11 - ORIGINAL ARTICLE
NEW METHODOLOGY

Portland cement *versus* MTA as a root-end filling material. A pilot study[1]

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ABSTRACT

PURPOSE: To assess periradicular lesions clinically and by computed tomography (CT) after endodontic surgery using either Portland cement or mineral trioxide aggregate (MTA) as a root-end filling material.

METHODS: Three patients diagnosed with periradicular lesions by cone-beam CT underwent endodontic surgery with root-end filling. Patient A was treated with MTA as the root-end filling material, patient B was treated with Portland cement and patient C had two teeth treated, one with MTA and the other with Portland cement. Six months after surgery, the patients were assessed clinically and by CT scan and the obtained results were compared.

RESULTS: Periradicular tissue regeneration was observed in all cases, with no significant differences in bone formation when comparing the use of MTA and Portland cement as root-end filling materials.

CONCLUSION: Both mineral trioxide aggregate and Portland cement were successful in the treatment of periradicular lesions.

Key words: Apicoectomy. Oral Surgery. Biocompatible Materials. Dental Cements. Translational Medical Research.

Introduction

Endodontic surgery is a therapeutic resource indicated when conventional endodontic treatments fail. The development of biocompatible cements made this surgery a viable alternative for the preservation of the tooth as a functional unit[1,2]. Root-end filling materials are required to provide hermetic sealing and to be biocompatible and a precursor for carbonate-apatite formation, which promotes biomineralization, resulting in periodontal ligament at the bone-cement-dentin interface[3].

Mineral trioxide aggregate (MTA), which was developed by Mahmoud Torabinejad, is currently the cement of choice, meeting all requirements for use as a root-end filling material[4]. However, its high cost prevents its use in the public health system.

Portland cement is the most common type cement used in civil engineering applications. The major components of Portland cement are comparable to those of MTA, except for the presence of the radiopaque agent bismuth oxide in MTA[5,6]. Other similarities between the two materials include antimicrobial activity and biocompatibility[7-11].

The prospect of using Portland cement in the public health system means that dental procedures such as endodontic surgeries can be performed at a lower cost[11]. The present trend in the scientific community is to recognize translational science (a branch of sciences that provides an integrated approach to basic, social and political sciences) as an important tool to optimize the distribution of resources from the public health care system to patients[12]. Translational science is a process of production originated from evidence-based research that aims to provide sustainable solutions to community health problems[13]. It can be seen as a strategy for solving issues of great social impact, and if focused on saving a tooth, it may provide viable means to minimize the frequent loss of teeth that occur, especially in the public health system.

The clinical use of Portland cement would be an alternative to MTA in root-end filling procedures. Portland cement has a lower cost and is readily available, which are important factors in developing countries. Thus, this study was conducted to compare periradicular tissue regeneration following endodontic surgery using Portland cement and MTA as root-end filling materials.

Methods

This was a pilot prospective clinical study conducted at the University of Vale do Sapucai, Pouso Alegre-MG, Brazil. The study was approved by the Institutional Ethics Committee (protocol number 1702/11). Written informed consent was obtained from all patients prior to their inclusion in the study and anonymity was assured.

Three adult patients, two female and a male, who had single-rooted teeth with persistent periradicular lesions were selected to participate in this study. The lesions were diagnosed with cone-beam computed tomography (cone-beam CT; Model i-Cat 17–19, Imaging Sciences International LLC). The dimensions of the long axes of the lesions in the bucco-palatal and coronal-apical directions were measured using CT images. Patient A, 21 years-old, underwent endodontic surgery of the maxillary left second premolar (tooth A) using MTA as a control root-end filling material. Patient B, 40 years-old, underwent endodontic surgery of the maxillary right lateral incisor (tooth B) with Portland cement as root-end filling material. Patient C, 42 years-old, underwent endodontic surgery of two teeth, the mandibular right central incisor (tooth C1) and the mandibular right lateral incisor (tooth C2). MTA was used as root-end filling material for tooth C1 and Portland cement was used for tooth C2.

