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Case Report

Intentionally Replanted Tooth, Biomaterials and Bone Regeneration

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ABSTRACT

Introduction: The main reason of endodontic failure is the persistence of bacteria and their by-products within root canal system. Intentional replantation has been defined as the introduction of a tooth into its alveolus after the same tooth has been extracted for accomplish a specific treatment. This procedure is considered a valuable alternative for avoid tooth extraction and subsequent tooth implant placement, keeping natural dentition and beneficial low cost-effectiveness for patients. Biomaterials such calcium silicates are very popular in endodontics due to outstanding physical and chemical properties stimulating cellular response and tissue regeneration. However, more research and clinical trials are necessary worldwide to evaluate more deeply its cellular interaction and long-term outcomes on apical periodontitis treatment.

Objective: To report a clinical case of intentional replanted second mandibular molar using calcium silicate cement as root-end filling material.

Case Report: A 55-year-old Hispanic/Latino female patient attended the School of Dentistry, Endodontic Department at University of Buenos Aires with symptoms of persistent apical periodontitis on her second left mandibular molar. Tooth was intentionally extracted, resected 3 mm in its apical part and a Class I cavity was completed with ultrasonics tips and high-speed burs. Root-end filling was performed with calcium silicate cement and the tooth was intentionally replanted again.

Conclusion: Intentional replantation procedures can be a valuable option for teeth diagnosed with persistent apical periodontitis. In addition, calcium silicate cements are advantageous materials for root-end filling due to biocompatibility.

Keywords

Intentionally replanted teeth, Calcium silicate biomaterials, Angiogenesis, Bone regeneration.

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Introduction

The primary objective of endodontic procedures is to avoid or treat pulpal/periradicular pathosis conserving natural dentition. However, after endodontic treatment, success is not assured and persistent apical periodontitis can take place producing different levels of pain or discomfort in patients. Intentional replantation techniques were reported in the literature since 11th and 18th centuries and its effectiveness was widely criticized. This procedure is considered a valuable resource when nonsurgical or surgical treatment is not feasible and tooth extraction is indicated. In addition, cost-effectiveness of procedures in intentional replanted teeth are more favorable over implants. Some research studies revealed low risk of ankylosis or external root resorption after this kind of procedures. Other reasons for teeth intentional replantation are mandibular canal location, complex anatomy, extruded materials, cyst or compromised perforations [1,2].

The excellent biocompatibility and apical seal features of calcium silicate biomaterials make it the first option against persistent apical periodontitis and stimulation of bone regeneration. Some studies have shown that Ca and Si ions are determinant in promoting osteogenesis and proangiogenesis. Their biocompatibility, biodegradability and bioactivity features stimulate proliferation and differentiation of osteoblastic cells. Calcium silicate biomaterials promote proangiogenic activity developing Si and Ca ionic dissolutions in a physiological environment [3,4]. However, cellular adhesion and subsequent cellular response of calcium silicate biomaterials should be more analyzed in the future.

In this clinical case, calcium silicate cement was the choice for root-end filling material due to its antibacterial properties and supporter of bone regeneration.

Case Report

A 55-year-old Hispanic/Latino female patient arrived to the Endodontics Section in the School of Dentistry at University of Buenos Aires complaining pain and discomfort in her lower left mandibular region. The patient's medical history was insubstantial and clinical inspection revealed a full crown restoration and sinus tract on the buccal gingiva; tooth probing was within normal limits and test to percussion (vertical) were positive (figure 1). Preoperative periapical radiograph of the tooth showed a long and wide cast post in the distal root and considerable radiolucency in apical zone (figure 2). The tooth was diagnosed with persistent symptomatic apical periodontitis and patient signed informed consent after agreement of treatment. Two operators and two dental assistant were assigned to perform the treatment.

Figure 1: Pre-operative image.

