

# **Influence of core materials in the microleakage of cast crowns**

## ***Influência do material constituinte do núcleo na infiltração de coroas fundidas***

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### **ABSTRACT**

Endodontically treated teeth can be restored with prosthetic crowns over cast metal cores or prefabricated posts with composite resin cores. Prosthetic failure is frequently observed possibly due to microleakage. To verify the influence of the core materials in the microleakage of cast crowns, this research studied three experimental conditions: (a) teeth with partial dental remaining core with prefabricated post and partial composite resin cores, (b) teeth with cast metal posts/cores, and (c) teeth with prefabricated posts and composite resin cores. Teeth preparations were standardized, duplicated and the crowns were made in NiCr alloy, which were cemented with zinc phosphate cement. The specimens were submitted to thermocycling and mechanical stresses. They were immersed in a 0,05% aqueous solution of basic fuchsin for 8 hours during 3 days. The crowns were sliced buccal-lingually, and their microleakage was evaluated by glass magnification, according to a score scale. There was no statistical difference between conditions (a) and (c). Microleakage at cervical region of axial wall was observed in both cases. Condition (b) showed higher microleakage, which reached medium third of axial wall.

### **UNITERMS**

Dental leakage; post and core technique; dental prosthesis; crowns, in vitro

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## **INTRODUCTION**

A discerning analysis must be used when restoring endodontically treated teeth. Many teeth need rehabilitation for several reasons like: caries, endodontical access, large restorations and trauma. In general, endodontically treated teeth can be restored by two techniques: cast dowel cores or prefabricated posts with cores of composite resin.

Cast cores are traditionally used and the main advantage is scientific documentation showing evidence of effectiveness, good adaptation and resistance (BERGMAN et al.<sup>2</sup>, 1989 & MORGANO MILOT<sup>7</sup>, 1993). However there are also disadvantages like: extended work time, laboratory costs, chromatic alterations in the root or gingival tissues, difficulty of removal, and possibility of corrosion.

Prefabricated posts used with direct material core appeared because of the advantages that includes simple insertion technique and less work time. Depending on the dental material used as core, it can be prepared and molded in one session. These dental materials also have esthetic properties, resistance and are easier to remove than a cast core. Main disadvantages are: difficulty of post adjustment in the root cavity and this technique is not indicated when there is total destruction of the tooth (TJAN et al.<sup>11</sup>,1991).

Hatzikyriakos et al.<sup>5</sup> (1992) compared cast cores with two types of prefabricated dowels used with composite resin cores, concluding that the cast cores were more successful in this 3 year observation study.

Despite the several researches focusing on this clinical technique, it is still difficult to state what technique is more efficient and lasts longer (MORGANO & BRACKETT<sup>6</sup>, 1999)

The aim of this research was to verify the marginal leakage of cast crowns cemented over cast metal cores or direct composite resin cores.

## MATERIAL AND METHOD

Twenty one human caries-free extracted premolars were used in this research. The teeth were inserted in acrylic resin cylinders. The standardized dental preparations were made with a high-speed handpiece and a round-ended tapered diamond bur (2224 MKS, Brazil), fixed in a support. The chamfer margins of dental preparations were made 1mm beyond dentoenamel junction.

The teeth were divided into three groups, represented in Figure 1: (A) a partial composite resin core, (B) a total cast core, and (C) a total composite resin core.

Group (A) received dental preparations with 3mm high. Groups (B) and (C) had coronal portion of the teeth sectioned at 1mm from the margins of preparations.

Groups (A) and (C) received prefabricated dowels, cemented with zinc phosphate cement (SSWhite, Rio de Janeiro, Brazil), and a composite resin core (TPH, Denstsply, Rio de Janeiro, Brazil). The teeth were standardized prepared with 6 mm high and a six degree axial taper.

Group (B) received cast cores made with pattern acrylic resin (Duralay, Reliance Dental Mfg Co, Worth, IL, USA), which had equal forms from the other groups. The acrylic resin patterns were sprued, invested and cast in a silver-palladium alloy (Pors-

on 4, Dentsply Ceramco, York, PA, USA). The cast cores were cemented in the teeth with zinc phosphate cement.