Before the surgical procedure, the patients rinsed their mouth with 5 ml of 0.12% chlorhexidine digluconate for one minute. The patients received 2% lidocaine with noradrenaline 1:100,000 as supraperiosteal infiltration, according to conventional techniques. A relaxing incision was made in the gingival sulcus with a scalpel blade (no. 15). Blunt dissection was carried out with a Molt elevator; the apical lesion was located using a no.5 dental explorer; and osteotomy was made using an Ostby chisel and a carbide bur no. 4. Next, curettage of the lesion was done with a periodontal curette (no. 13/14). A low-speed bur (no. 700) was used for apicoectomy. A step-back instrumentation technique performed with an ultrasonic tip (SD90, Dabi Atlante®, Brazil) was used for root-end cavity preparation. The cavity was dried with absorbent paper points and root-end filling was carried out with either MTA (teeth A and C1) or Portland cement (teeth B and C2). The root-end filling material was packed and the root was planed to the apical end using appropriate instruments. Periapical radiographs were obtained with a periapical film. The bone cavity was cleaned with sterile saline solution and filled with calcium carbonate powder. The flap was repositioned and secured with 4-0 silk suture. All patients were prescribed 875-mg amoxicillin-clavulanate potassium tablet twice daily for seven days, 4-mg dexamethasone tablet twice daily for three days, and 750-mg paracetamol tablet every four hours in the first postoperative day. The suture was removed seven days after surgery.

The teeth and surrounding tissues were assessed clinically and by CT scan at the 6-month follow-up.

The dimensions of the long axes of the lesions in the bucco-palatal and coronal-apical directions were measured preoperatively and 6-month postoperatively using CT images and descriptively compared.

Results

Images of the teeth A, B, and C1 and C2 obtained preoperatively and at the 6-month follow-up using a cone-beam CT scanner are shown in Figures 1, 2, 3 and 4, respectively.

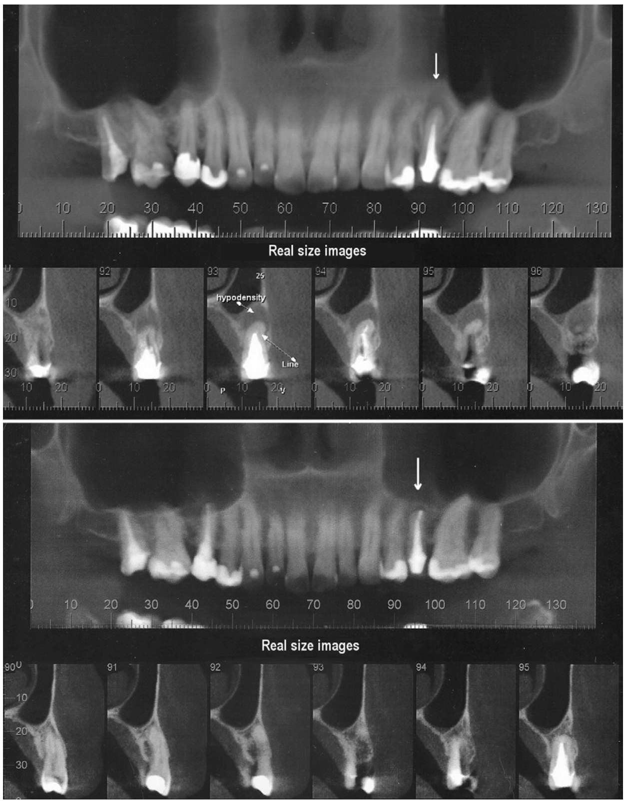

FIGURE 1 - Preoperative (*top*) and 6-month postoperative (*bottom*) cone-beam CT images of tooth A.