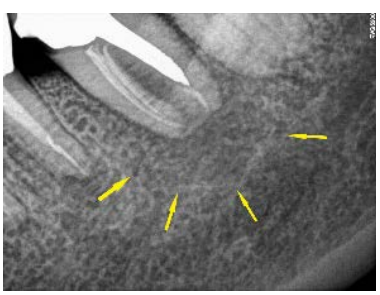

Figure 2: Preoperative radiograph.

Local infiltration anesthesia (4% carticaine and 1:100.000 adrenaline) was administered to the patient to block the mental nerve, additionally buccal and lingual side also were anesthetized. After careful tooth extraction with forceps, avoiding any risk of fracture and minimizing the injury to the periodontal ligament (PDL), the tooth was inspected under dental operating microscope to determinate any additional foramen, root fracture, isthmus, etc. PDL cells are a key factor in the healing process (figure 3).

Figure 3: Tooth inspection.

Root resection was completed using a high-speed handpiece and cylindrical bur to remove apical ramifications and lateral canals (figure 4). C-shaped root canal configuration was noticed although previously suspected radiographically (figure 5). Class I cavity with at least 3 mm in depth was performed with ultrasonic tips and bur avoiding excessive pressure for potential fractures (figure 6,7).

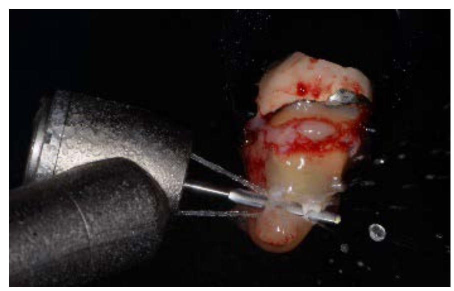

Figure 4: Apical root resection.

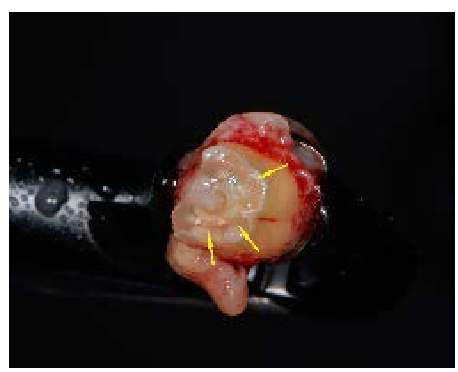

Figure 5: C-shaped root canal configuration.

Figure 6: Class I cavity with ultrasonic tips.

Figure 7: Class I cavity revision with bur.

Calcium silicate cement was the choice for root-end filling material due to biocompatibility and sealing ability promoting precipitation of apatite crystals on dentinal surfaces (figure 8). The tooth was then replanted again in its own alveolus in axial direction and using digital pressure around the socket to get more adjustment between tooth root and walls (figure 9). Occlusion was adjusted and a postoperative periapical radiograph was taken to observe the tooth stability into the alveolus (figure 10).

Figure 8: Calcium silicate cement application.

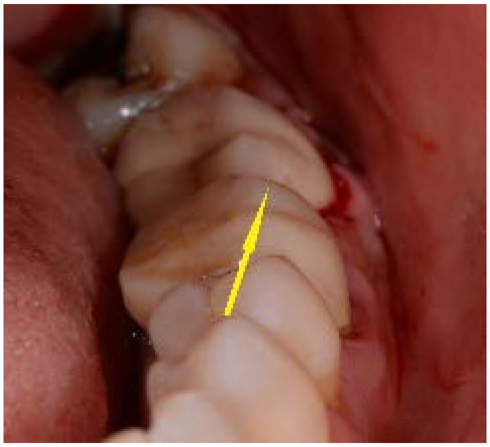

Figure 9: Tooth replanted.

