Use of Biomaterials in Periradicular Surgery: A Case Report

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Abstract

This article reports a case of periradicular surgery in which biomaterials, such as mineral trioxide aggregate (MTA), human lyophilized bone, and calcium sulfate, were used. A 21-year-old female patient was referred to our endodontic clinic as a result of recurrent episodes of acute exacerbation of a chronic process involving the maxillary left lateral incisor. There was complete destruction of the buccal bone plate at the apical third, leaving this portion of the root exposed to the oral cavity. After conventional root canal therapy carried out under special tooth isolation conditions, apicoectomy was performed, and a root-end cavity was prepared and restored with MTA as a retrofilling material. Because of the exposure of the root-end resection to the mouth, osteoinductive and osteoconductive materials (human lyophilized bone and calcium sulfate, and calcium sulfate alone, respectively) were used, with the goals of modeling the lost bone structure, preventing invasion of the oral epithelium, and avoiding the occurrence of secondary infection. Two years after the periradicular surgery, there were no clinical or radiographic signs suggestive of treatment failure, but instead the patient's follow-up has shown that the case management has been successful as indicated by lesion regression and periodontal repair. On the basis of the review of literature and the clinical-radiographic outcomes hereby presented, it might be concluded that (1) large bone destructions caused by periradicular lesions might and should be filled with recognizably effective bone-replacing materials during regenerative tissue process. MTA, human lyophilized bone, and calcium sulfate seemed to have an important role in alveolar bone induction, remodeling, and repair. (2) Because of its characteristics of promoting excellent marginal sealing and stimulating osteoblastic adherence to the retrofilling surface, MTA has been considered as the retrofilling material of choice. *(J Endod 2008;34:490–494)*

Key Words

Biomaterials, periradicular surgery, tissue regeneration

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Periradicular surgery is indicated as a complementary procedure in cases in which the conventional endodontic treatment failed. In addition to elimination of pathologic tissues, periradicular surgery usually comprises resection of the apical root third (apicoectomy), preparation of root-end cavity, and placement of a retrofilling material.

During the last decade, new techniques and materials have been especially developed. These innovations, among other aspects, include the placement of human and/or bovine lyophilized bone and the use of ultrasound devices with stainless steel or diamond tips for apical retropreparation. The rational use of other biomaterials such as mineral trioxide aggregate (MTA), which has remarkable chemical, physical, and biologic properties, and more recently the autogenous growth factors, like platelet-rich plasma, should also be considered.

Currently, the most common type of periradicular surgery is apicoectomy associated with root-end filling, in which a portion of the apical root third is removed (3–4 mm), and a cavity with the characteristics of Black's Class I cavity design (1) is prepared (retropreparation) and filled (retrofilling). The root-end cavities should be prepared with stainless steel or diamond burs that are capable of producing deep cavities, with high degree of cleanness and retentive and parallel walls (2). Moreover, Arens (3) reported that only root-end cavities prepared with ultrasound devices and their specific tips were able to produce safe cavities, which preserved the mineralized surfaces of the remaining apical third. In addition to these cares, it is important to keep the surgical site dry and completely free of any kind of tissue fluid or blood. MTA was developed by Torabinejad et al. (4) as a retrofilling material with better chemical, physical, and biologic properties than the existing materials at the time such as amalgam, intermediate restorative material, and super EBA. MTA is still considered one of the best of such materials (4).

According to the manufacturer, the main components of MTA are tricalcium silicate, tricalcium oxide, tricalcium aluminate, silicate oxide, and bismuth oxide, which is a radiopacifier. Its setting time is approximately 2 hours and 30 minutes, and its pH is around 12.5 approximately 3 hours after preparation. In addition to these characteristics, MTA presents good physical properties and biocompatibility, which makes it an excellent retrofilling material. Since its introduction to commercialization, several studies have compared MTA with other materials used until then for root-end filling purposes (5, 6). In addition to other advantages, MTA has a desirable osteoinductive property (6).

Allogenic bone grafts have been used in periodontal therapy during the last 3 decades (7) as either freeze-dried bone allograft (FDBA) or demineralized freeze-dried bone allograft (DFDBA). Both types of allografts have been successfully used for regeneration of the supporting periodontium during periodontal therapy, in comparison to periodontal treatment with no grafting procedures. These grafting materials have different mechanisms of action. FDBA creates an osteoinductive mesh and allows resorption when implanted in mesenchymal tissues. DFDBA also provides an osteoinductive surface and acts as a source of osteoinductive factors as well (8). In particular, DFDBA stimulates mesenchymal cell migration, fixation, and osteogenesis, when implanted in well-vascularized bone, and also induces endochondral bone formation when implanted in tissues that otherwise would not form bone (9, 10). Because of its mineralized nature, FDBA was expected to have better physical characteristics; however, it is not an osteoinductive material. Although there are no significant clinical differences between FDBA and DFDBA in cases of primary intrabony defects in which regeneration is more critical, DFDBA seems to be the most appropriate choice (9). If required, DFDBA might be used only as a space maintainer or a bone defect filling material. Nevertheless, DFDBA preparations might be considered as osteoinductive materials because they might potentially act as carriers of bioactive compounds of recognized activity, such as bone morphogenetic proteins (BMPs) (10).

In addition to these, other biomaterials such as calcium sulfate have been used in periradicular surgery for barrier because it is completely reabsorbed and does not cause inflammatory reaction (11).

This article reports a case of periradicular surgery in which biomaterials such as MTA, lyophilized bone, and calcium sulfate were used. A brief literature review addresses important issues referring to some of the available biomaterials, operative stages, and procedures involved in periradicular surgeries and discusses the importance and validity of the use of biocompatible materials.

