Use of Concentrated Growth Factor (CCGF) in Reconstruction on Two-Wall Bone Defect After Cystectomy, An Alternative to Traditional Regeneration- Case Report

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Abstract

Aim: The purpose of this clinical case report was to describe an alternative technique performed to ensure bone regeneration after removing a cystic lesion in the upper jaw. Bone defect after cystectomy was filled with autologous fibrin rich clots containing CGF. **Materials and methods:** A 45 years old female patient was suspected to have a cystic lesion with massive bone destruction on the vestibular and palatal walls between teeth 2.2 and 2.3. Concentrated growth factor (CGF) was used to cover the defect in order to favourite the bone grow. **Results:** After 12 months, the clinical and radiological follow-up examination showed that the tooth was asymptomatic and that the healing was in progress. **Conclusions:** this article describes a different way to

treat a two-wall defect involving both the palatal and buccal bone, after removing a cystic lesion, with the use of CGF as an alternative to traditional use of autologous or heterologous bone. CGF fibrin could promote new bone formation in jaw defects, with benefit to the healing of bone tissue and, thus, is a promising bone repair material.

Keywords: jaw cysts; platelet-derived growth factor; CGF

Introduction

Bone regeneration processes are highly dependent on the range and extent of the defect, provided that coagulum formation process is not impaired. The average healing time of small cystic defects is usually up to one year, while healing time extends with the size of a defect, ranging from two to five years for medium-size and large cysts [1]. After removal of cystic sac and closing the wound primarily, the bone defect is filled entirely. The initial blood clot formation is followed by clot retraction and serum extrusion, this producing peripheral serum-filled spaces between bony wall and coagulum surface. This significantly interferes with protrusion of vascular epithelium and the healing process. On the other hand, the space formed by the removal of dental cysts usually provides favourable conditions for microbial growth and a risk of infection. Therefore, stabilization of blood coagulum and preservation of primary healing has been accomplished by several methods, such as autotransplantation, allotransplantation, xenotransplantation, or application of autologous platelet concentrate (APC) and concentrated growth factor (CGF) procedures [2]. Growth factors are proteins, which regulate complex processes during wound healing. Growth factors are mainly located in blood plasma and platelets, and perform an important role in cell migration, cell proliferation and angiogenesis during bone regeneration[3]. Most important and representative growth factors are: platelet derived growth factor (PDGF), transforming growth factor (TGF), vascular endothelial growth factor (VEGF), epidermal growth factor (EGF) and insulin like growth factor 1 (IGF 1) [4,5].

The first generation of platelet concentrates are Platelet Rich Plasma (PRP) and Plasma Rich in Growth Factors (PRGF). PRP and PRGF require chemical additives, such as anticoagulants and thrombin or calcium chloride, to induce fibrin polymerization before applying to the surgical site. Platelet rich fibrin (PRF) and concentrated growth factors (CGF), as second generation of platelet concentrate, utilize patient's venous blood alone to trigger platelet activation and fibrin polymerization.

Concentrated GF (CGF) was developed by Sacco in the year 2006[6].

CGF is a therapeutic protocol that shows higher tensile strength, more growth factors, higher viscosity and higher adhesive strength than PRF. The use of autologous fibrin

does not cause any side effect and it is a safe and simple procedure for a specialist, and inexpensive and efficacious for the patients[1].

Concentrated growth factor is mainly used in bone regeneration[7].

CGF fibrin could promote new bone formation in jaw defects, with benefit to the healing of bone tissue and, thus, is a promising bone repair material. A variable-speed centrifugation strategy with physical acceleration and deceleration, at constant temperature, was used to fully activate alpha-granules in platelets and produce autologous blood products enriched with greater concentrations of growth factors compared with PRF and hematopoietic stem cells (CD34+ cells)[8].

CGF acts by degranulation of the alpha granules in platelets which play a vital role in early wound healing[9]. It has been found that CGF contains more GFs than other platelet-based preparations such as platelet rich fibrin (PRF) and platelet-rich plasma (PRP), and unlike PRP, CGF does not dissolve rapidly following application[10].Qin et al. proved that CGF could release GFs for at least 13 days[11].