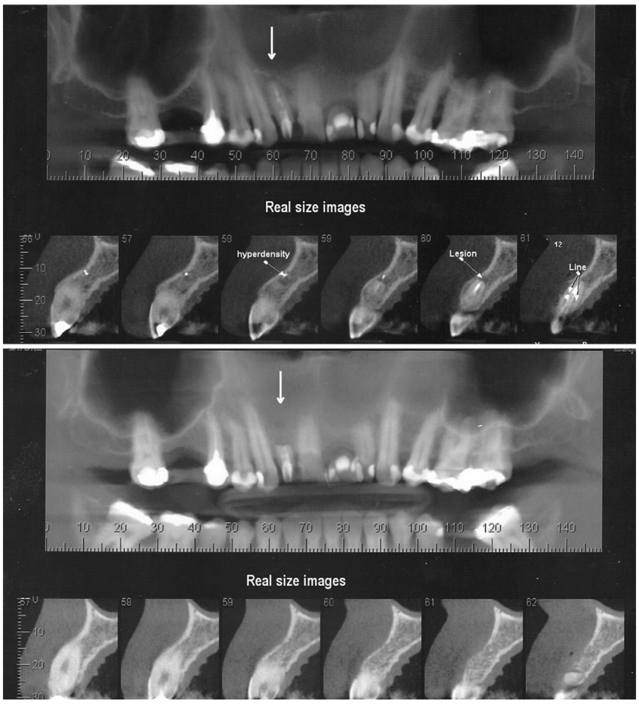

FIGURE 2 - Preoperative (*top*) and 6-month postoperative (*bottom*) cone-beam CT images of tooth B.

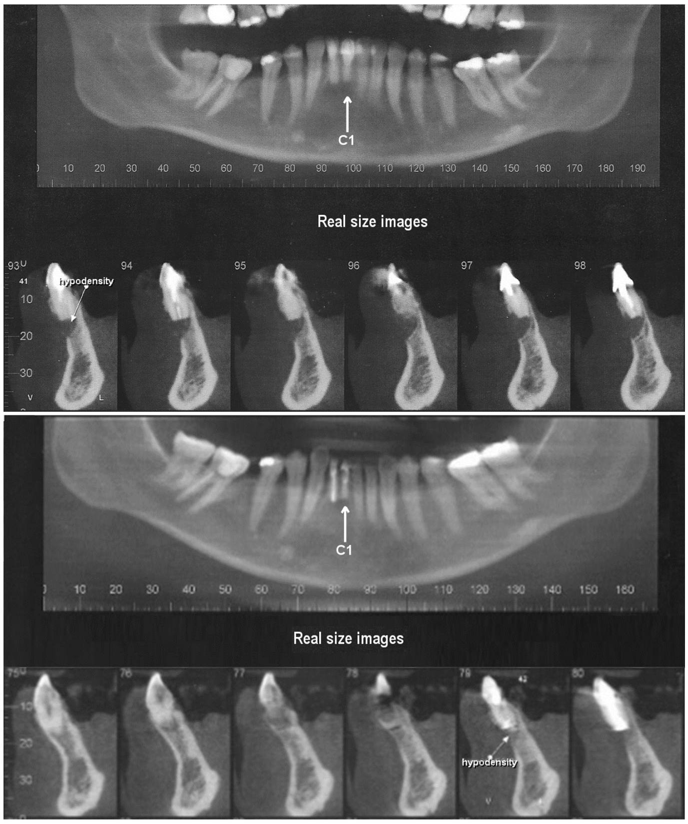

FIGURE 3 - Preoperative (*top*) and 6-month postoperative (*bottom*) cone-beam CT images of tooth C1.

