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Treatment of Maxillary Bone Cysts with Addition Materials

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ORIGINAL ARTICLE

Abstract

Objective. The aim of this study was to follow the bone healing in the cavities left by the enucleation of large odontogenic cysts.

Material and method. They were taken into study 12 patients with odontogenic cysts in the jaws. Cystectomy with resection or extraction of the causal teeth was used as a surgical procedure. In the cavity resulting from the excision of the membrane and the curettage of the bone walls, hydroxyapatite mixed with β-tri-calcium phosphate and platelet-rich plasma obtained by centrifugation of autologous blood was applied.

Results. The postoperative evolution was generally very good, with moderate edema of the skin that reached maximum intensity at 48 hours.

Conclusions. Both hydroxyapatite and tricalcium phosphate are relatively inexpensive, safe and very well tolerated materials. Platelet-rich plasma obtained from the patient's blood is used as a supplement to other materials.

Keywords: odontogenic cyst, hydroxyapatite, tricalcium phosphate, platelet-rich plasma

I. INTRODUCTION

Augmentation and addition materials can be used to restore bone lost from surgical treatment of odontogenic cysts. Bone substitutes will be classified in two main categories: bone substitutes derived from biological products and synthetic bone substitutes.

In order to be used for augmentation or addition, biomaterials must meet several conditions: biocompatible, bioresorbable, osteoconductive, osteoinductive, structurally similar to bone, porous, mechanically resistant, easy to use, safe, and cost-effective [1-4]. Three different mechanisms are incriminated in bone augmentation. These are: osteogenesis (represents bone shape and development), osteoinduction (represents the process of stimulating osteogenesis) and osteoconduction (provides a physical matrix or a support for the deposition of new bone).

The most commonly used materials as a bone substitute are ceramic materials, synthetic calcium phosphate ceramics (hydroxyapatite or tricalcium phosphate), as well as calcium or coral carbonate. The mechanism of action of these materials is based on osteoconduction, the bone formation taking place along their surface. These materials are used for the reconstruction of bone defects, providing support for tissue repair and bone growth. Alloplastic materials and xenografts are available in a wide variety of granulations, textures, sizes and shapes [2,5,6].

Hydroxyapatite (HA) (Ca10(PO4)6(OH)2) is the primary inorganic component of teeth and bones, and has a high degree of biocompatibility and readily adheres to soft and hard tissues [3]. Bovine-derived hydroxyapatite is an excellent replacement for autogenous bone grafts. The physical and chemical properties of hydroxyapatites determine their resorption rate and clinical applicability: larger particles resorb over a longer period of time and consequently persist longer in the augmented area. The higher the porosity of the material,

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the better it provides support for the newly formed bone and the faster it is resorbed. The more crystalline the graft, the lower the resorption rate. So amorphous grafts resorb faster than crystalline ones. The solid and dense blocks of hydroxyapatite have an increased resistance to compression, but they are friable, so they are not indicated in areas where they will receive an excess of forces. A general disadvantage of porous ceramic materials is that the strength is inversely proportional to the porosity. Hydroxyapatite particles of about 1mm diameter are used mainly for augmentations of the alveolar ridge, but at the same time adhere extremely well to the underlying bone structures. [2,5-7]. HA is extremely biocompatible and does not promote an inflammatory response [8-11].

β-tri-calcium phosphate (β-TCP) (Ca3(PO4)2) it is similar to hydroxyapatite, but it is not a natural component of the bone structure, being partially transformed into crystallized hydroxyapatite. The rate of resorption of tricalcium phosphate is varied and depends to a large extent on the chemical composition, structure, but also on the porosity and particle size. Like other materials used for augmentation, tricalcium phosphate is biocompatible [12,13], bioresorbable [3,14-17], osteoconductive [12,18-20] and form a matrix that promotes bone apposition.

Biphasic calcium phosphate (BCP) belongs to a group of bone substitute ceramics biomaterials that consist of an intimate mixture of HA and β-TCP ceramics, of varying HA/ β-TCP ratios. BCP is obtained when a synthetic or biologic calcium-deficient apatite is sintered at temperatures at/and above 700 ºC.