Material and Methods: Case Report

A female 45 years old, was presented with pain and swelling in the anterior upper jaw region. Clinical examination revealed swelling in the lower vestibule, painful and fluctuant to palpation. The mucosa above the swelling was regular in colour and moisture.

Subsequent to the clinical examination, orthopantomography (OPT) and Cone Beam Computed Tomography (CBCT) scans were taken, showing a clearly demarcated oval radiolucency, localized in the anterior region of the upper jaw (Fig. 1), and indicating massive bone destruction on the vestibular and palatal walls between teeth 2.2 and 2.3.

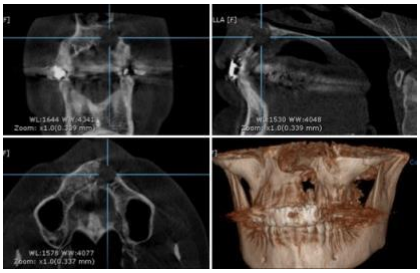

Fig. 1 pre-operative CT scan

Preoperatively, the patient was fully informed about the surgical protocol and personally signed and dated the consent form before treatment. A prophylactic oral antibiotic (Augmentin 1 g.) was used, beginning one day prior to the procedure and continuing for five days postoperatively. Before the surgery, the patient rinsed her

mouth with an antiseptic mouthwash containing 0.2% chlorhexidine digluconate to reduce the risk of contamination of the surgical field. Under local anesthesia a vestibular triangular flap access was made, with one horizontal incision and one vertical incision, the latter located distally to tooth 1.1 Endodontics on 2.2 was done 1 week earlier (Fig. 2).

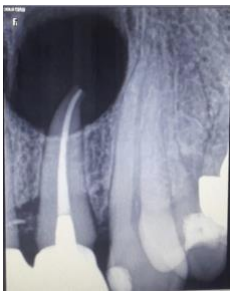

Fig 2 periapical rx on #22 taken after root canal therapy

A full thickness flap was elevated and it was irrigated continuously to prevent dehydration of the periosteum. Following flap elevation, evidence of buccal bone fenestration was clearly detected. Following cystectomy, root resection of the affected tooth 2.2 was done (Fig. 3). The resulting bone defect was restored by placing *two fibrin-rich blocks* with CGF, which completely filled the bone cavity.

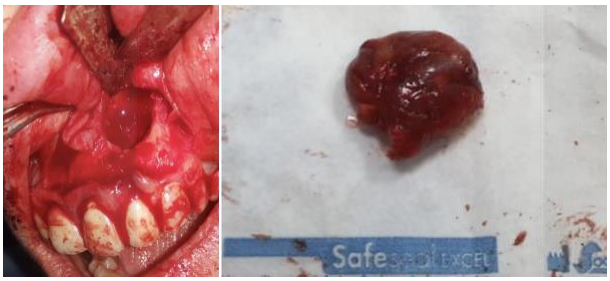

Fig. 3 Resulting bone defect after cystectomy

20 CC of patient's peripheral venous blood was taken from patient's vein, and was used to fill 2 tubes (without anticoagulant) each of 10 mL. The CGF was prepared following the instructions provided by the manufacturer (Silfradent, Medifuge MF200, Italy).

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The tubes were placed at the two opposite sides of the centrifuge and immediately centrifuged in the following manner: 30'' acceleration, 2' 2700 rpm, 4' 2400 rpm, 4'

2700 rpm, 3’ 3000 rpm, 36’’ deceleration until end. At the end of the procedure, four layers are obtained from bottom to top: RBC layer, GF and stem cell layer (CGF), Buffy coat layer, serum layer (PPP). The CGF layer is separated using sterile surgical scissors (Fig. 4). The CGF clot is then squeezed in a special box at a thickness of 1 mm. The CGF is then placed over the target site.

