CHAPTER I

INTRODUCTION

1.1 Background and rationale

Apical periodontitis is an inflammation process on the periradicular tissues caused by microbes in the root canal system. The goal of endodontic treatment is to prevent and eliminate apical periodontitis. This goal is accomplished through disinfection of root canal space and adequate root canal filling to prevent recontamination. Long term success of endodontic therapy depends on the level of root-canal disinfection as well as proper sealing of both root canal and access cavity with materials (Ray *et al.*, 1995).

The goal of attaining a complete seal, which Grossman (1981) lists as one of the requirements of obturation, has not been achieved by the current obturation materials or techniques to date. Swanson and Madison (1987) examined coronal microleakage in single-rooted extracted endodontically treated teeth, and found that all experimental teeth were contaminated from 79% to 85% of the root length when exposed to saliva. Masters *et al.* (1995) also demonstrated the high incidence of coronal microbial penetration by demonstrating leakage along the entire root surface of 50% of the teeth within 19 to 42 days depending on the microorganism. Therefore, the quality of the coronal seal has been shown to be as important as the quality of the root canal filling for periapical health after root canal therapy (Ray and Trope, 1995).

The ideal root filling material should entomb residual bacterial after instrumentation, seal the root canal space, prevent re-infection from coronal leakage, and stop apical penetration of tissue fluids from reaching surviving bacterial in the root canal system (Sundqvist *et al.*, 1998). Gutta-percha has universally been accepted as the gold standard for root canal filling materials. It appears to be the least toxic and tissue-irritating root canal filling material available. However, gutta-percha does not adhere to the dentinal walls and consequently, a sealing agent is required. Ishley and

ElDeeb (1983) demonstrated that gutta-percha leakage increased 5- to 10-fold when sealer was not used with thermomechanical condensation techniques.

Recently, an innovative adhesion material, Resilon® has become available for filling the root canal space. Resilon® is a thermoplastic synthetic polymer-based root canal filling material, which contains bioactive glass and radiopaque fillers. Resilon® has same handling properties as gutta-percha, and can be softened with heat or dissolved with solvents like chloroform for retreatment purposes. Similar to gutta-percha there are master cones in all ISO (International Organization for Standardization) sizes and accessory cones in different sizes are available. In addition, Resilon® pellets are available, which can be used for the backfill in the warm thermoplasticized technique. The sealer used specifically for Resilon® is a dual curable dental resin composite sealer. This sealer forms a bond to the core filling material and the cleaned dentine wall, hence creating a "monoblock" (Shipper *et al.*, 2004; Shipper *et al.*, 2005).

Most importantly, neither gutta-percha nor Resilon®, both require a sealer. Endodontic sealers can be grouped according to their basic components such as zinc oxide-eugenol, calcium hydroxide, resins, glass-ionomers, iodoform or silicone. Ideally, sealers should seal the canal laterally and apically and have good adaptation to root canal dentin (Grossman, 1981). The unique ability of Resilon® to bind to the sealer and then the sealer to bind to cleaned surfaces of the dentin wall decreases available space for bacterial penetration.

During canal preparation, dentine chip created by the action endodontic instruments add to the remnants of organic material and irrigating solutions, forming a smear layer that adheres to the canal walls. This layer can form two zones: the first, 1-2 µm-thick, made up of organic matter and dentine particles; the second, extending into dentinal tubules to a depth of 40 µm (smear plugs) is formed largely of dentine chip (Mader *et al.*, 1984).

It is known that the smear layer may harbor bacteria, preventing the canal from being disinfected. In addition, it has been demonstrated that the removal of this layer promotes dentine permeability, enhancing diffusion and the action of intracanal medication, allowing and producing greater penetration of filling material into lateral canals and dentinal tubules.

Another important consideration in endodontics is the ultimate seal of root canals in order to prevent possible microleakage which may be the cause of the future failure of root canal filling. Prepared dentine surfaces should be very clean in order to increase sealing efficiency of obturation (McComb *et al.*, 1975). Smear layer on root canal wall acts as an intermediate physical barrier and may interfere with adhesion and penetration of sealers into dentinal tubules. Lester and Boyde (1977) found that zinc oxide-eugenol (ZOE)-based root canal sealer could not penetrate into dentinal tubules in the presence of smear layer. In two consecutive studies, White *et al.* (1984, 1987) observed that plastic filling materials and sealers penetrated into dentinal tubules after removal of smear layer. Oksan *et al.* (1993) also found that smear layer obstructed the penetration of filling materials; while no tubular penetration of the sealers was observed in the control groups, the penetration in the smear-free groups ranged from 40 µm to 60 µm. It may be concluded that such tubular penetration may increase the interface between the filling and the dentinal structures and this process may improve the ability of a filling materials to prevent leakage (White *et al.*, 1984). If the aim is maximal penetration into dentinal tubules to avoid microleakage, root canal filling materials should be applied at surface free of smear layer and they should have a low surface activity (Aktener *et al.*, 1989).