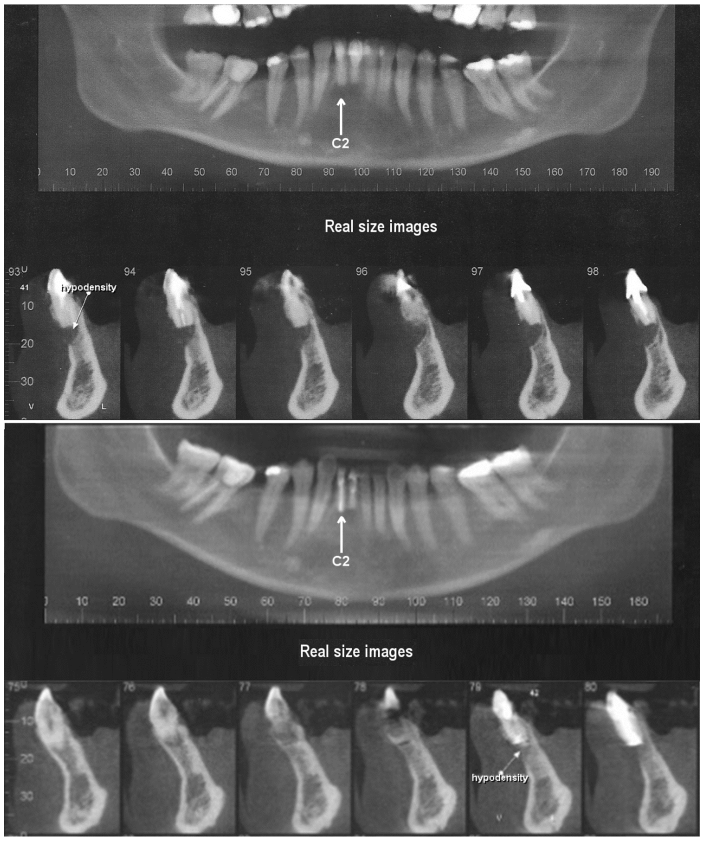

FIGURE 4 - Preoperative (*top*) and 6-month postoperative (*bottom*) cone-beam CT images of tooth C2.

Preoperative (baseline) and 6-month postoperative measurements obtained from the CT images are summarized in Table 1. The measurements show that the size of the lesion decreased over time in all teeth, indicating the formation of cortical bone.

TABLE 1 - Dimensions of the long axes of the lesions measured at baseline and 6-month postoperative on cone-beam CT images

Tooth	End-filling material	Long axis (mm) - BP direction		Long axis (mm) - CA direction	
		Baseline	6-month PO	Baseline	6-mo PO
A	MTA	6	5	5	1
B	Portland cement	3	2	3	1
C1	MTA	5	6	5	4
C2	Portland cement	5	5	5	3

BP, bucco-palatal; CA, coronal-apical; PO, postoperative

Discussion

When conventional endodontic treatments fail, apicoectomy is an alternative to save the tooth. However, cements used for root-end filling must meet certain requirements for the success of the treatment[3]. MTA is a material that has revolutionized endodontic procedures regarding tooth preservation. MTA is the cement of choice because it meets standards of performance for root-end filling. However, the high cost of MTA restricts its use[4]. MTA has the same basic composition of type I Portland cement with the addition of bismuth oxide as a radiopaque agent[14]. Because of this, some studies have suggested that Portland cement may be used in the clinical practice[15].

Portland cement has hydraulic properties and is used in civil construction. The biological properties of type I Portland cement and MTA are very similar; both materials release calcium ions, leading to the formation of carbonate apatite, which is involved in biomineralization[10,11,16,17]. Histological findings have demonstrated the biocompatibility of Portland cement, even when additives are used to increase the resistance of the cement[10,11]. These studies have served as a starting point for other clinical studies to determine the feasibility of using Portland cement as a biomaterial.

The design of the clinical study was initiated by this pilot study. One of the main reasons for conducting a pilot study is to determine the initial data for the primary outcome in order to perform a calculation of sample size for the major study[17]. It also involves checking the instruments and procedures of the research on a small part of the sample[17,18]. This study consisted of a mini version of the full study - three patients and four teeth were part of this study - to observe instruments and procedures of the method to ensure bias-free results.

Several authors performed pilot studies is to calibrate instruments for designing studies with larger samples[19-22]. We conducted a pilot clinical study comparing outcomes of endodontic surgeries using either MTA or Portland cement as a root-end filling material. Our results showed that restoration of periradicular tissues occurred when Portland cement was used.

MTA is considered the gold standard, but its cost and the presence of bismuth oxide in its composition are factors that must be taken into consideration when using MTA as a root-end filling material. Bismuth oxide is added to MTA for radiopacity, but in the long term bismuth oxide can cause changes in the cement, resulting in increased porosity and decreased resistance[5,23]. On the other hand, the presence of Portland cement can be detected in radiographs without the addition of radiopaque agents.

The discussion on the use of Portland cement as an alternative to MTA is important because it can determine whether or not it is possible to save a tooth that otherwise would be extracted. The high cost of MTA makes its use prohibitive in the public health system[24]. Researchers must make efforts to combine discoveries of basic science and findings of clinical investigations, and transform these results into changes in clinical practice[13]. The present pilot study provides a basis for further clinical studies with a larger sample size, using Portland cement as a biomaterial and aiming to contribute to dental rehabilitation.

Conclusion

Both mineral trioxide aggregate and Portland cement were successful in the treatment of periradicular lesions.

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