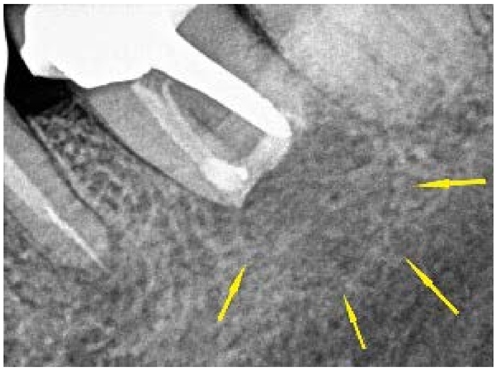

Figure 10: Immediate post-operative periapical radiograph.

Patient returned after 14 months and clinical examination revealed probing within normal limits, no mobility and no tenderness to percussion; the patient was fully asymptomatic. Post-operative radiograph examination showed complete resolution and bone regeneration around the apex. Continuous PDL space around the root also was observed (Figures 11,12,13).

Figure 11: Clinical partial occlusal view.

Figure 12: Clinical buccal view after 14-months re-call.

Figure 13: Periapical radiograph after 14-month re-call.

Discussion

Bone is mineralized connective tissue containing cell populations and is under structural reorganization trough long-life. It gives mechanical support to muscles and joints, is also an active shield of vital organs and regulator of minerals storage. There are four type of cells involved in bone remodeling process: osteoblasts and osteocytes of mesenchymal origin, and osteoclasts and osteal macrophages, which are of hematopoietic origin [5]. The cells in control of bone regeneration are osteoblasts derived mainly from mesenchymal cells. Osteoclasts are multinucleated cells responsible for bone resorption; these cells are originated from hematopoietic progenitors in the bone marrow.

Bone homeostasis is closely related to chronic inflammation. Cytokines such as lymphokine, monokine, chemokine and interleukin plays an essential role in preserving bone balance, enhancing cellular migration and developing angiogenesis process favorable for bone regeneration [6]. Interleukins 1 beta (IL-1 β), 6 (IL-6) and 17 (IL-17), and tumor necrosis factor alpha (TNF-α) are the most important stimulators of osteoclastogenesis, promoting osteoclastic differentiation and bone resorption [7]. Osteoclastogenesis is the differentiation process of monocytes into osteoclasts. These cells increase the resorptive activity in bone under pathological conditions. Osteoclast differentiation is moderated by immune cells through blocking RANKL signaling and osteoprotegerin (OPG) which is regulator of osteoclastogenesis [8].

Biomaterials can interact at cellular level enhancing the environment for tissue regeneration activity inducing pro-regenerative immune response. There is an increase in fibrinogen scaffolds and cell infiltration interacting with monocytes, therefore chronic inflammation is reduced. Thus, the human body replies with lines of defense resisting bacteria and any other particular offender [9]. Some agents, such as bacteria Gran negative, trauma, heat or other different causes, can trigger an inflammatory response activating the immune system. Immune cells such as neutrophils, release antimicrobial substances, cytokines, growth factors and proteases avoiding bacterial proliferation and migration of more neutrophils and macrophages. Inflammation stimulate Mesenchymal stem cells (MSCs) to release cytokines which impact on different types of T cells (from immune system) promoting releasing of more cytokines, necessary for bone balance and regeneration but also stem cell recruitment and differentiation [6,10]. Physical properties of ceramic biomaterials activate undesirable inflammatory responses promoting bone tissue repair. Furthermore, some studies revealed that immunomodulatory reaction is based on particle size, chemical compositions and dosage of the osteoconductive materials. Nano-sized hydroxyapatite particles revealed lower pro-inflammatory immune cell population and cytokine level compared to micro-sized hydroxyapatite, stimulating bone regeneration by increasing anti-inflammatory cytokine level [11].

Conclusion

Intentional replantation procedures are an alternative when nonsurgical or surgical endodontic treatment are not feasible in the elimination of pathosis within root canal system. Additionally, cost-effectiveness and predictable outcomes using calcium silicate biomaterials, makes this therapy a valuable option for persistent symptomatic apical periodontitis treatment. Biomaterials can foster angiogenesis activation and bone cells proliferation, which are contributory factors in tissue regeneration assisting to the patient keeping their natural dentition.

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