THE SEALING ABILITY OF SILVERFIL AMALGAM IN RETROGRADE CAVITY PREPARED BY ULTRASONIC AND ROTARY INSTRUMENT

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INTRODUCTION

With the better facilities and well trained clinician today, the conventional root canal treatment has a high rate of success (85-95%). Somehow, there are still failed cases, in which periradicular surgery is needed. Periradicular surgery includes surgical debridement of pathological periradicular tissue, root-end resection, preparation of a root-end cavity, and placement of a root-end filling to seal the root canal (Gutmann and Harrison, 1991). The aim of root-end preparation techniques during periradicular surgery is to create a well shaped cavity to be filled, in order to seal the apical terminus of the root canal system (Gutmann *et al.*, 1993).

Traditionally, the root end cavity is prepared by a round bur on a micro-contra angle slow-speed handpiece (Gutmann *et al*, 1994). However, this technique is gradually replaced by the use of ultrasonic instrument and specialized root-end retrotip. Recent studies have shown that an ideal root-end cavity is very difficult to achieve with the use of burs on micro-motor, and the better results are obtained with the use of ultrasonic tips (Kim 2002; Engel *et al*, 1995; Gutmann *et al*, 1994). Advantages on ultrasonic instrument when compared to rotary instrument include less bone removal, easy access to the operating site, deeper root-end preparation, lesser risk of penetration and ability to follow the architecture of the canal system.

Although the ultrasonic instrument has many advantages over the rotary instrument, however Saunders *et al.* (1994), Abedi *et al.* (1995), Calzonetti *et al.* (1998) and Rainwater *et al.* (2000) reported that a high incidence of dentine cracks has been noticed when root-ends were prepared ultrasonically. Abedi *et al.* (1995) found that root-end preparation had significantly less or no microcrack formation with bur when compared to ultrasonic retrotip.

Layton *et al.* (1996) and Von Arx and Walker (2000) claimed the microcrack formation by ultrasonic preparation is still controversial. The dentine microcrack formation may affect the apical sealing, lead to microleakage and subsequently failure of treatment. However, the relation between microcrack formation and microleakage is still in doubt.
The purpose of this study is to compare the sealing ability in retrograde cavity prepared by ultrasonic instrument and rotary instrument, by using Silverfil argentum amalgam as the retrograde filling material.

MATERIALS AND METHODS

The study was a comparative experimental study. It was conducted from 8/6/06 to 27/6/06 at the polyclinic A and craniofacial lab of USM School of Dental Sciences. 30 extracted human incisor and canine with single root, no previous root therapy and fully developed apices were used in this study.

All teeth were immersed in a saline solution for 7 days. After that, the crown of each tooth was removed at the cervical level (Figure 1), by using a diamond-coated straight fissure bur in high speed handpiece with continuous water spray. The root canals were then cleaned and shaped with the step-back technique (Figure 2). The master apical file (MAF) for all teeth was at least K-file No: 55. NaOCl 6% was used as the irrigant. The canals were dried with paper point and AH Plus® (Dentsply, Germany; Figure 3) as the root canal sealer. The obturation was done with gutta percha by using lateral condensation technique. Afterwards, 3 mm of the root ends were resected with diamond-coated straight fissure bur in high speed

hand piece with continuous water spray (Figure 4). The root resections were done perpendicular to the long axis of the teeth.

All the teeth were divided into 2 groups by simple randomization technique. The 2 groups were ultrasonic (US) and high-speed (HS), and each contained 15 teeth. For the teeth in the US group, the root-end cavities were prepared by using P5 Newtron unit (Satelec Acteon Group, France; Figure 5, 6), with power setting 6 (medium) and stainless steel retrotip no. S1 (KIS). For the HS group, the root-end cavities were prepared with a diamond-coated round bur no. 3 in high speed handpiece with water spray (Figure 7). All retrograde cavities were prepared 3 mm deep followed the long axis of the tooth and filled with Silverfil® argentum amalgam (Dunia Perwira). All teeth were then painted with nail varnish at every surface, except the root-end surface where retrograde filling were done. When the varnish dried up, the teeth were immersed in Methylene Blue 1% solution for 72 hours within containers sealed with aluminium foil (Figure 8).

After 72 hours, the teeth were washed under pipe water and dried. The teeth were dissected longitudinally by using the diamond blade hard tissue cutter (Exakt, Germany; Figure 9). The non-dissected surfaces of teeth were flatten with sand paper and mounted on glass slide with superglue (Figure 10). The depth of dye penetration at the root-ends was then observed under image analyzer (Leica MV, Germany; Figure 11, 12, 13) at the magnification of 34, and the results were recorded in table (Table 1).

Mann Whitney test was applied to compare the depth of dye penetration between the 2 methods of root-end preparation, by using SPSS version 12.0 software. P value less than 0.05 was considered statistically significant.