Case Report

A 21-year-old female patient was referred to the clinic of the Specialization Course in Endodontics of the School of Dentistry, Estácio de Sá University (Brazil) because of recurrent episodes of acute exacerbation of a chronic process involving the maxillary left lateral incisor.

The patient presented with complete destruction of the buccal bone plate at the apical third of the affected tooth, leaving this portion of the root exposed to the oral cavity. In the review of the medical history, the patient did not mention any kind of health problems and denied a history of allergies or use of any medication. In the dental history review, she stated that she had not suffered any kind of dental trauma or orthodontic treatment. Nevertheless, she affirmed having used a sharp instrument (a needle) several times to empty an existing lesion in the oral mucosa at the root apex level. Probably this continual procedure was responsible for the destruction of the buccal plate of bone in the area. The initial periapical radiograph showed a large radiolucent area surrounding the tooth apex (Fig. 1).

The treatment approach started with the improvement of the periodontal conditions in the surroundings of the exposed root by means of plaque removal, scaling, and root planing.

In a second stage, conventional endodontic treatment was performed under special conditions. Because the apex was exposed to the oral cavity, the conventional rubber dam isolation technique had to be modified and adapted to the case to ensure complete isolation of the apical region and protection to the adjacent tissues from potential damage caused by the cytotoxic action of the chemical irrigating solutions used during chemomechanical root canal therapy. For such purpose, in addition to the placement of the rubber dam frame and clamp, rubber dam isolation was achieved with the aid of an orthodontic elastomeric ring that was firmly tied to the exposed apical root third (Fig. 2).

The root canal was instrumented by using the alternate rotary motion, a technique described by Siqueira Jr et al. (12), and obturated according to the technique of Schilder (13). There was no concern about extrusion of filling material because the periradicular surgery was performed immediately after the completion of the endodontic therapy (Fig. 3).

The completion of the case was carried out in 2 phases. The first phase consisted of an apicoectomy with removal of the apical 4 mm of the root and preparation of a root-end cavity by using a specific diamond tip attached to the handpiece of an ultrasound device (Enac OE-3 Ultra-Endo Instrument System; Osada Electric Co Ltd, Tokyo, Japan). Next, for insertion of the retrofilling material into the root-end cavity, a pediatric tooth isolation set was used to prevent as much as possible any interference of tissue fluids during this phase of the treatment (Fig. 4). MTA was the material of choice because among other advantages, this biomaterial promotes an effective marginal sealing, which minimizes substantially the risk of recontaminations.

For internal filling and remodeling of the destroyed bone structure, a mixture of human lyophilized bone (a material with osteoinductive potential) and calcium sulfate (an osteoconductive material) was used in an attempt to stimulate the conversion of progenitor cells into bone-forming cells. Thereafter, calcium sulfate alone was used as a load material aiming at the reconstruction of the original bone architecture of this region (Fig. 5).

After the mucoperiosteal flap was repositioned, 2 types of sutures were placed. The first was a conventional suture for fixation of the flap; the second suture was necessary to join the alveolar mucosa that had been torn as a result of the infectious process that origi-

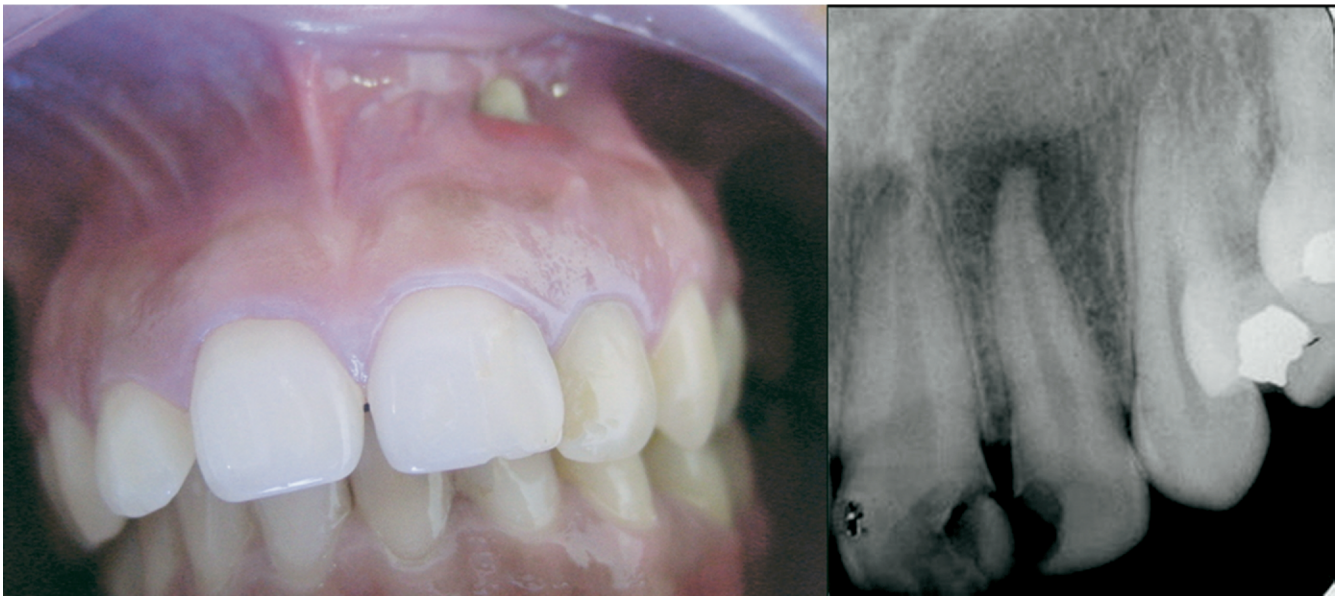

Figure 1. Exposed apical root third observed during clinical examination, and periapical radiograph showing a large radiolucent area surrounding the tooth apex.