Platelet-rich plasma (PRP) is generally used as a gel obtained from the patient's blood [3]. Blood is centrifuged through gradient density, and the resulting blood platelets are mixed with thrombin and calcium chloride [21]. PRP contains a high concentration of platelets and fibrinogen, as well as growth factors: platelet-derived growth factors (PDGF), vascular endothelial growth factor (VEGF), insulin-like growth factor (IGF) and transforming growth factor (TGF) [21-25].

Aim and objectives

The aim of this study was to follow the bone healing in the cavities left by the enucleation of large cysts, with the help of addition materials based on HA with mixed granulation (0.4mm-1.2mm) mixed with β-TCP and plasma factor PRP.

II. MATERIAL AND METHODS

They were taken into study 12 patients with odontogenic cysts in the jaws. Cystectomy with resection or extraction of the causal teeth was used as a surgical procedure. In the cavity resulting from the excision of the membrane and the curettage of the bone walls, HA with mixed granulation (0.4 mm-1.2 mm) mixed with β-TCP and PRP obtained by centrifugation of autologous blood was applied. In some cases, isolation from the oral environment was achieved by applying non-absorbable titanium membranes.

Case I: cyst of the left hemimandible with the interest of teeth 33-36 and the mesial roots of 37 (Figure 1). Preoperatively, endodontic treatments are performed on teeth 33-35 and 37.

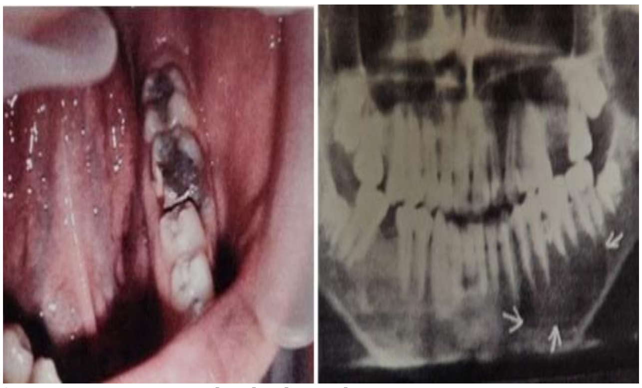

Figure 1. Case I - intraoral and radiographic aspect

Under general anesthesia and nasotracheal intubation, a trapezoidal incision is made with a small base placed at the free edge of the gum from 33 to 37, and two oblique incisions, divergent towards the bottom of the vestibular groove. The mucoperiostal flap is taken off, the vestibular bone plate is drilled on an area of approximately 4 cm, the roots of teeth 33-35, 37 are resected and the extraction of the molar 36 is performed.

After curettage of the bone walls, the wound toilet and hemostasis, HA is introduced with mixed granulation (0.4mm-1.2mm) mixed with β-TCP and plasma factor PRP, which is isolated from the oral environment with a titanium plate over the alveolus of 36, immobilized with a titanium staple applied to the vestibular cortex (Figure 2). This has the role of directing the healing process and promoting the regeneration of bone tissue, preventing the formation of fibrous tissue that has a speed of formation about 10 times faster than bone.

Figure 2. Case I - fixing the titanium membrane

Case II: swelling of the right hemimandible in region 44-48. At the OPT radiological examination, a radiolucent formation of 6/2 cm is visualized, which includes the root of 45 and descends to the vicinity of the mandibular canal which it moves inferiorly, but does not interrupt the basilar edge, which has a thickness of 2-3 mm (Figure 3).

Figure 3. Case II - intraoral and radiographic aspect

After endodontic treatment at tooth 45, cystectomy was performed by filling the bone cavity with HA+β-TCP+PRP (Figure 4)

Figure 4. Case II - filling the bone cavity with HA+β-TCP+PRP

Case III: Swelling in the left upper vestibule in the apical region 21-23, with slightly congested mucosa. The OPT radiological examination reveals a radiolucent formation of almost round shape, with a diameter of 15 mm, which borders the left nasal fossa. The diagnosis of odontogenic cyst with starting point 22 is made (Figure 5).

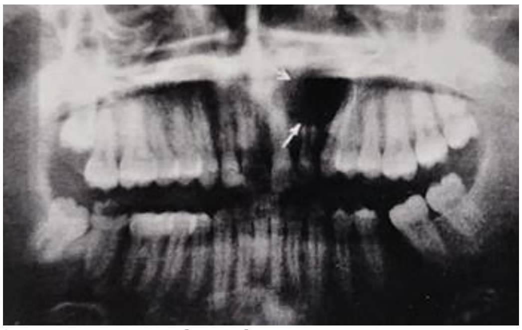

Figure 5. Case III - radiographic aspect

The cystectomy was performed (Figure 6) and the membrane was sent for histopathological examination. The apexes of the teeth 21-23 are resected and the intraoperative endodontic treatment is performed. In the bone defect, mixed granulation HA, β-TCP and PRP are applied, the mucoperiosteum slides over the remaining cavity and is sutured in several points with non-absorbable materials.