RESULTS

The recorded depths of dye penetration are shown in Table 1. The table below shows analyzed data from Table 1.

Table 1: Depth of dye penetration

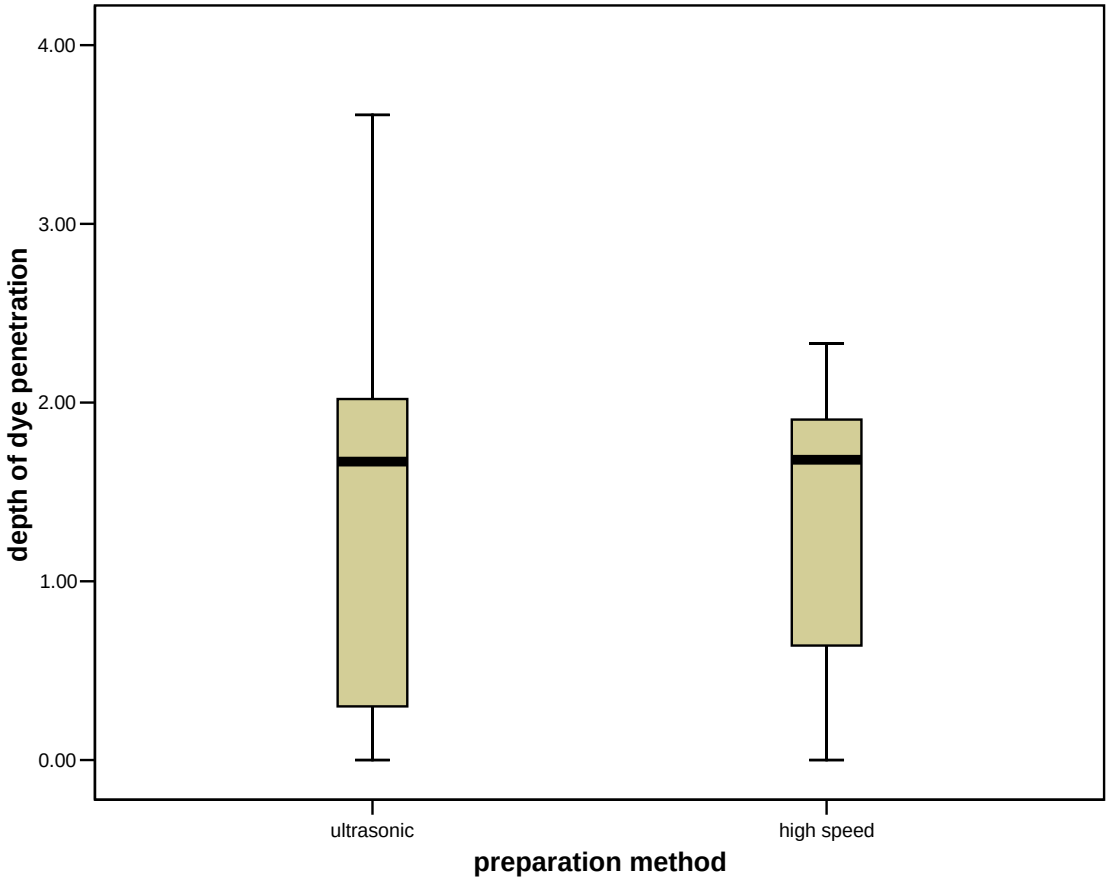
Method	Total	No leakage	Leakage	Dye Penetration	
				Minimum(mm)	Maximum(mm)
Ultrasonic retrotip	15	4	11	0.0	3.6
High speed handpiece with diamond bur	15	2	13	0.0	2.3

Table 2: Depths of dye penetration at the retrograde filling between ultrasonic and high speed round bur.

Variable	US group (n=15) Median (IQR)	HS group (n=15) Median (IQR)	*Z* statistic[a]	*P* value[a]
Depth of dye penetration (mm)	1.67 (2.09)	1.68 (1.38)	-0.02	0.983[*]

a Mann Whitney Test
* *P* value not significant (less than 0.05).

Graf 1: Depths of dye penetration at the retrograde filling between ultrasonic and high speed round bur.



DISCUSSIONS

The ultrasonic root-end preparation has become more popular in the endodontic surgery. It has many advantages over the conventional rotary instrument, because the cavity shaped by ultrasonic retro-tips are deeper, rarely deviate from the canal space, and required smaller bony crypts and smaller bevel angles for preparation (Waplinton *et al.*, 1997). Bader and Lejeune (1998) reported the clinical study comparing ultrasonic and conventional root-end preparation, and the success rate is significantly better with the former, other studies also show similar difference between the 2 root-end preparations.