The specimens were molded with a silicone impression material (Polysiloxane, Optosil-Xantopren, Bayer, Santa Catarina, Brazil) to obtain a gypsum model (Durone, Dentsply, Rio de Janeiro, Brazil), in which the wax patterns of the crowns were made. These patterns were cast in Ni-Cr alloy and cemented with zinc phosphate cement, under a static load of 6kg for 10 minutes.

Clinical conditions were simulated using the MFD-08 AMM device (Instrumental, São Paulo, Brazil), a mechanic cycling machine, in 37°C temperature. This device was used at an impact of 200,000 cycles, with a rotation of 70%.

Another method used was thermocycling, maintaining 700 cycles between 5 e 55° C in this research.

After thermocycling, the specimens were embedded in 0,05% aqueous solution of basic fuchsin for 8 hours, during three days. Then, each tooth was washed in water and longitudinally sectioned to evaluate the leakage.

The extent of marginal microleakage in the axial wall was evaluated by digital photographs, under the score: 0 (without microleakage), 1 (microleakage in the 1/3 cervical), 2 (microleakage in the 1/3 medium) e 3 (microleakage in the 1/3 oclusal)

## RESULTS

A confidence interval gives an estimated range of values which is likely to include an unknown population parameter, the estimated range being calculated from a given set of sample data.

This statistical tool was applied to the results, and, under 90% confidence level, the of degree microleakage of cast metal core (CMC) is equal to partial resin core (PRC). The microleakage of the total resin core (TRC) presented was higher than both CMC and PRC. These results are presented in Table 1.

## DISCUSSION

One of the main objectives of fixed partial prosthesis is retention and stability. These properties depend on bio-mechanical characteristics from prepared teeth, prosthesis adaptation and type of cement used.

In the case of endodontically treated teeth, which have expressive dentin loss, the coronal rehabilitation

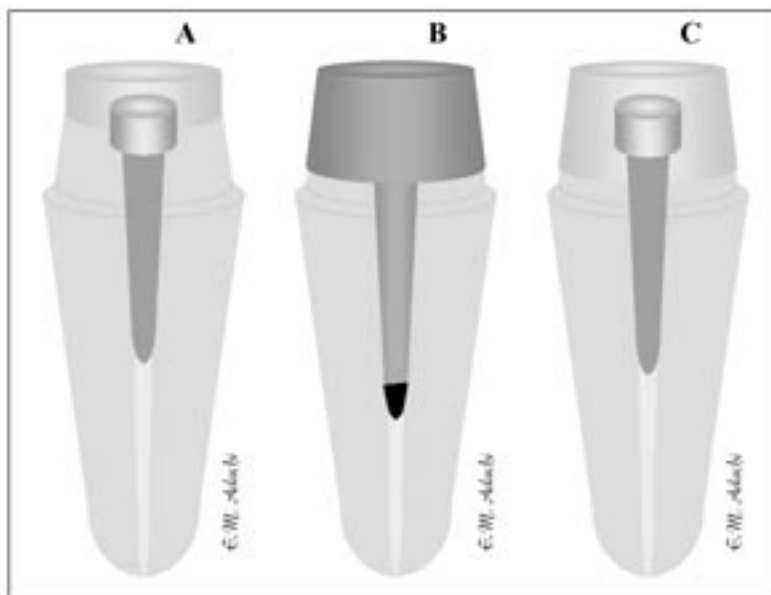


FIGURE 1 – Diagram of the samples: (A) tooth with partial dental remaining core with prefabricated post and partial composite resin core, (B) tooth with cast metal post/core, and (C) tooth with prefabricated post and composite resin core

**Table 1 – Microleakage observed in the samples (confidence interval). Mean of 7 samples**

	CMC	PRC	TRC
Inferior limit	0,77	0,87	1,54
Mean	1,20	1,14	2,14
Superior limit	1,63	1,42	2,65
Standard deviation	0,45	0,38	0,69

0 = with

can be performed with several materials. The most common used are the cast metal cores or the composite resin cores.

Authors like Tjan et al.<sup>11</sup> (1991) studied microleakage in composite resin cores and concluded that adhesive systems were not capable of preventing the leakage. On the other hand, Nathanson<sup>9</sup> (1993), has encouraged the use of prefabricated dowels with composite resin cores. This researcher concluded that composite resin cores do not change elasticity and compression resistance properties of dentin, while cast metal cores would conduct stresses to the dental root.