Figure 6. Case III - cystectomy, intraoperative aspect

III. RESULTS AND DISCUSSION

RESULTS

The postoperative evolution was generally very good, with moderate edema of the skin that reached maximum intensity at 48 hours. In most cases, treatment with Amoxicillin 2g / day, 7 days, was indicated, and the wires were suppressed at 10 days postoperatively.

Patients developed afebrile except for one case that showed an increase in temperature at 38-39ºC for 5 days. Drainage was performed by applying a drain tube, washing with weakly antiseptic solutions (chloramine 1%, chlorhexidine 0.6%) and antibiotic therapy until the wires were removed.

The cases were followed postoperatively at 1, 3 and 6 months, both clinically and radiologically. The good integration of the biomaterials used in the addition of the bone substance was found (Figures 7,8).

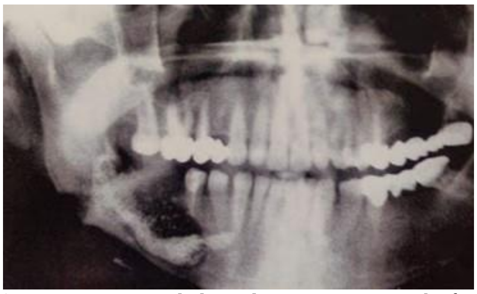

Figure 7. Case II - radiological appearance 1 month after treatment

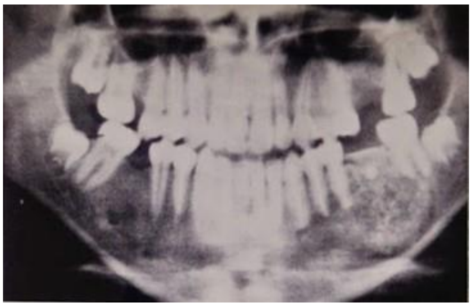

Figure 8. Case I - radiological appearance 6 months after treatment

DISCUSSION

PRP should have procoagulant effects due to platelets, but there is insufficient evidence in the literature of the benefits of adding PRP to accelerate bone healing [22,23,26]. PRP has infectious risks and side effects limited by its origin (autologous blood), but does not show mechanical strength and is not validated as an independent bone substitute [3,26]. PRP is used as a supplement to other materials [21,27-29].

Tricalcium phosphate can be used in combination with other osteogenic and osteoconductive materials to improve handling and facilitate the adaptation of bone transplantation. β-TCP is mostly used in association with HA [3,4,14,30-32]. This association presents all the advantages of its two components: biocompatibility, osteoconductivity, promotion of bone formation, nonallergen and safe use [14,29,33-37].

Biphasic calcium phosphates (HA and β-TCP ceramics) have the advantage that concerns their resorption: the resorption of β-TCP is faster than the resorption of HA, but mechanical properties of HA are slightly better than βTCP's [30,38,39].

In an in vivo study, the histopathological evaluation showed that the use of HA+β-TCP granules has properties to cure the segmental defect of the femur in rats [40].

β-TCP and PRP are commonly used in bone augmentation. As early as 1995, Slater et al. revealed that PRP was able to promote the proliferation of osteoblasts in vitro [41]. β-TCP granules represent a scaffold serving for the anchorage of bone by osteoblasts at the surface of the granules associated with a direct resorption by mononucleated macrophages and osteoclasts [42].

The use of autogenous bone grafting is a gold standard, difficulties with the limited amount of autogenous bone and frequent morbidities and local complications are another major obstacle. Therefore, research in the field of bone addition based on the development of promising alternatives for autogenous grafting, such as the use of scaffolds (HA+β-TCP), growth factors and stem cells [43], is encouraged.

IV. CONCLUSIONS

Both hydroxyapatite and tricalcium phosphate are relatively inexpensive, safe and very well tolerated materials. Platelet-rich plasma obtained from the patient's blood is used as a supplement to these materials.

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