Fig. 4 Preparing CGF

In order to mobilize the flap and facilitate its repositioning, periosteal incisions were performed, releasing muscle tension. The reflected tissues were then replaced into their original position (Fig.5) and sutured with a resorbable 5-0 suture (Ethicon Inc., Piscataway, NJ, USA). After surgery, the patient was advised to avoid mouth rinsing, hard and hot food, hot drinks, heavy physical work, and tooth brushing on the day of surgery. The patient was instructed to rinse his mouth twice daily with 0.2% chlorhexidine digluconate for plaque control up to 10 days after surgery.

Non-steroidal analgesics (ketoprofen) were prescribed for pain relief if needed and steroidal ones (Bentelan 1mg cp), with decreasing dosage were prescribed after the surgical procedure, for swelling control if needed. Sutures were removed seven days after surgery. After 12 months of follow-up, the tooth was asymptomatic on clinical examination and a radiographic evaluation showed that healing was in progress.

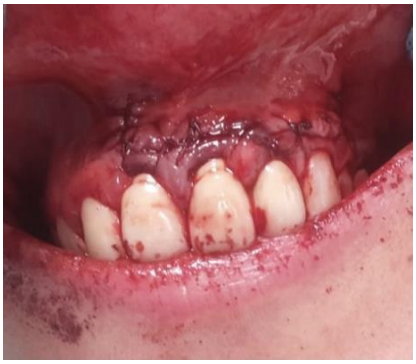

Fig. 5 after surgery

Results

CGF contains high concentrations of platelets, large amounts of fibrinogen, various growth factors, and CD34+ cells. New bone tissue, of satisfactory quality (density) and quantity, is formed within 12 months, and it's associated with minimum postoperative complications (Fig.6).

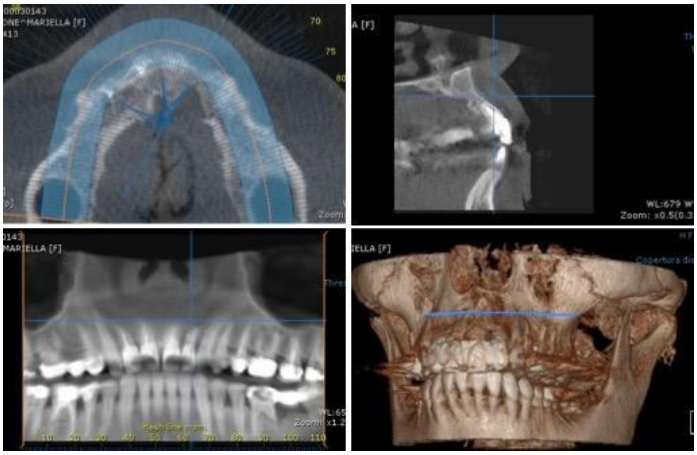

Fig. 6 post-operative CT scan

Conclusion

Moreover, the procedure is economically acceptable to the patient. CGF was applied to the bone defect area of the jaw, and 2 biochemical indicators, (osteocalcin and BAP) were used to clarify the concentration of the growth factor fibrin. BAP is an osteoblast marker active in the process of bone tissue repair.18,19 Osteocalcin is a bone matrix protein synthesized by osteoblasts. BAP and osteocalcin both reflect the osteogenesis status of osteoblasts.20 Increased levels of osteocalcin promoted bone healing in the patients with jaw fracture and bone defects. CGF might have both osteoconductive and osteoinductive capabilities and constitute a complementary functional repair material that is highly biocompatible and allows cells to secrete a variety of specific proteins that promote bone formation. Thus, CGF would have the dual abilities of bone guidance and osteoinduction. Histologic observations showed that more preosteoblasts and osteoblasts were seen in the CGF group 4 weeks after surgery. Also, more new bone tissue was present in the CGF group than in the control group, which could have been related to the high concentration of growth factors released by CGF.

The CGF membrane was placed in the defect in the jaw bone, and the released growth factors guided the body's undifferentiated mesenchymal cells to chemotaxis, adherence, and differentiation to the surface of the bone defect, relying on fibrinogen and other biologic materials as scaffolds to gradually proliferate, mineralize, and fuse the bones to achieve the goal of new bone formation. At 8 weeks postoperatively, a large number of flaky new bone formation was observed in the CGF group. In contrast, the new bone area in the control group was small.

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