An endodontic irrigant should ideally exhibit powerful antimicrobial activity, dissolve organic tissue remnants, disinfect the root canal space, flush out debris from the instrumented root canals, provide lubrication, and have no cytotoxic effects on the periradicular tissues.

Sodium hypochlorite (NaOCl), the mostly used endodontic irrigant nowadays, has many of these properties. But it has a cytotoxic effect when injected into the periapical tissues, a foul smell and taste, a tendency to bleach clothes, and corrosive potential. It is also known to produce allergic reaction. Therefore, an equally effective but safer irrigant is desirable.

Chlorhexidine (CHX) is widely used as a mouth rinse in the prevention and treatment of periodontal diseases and dental caries, and has been suggested as an irrigating solution or intracanal dressing in endodontic therapy. The antimicrobial property of chlohexidine irrigating solution has been against *E.faecalis*, *S.aureus* and *C.albican*, which are also considered to be resistant to endodontic therapy. A disadvantage of chlorhexidine is that it does not dissolve organic tissues.

Ethylene-diaminetetraacetic acid (EDTA) acts upon the inorganic components of the smear layer, causes the decalcification of peritubular and intertubular dentine, and leaves the collagen exposed.

Unfortunately, no irrigating solution is capable of acting simultaneously on the organic and inorganic elements of the smear layer. In an effort to remove the smear layer completely, many authors suggest the use of several solutions. Neutral EDTA solution, in a 15-17% concentration, is effective in demineralizing the dentine, and can be used to remove the smear layer. However, as it does not dissolve organic matter, EDTA has been used with sodium hypochlorite solution, which in addition, acting on pulp tissue remnants, has antimicrobial properties. Combined use of sodium hypochlorite and chlorhexidine within the root canal could gain an additive antimicrobial action, a tissue dissolution property that is better than that obtained with the use of chlorhexidine alone, and combined use of sodium hypochlorite and chlorhexidine are less toxic than sodium hypochlorite alone. However, the combined use of sodium hypochlorite and chlorhexidine within the root canal arise the residual organic matter on the root canal wall which may alter the sealing ability of the root canal sealer (Kuruvilla *et al.*, 1998).

Removal of the smear layer, thus no residual organic matter within the root canal prior to filling the root canal system, may enhance the ability of filling materials to enter dentinal tubules. This may actually increase the adhesive strength of sealers to dentin and improve the sealing ability of the filling (White *et al.*, 1984).

To date, no studies have demonstrated the effect of final irrigation of chlorhexidine on leakage between Epiphany® root canal sealer and radicular dentin.

1.2 Research questions

Are there effects on leakage of roots filled with Epiphany® and Resilon® after final irrigation with 2% chlorhexidine?

1.3 Research objectives

The purpose of this *in vitro* study was to compare the leakage of roots filled with Epiphany® and Resilon® after final irrigation with 2% chlorhexidine.

1.4 Hypothesis

The null hypothesis is that there is no difference on leakage of roots filled with Epiphany® and Resilon® after final irrigation with 2% chlorhexidine.

1.5 Experimental design

The leakage of roots filled with Epiphany® and Resilon® were analyzed with glucose liquicolor in spectrophotometer at a wavelength of 500 nm. Concentrations of glucose in centrifuge tube were calculated by using standard curve between absorbance value and glucose concentration and presented in mmol L^{-1} at each time interval following root canal obturation.

1.6 Key words

Chlorhexidine, Epiphany®, Final irrigation, Leakage, Resilon®

1.7 Research design

Experimental research: Non-randomized controlled trial.

1.8 Limitations of research

The lowest glucose level for which the current procedure is believed to be accurate is 0.04 mmol L^{-1} which derive from an absorbance value of 0.05.

1.9 Expected benefit and application

From the results of this study, we know that final irrigation with 2% chlorhexidine will have effect on leakage of Epiphany® and Resilon® and we will choose to use final intracanal irrigants for minimize leakage.

1.10 Ethical consideration

There was no ethical problem because single-rooted teeth were obtained from orthodontic planning or periodontally treated teeth which extracted for clinical reason with patient's informed consent at the Department of Oral Surgery, Faculty of Dentistry, Chulalongkorn University.