000-0.0625	

* P > .05 (independent t-test was used)

Table 2: Comparison in time to remove RealSeal™ between different types of files

Groups	n	Debris (g)Median(IQR)	Range	P value
Hedstrom	30	0.0004 (0.0165)	0.000-0.0703	
ProTaper rereatment	30	0.0004 (0.0004)	0.000-0.0018	0.291*
R-Endo	30	0.0003 (0.0009)	0.000-0.0062	

*****P > .05 (Kruskal-Wallis Test)

Fig. 1: Assembly prepared to collect the apical debris during removal of RealSeal™
a. Disposable needle inserted in the rubber stopper of glass container to equalize the internal and external pressures.
b. Rubber stopper to hold the root.
c. Quartz cuvette in which debris was collected.
d. Glass container acting as a holder to this assembly.

Conclusion:

With limitation of this study, the above used methods were had the same effect on the quantity of apically debris during re-treatment.

ACKNOWLEDGMENTS

This study was supported by IPPP fund, University of Malaya, Kuala Lumpur, Malaysia

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