However, the micro-crack formation on the dentinal wall during ultrasonic root-end preparation has become an issue of debating. The significance of root-end cracking would seen to be increased susceptibility to root fracture, the inability to adequately seal the root-end preparation, and the likelihood of additional sites of bacterial contamination. Since then, the incidence of root-end cracking during apical preparation has been investigated extensively. Somehow, Saunders *et al.* (1994) said the cracking will not affect the sealing ability of the root-end preparation. Some results indicated that ultrasonic devices are responsible for generating cracks at the root-end surfaces (Layton *et al.*, 1996; Waplinton *et al.*, 1997; Bader *et al.*, 1998; Gray *et al.*, 2000), but other results indicated the opposite (Engel *et al.*, 1995; Waplinton *et al.*, 1997; Loyd *et al.*, 1996). On the other hand, Abedi *et al.* (1995) observed significantly fewer microcracks in teeth prepared with burs compared to those prepared with ultrasonic devices.
In this study the results show no significant difference on the sealing ability between the 2 types of root-end preparation method. It may suggest that the cracking, which is believed due to ultrasonic preparation, does not significantly lead to more leakage when compare to rotary instrument.

Somehow, there are few limitations that need to be considered in this study. In this study, only extracted teeth are used. Stress exerted during extraction, careless handling of the teeth, inappropriate storing may predispose to dentin alteration and cracking. Besides, the in vitro approach is conducted in the absence of periodontal ligaments, which can dissipate some of the stress when the root is subjected to instrumentation. The study is conducted by an undergraduate dental student, so the result may be inaccurate due to lack of skills and experience during root-end preparation, or packing of amalgam.

Thus, the limitations have to be overcome in order to achieve a better study. The simulation of PDL ligament can be obtained by mounting the teeth into the acrylic resin blocks, as in the study done by Marouan *et al.* (2004). For real resemblance of the periodontal ligament, Gray *et al.* (2000) use cadaver in their study.

Whether or not the cracking will lead to more leakage is still a doubt. Therefore, hopefully more studies will be done in order to reach a confirmative result.

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APPENDICES

Figure 1: Crown removed at cervical level with straight fissure bur in high speed handpiece.

Figure 2: Root canal cleaning and shaping.

Figure 3: AH Plus®.

Figure 4: Root resection

Figure 5: Ultrasonic preparation of the root-end cavity.

Figure 6: P5 Newtron.

Figure 7: Root-end preparation with round bur in high speed handpiece.

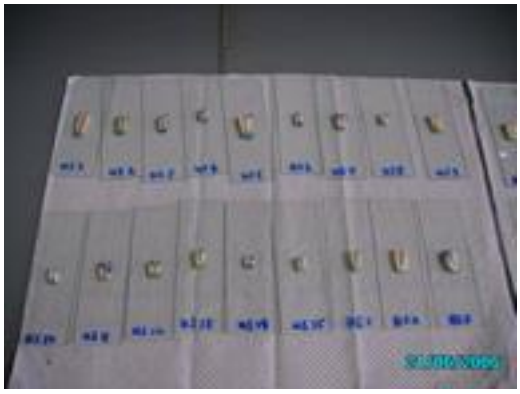

Figure 10: Teeth mounted on glass slides.

Figure 8: Teeth immersed in Methylene Blue 1%.

Figure 11: Leica MV Image Analyzer.

Figure 9: Tooth dissected along their long axis by hard tissue cutter.

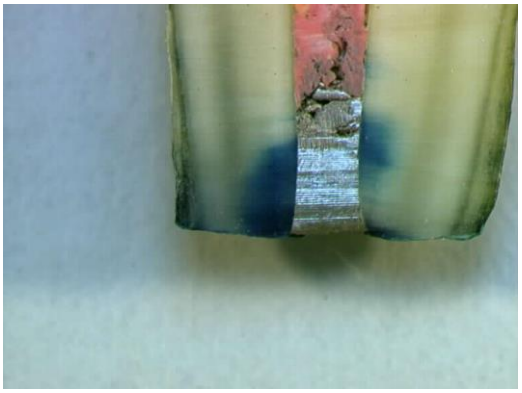

Figure 12: Image of ultrasonically prepared root-end under image analyzer.

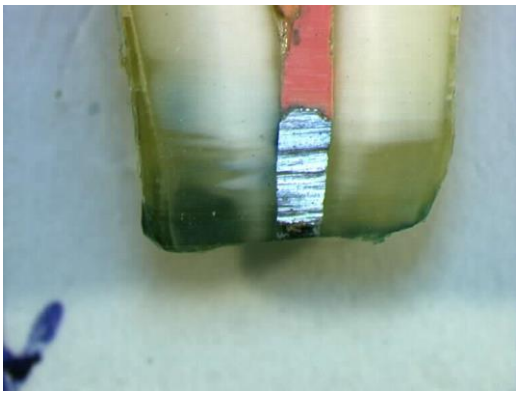

Figure 13: Image of root-end prepared by bur.