However, composite resin cores are the most commonly used because they are easier to manipulate, thus leading to a lower work time and less costs. Clinical experience shows that the cases of failure of partial dental prosthesis are more frequent when the dental retainors are cemented over composite resin cores, as compared to the cast metal cores.

Would the core material influence the prosthetic life time?

To simulate wear and tear in the specimens, thermocycling and mechanic cycling were performed in this research. Differences in temperature can provoke dimensional alterations in the materials (BOWEN et

al.<sup>3</sup>, 1982), leading to gaps and leakage, cement dissolution and prosthesis failure. Masticatory forces can cause deformation, also inducing restoration failure.

Many researches studied properties of dowels and cores submitted to thermocycling and mechanical cycling (TJAN et al.<sup>11</sup>, 1991 & COHEN et al.<sup>4</sup>, 2000; REID et al.<sup>10</sup>, 2003). However these researches did not use a prosthetic crown over the cores, simulating a clinical condition. The crown protects the cervical region of the dental root and could change results.

Assif et al.<sup>1</sup> (1993) concluded that, despite the differences between several types of dowels and core materials, these differences disappear after covering the core with a total crown. The prosthetic total crown modifies stress distribution in the dowel/core because it holds the cervical part of the tooth. The authors recommend that the crown must cover the core and at least 2mm of dentin.

The present research verified that cast metal cores and partial resin cores presented leakage only in the cervical region of the axial wall. In the case of total resin cores, there was some leakage in the medium third or in the occlusal third of the dental preparation.

The fact that prosthetic crowns are frequently released after some years of use can be explained by

this leakage. It is important to preserve coronal dentin tissue when preparing the tooth to receive a dowel. Prefabricated dowels with composite resin cores should only be used when there is a large amount of coronal dentin to support the prosthetic crown (MORGANO & BRACKETT<sup>6</sup>, 1999).

This research suggests that in the cases in which there is no coronal dentin left, cast metal cores should be used. When the teeth still have coronal dentin, cast metal cores or composite resin cores can be used.

Mori & Campos<sup>8</sup> (1999) also recommend that prefabricated dowels with resin cores should only be used under unique restorations, and not under partial fixed prosthesis.

## CONCLUSION

Based on the method employed, it was observed that composite resin cores presented higher microleakage, in the medium third of axial wall. In the case of partial resin cores, their behavior was similar to the cast metal cores, which presented microleakage only in the one third cervical of the axial wall.

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## RESUMO

*Os dentes endodonticamente tratados podem ser restaurados com coroas protéticas cimentadas sobre retentores intraradiculares metálicos fundidos (RIMF) ou sobre preenchimento retido por pinos pré-fabricados. Clinicamente, verifica-se que, ao longo do tempo, ocorre com frequência desprendimento da coroa, quando cimentada sobre preenchimento de resina composta. Uma das causas poderia ser a infiltração marginal que as coroas sofrem conforme a variação dos materiais que constituem o núcleo. Dessa forma, determinaram-se três condições experimentais: sete dentes com RIMF, sete dentes totalmente preenchidos com resina composta fotopolimerizável (RC) sobre pino pré-fabricado e sete com remanescente dentinário e preenchimento parcial com a mesma resina composta. Os preparos foram padronizados e moldados. As coroas foram fundidas em NiCr. Após a cimentação com cimento de fosfato de zinco, os corpos de prova foram submetidos à ciclagem térmica e à fadiga mecânica. Em seguida, foram imersos em fúccina básica a 0,05% por 8 horas. Após o seccionamento das coroas, três examinadores aferidos avaliaram visualmente, com lupa de aumento, o grau de infiltração, segundo uma escala de valores. Os dados obtidos foram submetidos à análise de intervalos de confiança, sob nível de 90% de confiança. Concluiu-se que os núcleos de metal fundido comportaram-se de forma semelhante aos núcleos parciais (dentina/RC) com infiltração ao nível cervical e os núcleos totalmente em resina apresentaram maior infiltração, chegando a alcançar o terço médio da parede axial.*

## UNITERMOS

*Infiltração dentária; técnica para retentor intra-radicular; prótese dentária; coroas; in vivo*

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