CHAPTER 1: INTRODUCTION, AIM AND OBJECTIVES OF STUDY

1.1. Introduction

A common and usual practice in dentistry is the necessity to cut endodontic access preparations through existing crowns (McMullen et al., 1989, 1990; Messer and Wilson, 2002) to treat a diseased pulp (Larson and Jensen, 1980; Bergenholtz and Nyman, 1984; Cheung, 1991; Goldman et al., 1992; Trautmann et al., 2001a; Messer and Wilson, 2002) and when subsequent permanent repair of the opening is often preferred (Marroquin et al., 1995; Gutmann and Lovdahl, 1997; Trautmann et al., 2000; Trautmann et al., 2001b; Messer and Wilson, 2002). More than 50 % of teeth with porcelain-fused-to-metal crowns or bridges (PFM) required non-surgical root canal treatment (NSRCT) (Goldman et al., 1992). This can be due to the extensive effect of the restorative procedure, the possible leakage of bacteria and their by-products at imperfect crown margins or recurrent marginal caries that cannot always be detected clinically (Larson and Jensen, 1980; Trautmann et al., 2001a).

Unfortunately, there is no evidence-based research suggesting the best material for these access repairs (Wood et al., 2006). Clinicians routinely use either amalgam, composite resin or glass ionomer. However, there is no evidence-based support for the choice of material for the restoration and no data on its clinical performance over time (Gutmann and Lovdahl, 1997). Trautmann et al. (2000) presented the results of a survey given to endodontists, prosthodontists and general practitioners as to the material of choice for a direct repair. The preferred and most frequently used material to restore a metal crown was a bonded silver amalgam restoration, whereas composite resin was the material of choice for the metal-ceramic crowns.

Today, several improvements in resin composite formulations have been developed recently (Craig and Powers, 2002; Peris et al., 2003; Blalock et al., 2006; Araujo et al., 2006). Two clinical characteristics are now well defined: (1) high-viscosity resins presenting structure which allows compression and consequent filler particle accommodation; this represents a “condensation” sensation since these particles are compacted into the cavity (Leinfelder et al., 1998, 1999; Helvatjoglu-Antoniades et al., 2006; Papadogiannis et al., 2007); (2) low-viscosity resin composites, which are fluid and injectable (Bayne et al., 1998; Stavridakis et al., 2005; Helvatjoglu-Antoniades et al., 2006; Blalock et al., 2006). Physical properties of packable composites such as reduced initial polymerization shrinkage, a coefficient of thermal expansion close to that of the tooth structure and a modulus of elasticity similar to that of amalgam have been reported. There are also improvements in their handling properties that should ease marginal adaptability (Tung et al., 2000; Görgül et al., 2002; Helvatjoglu-Antoniades et al., 2006; Celik et al., 2007).

Unlike packable composite, flowable composite-based resins possess the potential for flowing into a small undercut. The relative ease of flow allows these materials to be used in difficult-to-access areas and repair of amalgam, crown, porcelain or composite restorations (Bayne et al., 1998; Fortin and Vargas, 2000). Use of flowable composites in conjunction with the very high viscosity, high-modulus packable composites is a common clinical technique (Bayne et al., 1998; Nattar et al., 2003; Tredwin et al., 2005; Blalock et al., 2006). The main rationale behind the use of flowable composites is the formation of an elastic layer that may compensate for the polymerization shrinkage stresses (Sensi et al., 2004; Tredwin et al., 2005; Stavridakis et al., 2005; Giachetti et al., 2006; Helvatjoglu-Antoniades et al., 2006).

In modern adhesive dentistry, using a cavity liner appropriately can minimize some of the more troublesome problems with direct posterior composites. Although there are several materials that can be used as liners, only two types of materials had been recommended i.e. low viscosity (flowable) composites and light-cured resin-modified glass ionomers (Chuang et al., 2003; Ruiz and Mitra, 2006).

Coronal leakage is a major factor in bacterial contamination and the subsequent failure of nonsurgical root canal therapy (Saunders and Saunders, 1994). Many techniques have been used to assess microleakage, and the results vary considerably (Hilton, 2002b; Fabianelli et al., 2007). The use of organic dye as tracers is one of the oldest and most common methods of detecting microleakage in vitro (Kidd, 1976a; De Munck et al., 2005; Verissimo and do Vale, 2006; Fabianelli et al., 2007) because it is generally simple and fast to perform. The dye leakage model is used to determine if any of the dental materials in current clinical use has the ability to prevent coronal leakage in restored endodontic access opening in permanently fixed crowns following NSRCT (Trautmann et al., 2001b).

Aging of composite resin restorations at body temperature and subjecting them to cyclic thermal and/or mechanical loading are treatment methods commonly used before in vitro microleakage testing to simulate microleakage that may take place during the service life of a composite resin restoration (Crim and Mattingly, 1981; Crim et al., 1985; Momoi and McCabe, 1994; Rossomando and Wendt, 1995; Gale and Darvell, 1999; Hakimeh et al., 2000; Pazinatto et al., 2003; Wahab et al., 2003; Özcan, 2003; De Munck et al., 2005; Asaka et al., 2006).

There is little information regarding the best way to restore the endodontic access opening when the crown is to be retained following root canal treatment. The choice of restorative material for restoring access openings of crowned teeth which subsequently received NSRCT had been based routinely on empiricism and personal preference. Making a new crown is advisable; but, due to functional and/or financial considerations, this is not always practicable. Therefore, the operator is confronted with the question of the most adequate restorative material for a practical solution in this situation. The perforated PFM crown also presents a serious cosmetic clinical problem. No experimental studies have been carried out to determine and compare the ability between packable composite with/without flowable nanocomposite as a liner to prevent coronal leakage in restored endodontic access openings in porcelain fused to non-precious (Nickel-Chromium) metal specimens. This technique reduces the dentists' effort and patient cost.

1.2. Aim of Study:

The purpose of this *in-vitro* study was to determine if packable composite with/without flowable nanocomposite as a liner, has the ability to prevent coronal leakage in endodontic access openings in permanently fixed porcelain fused to non-precious Nickel-Chromium (Ni-Cr) metal specimens.

1.3. Objectives of this Study:

1. To evaluate the effect of packable composite without and packable composite with flowable nanocomposite as liner (restorative technique) in preventing coronal leakage in restored endodontic access openings in porcelain fused to non-precious (Ni-Cr) metal specimens.

2. To evaluate the effect of water storage (1 day and 7 days) on coronal leakage in endodontic access openings in porcelain fused to non-precious (Ni-Cr) metal specimens restored with composite resins.

3. To evaluate the effect of thermocycling (between thermocycled and non-thermocycled specimens) on coronal leakage in endodontic access openings in porcelain fused to non-precious (Ni-Cr) metal specimens restored with composite resins.

4. To determine the influence of two different evaluation criteria (mean and maximum dye penetration) on the outcome of the statistical analysis in a dye penetration study on standardized PFM models restored with composite resins.