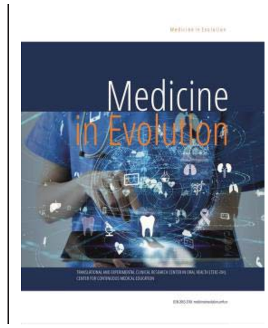
Augmentation of the Mandibular Alveolar Ridge Using Khoury Technique – Case Presentation



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Abstract

Implant-prosthetic rehabilitation of edentulous patients with various forms of bone atrophy represents a challenge in oral implantology. The long-term success and stability of dental implants is directly dependent on the quality and quantity of the supporting bone and surrounding soft tissue. When bone volume is inadequate for implant placement, a variety of bone augmentation techniques and materials can be used. Autogenous bone augmentation, autograft, is considered the gold standard in bone grafting, due to its biocompatible, osteoconductive, osteoinductive and osteogenic properties. The technique of obtaining autografts from the mandibular retromolar area is also called the Khoury technique or the split bone block technique.

Keywords: Bone atrophy, implant, autograft, Khoury technique

INTRODUCTION

The use of dental implants has increased in restorative dentistry due to high success and survival rates. They replace missing teeth or provide retention and support for dentures. In recent years, 3D-guided and computer-assisted implant surgery has become increasingly used, with the placement of osseointegrated dental implants becoming a frequent clinical intervention in dental practice [1-4].

Due to atrophies or bone defects in the jaw and mandible, it is often difficult to place the implant. In these clinical situations, bone grafts and substitute materials play a vital role in restoring the bone. These are biomaterials used to replace bone defects and to recover atrophied bone regions [5].

Classification of bone grafts and bone substitute materials used in dentistry is based on tissue source or material group (Figure 1) [6-8].

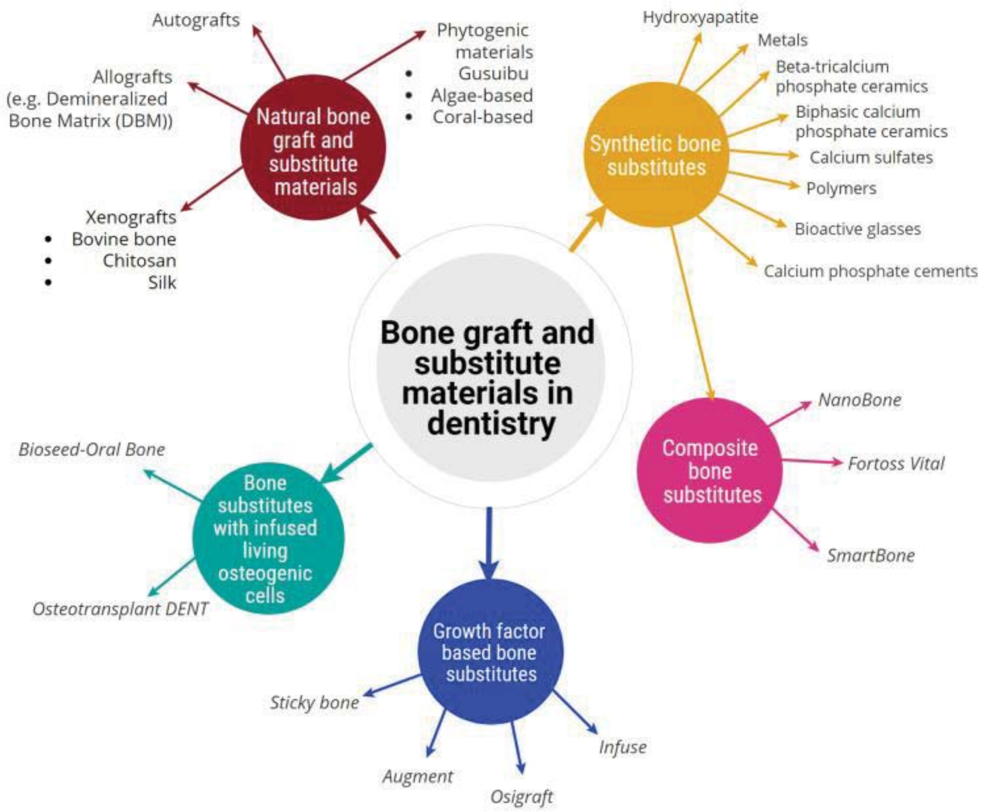


Figure 1. Classification of bone grafts and substitute materials used in dentistry [6]

Autograft, autogenous bone graft from the same individual, is considered the gold standard for bone grafting due to its biocompatible, osteoconductive, osteoinductive and osteogenic properties [9]. Autogenous grafting uses a combination of cancellous and cortical bone to increase bone remodeling performance and healing potential [10]. Cancellous bone has osteoinductive and osteogenic properties, allowing early revascularization and functional remodeling with low complication rates. The bone cortex ensures structural-mechanical integrity and bone healing through osteoconduction [6].

The disadvantages of autografts are: the need for a second surgery, morbidity at the donor site (bleeding, infection, inflammation, pain and the potential for scarring), higher therapeutic costs [7,8].

For complex augmentation procedures, such as posterior mandibular edentulous ridge reconstruction, autografts are the materials of choice because they can predictably increase the quality and quantity of bone, allowing the placement of implants with maximum diameters, thereby facilitating the distribution of forces, for long-term survival [11,12].

Autografts are commonly obtained from intraoral or extraoral areas such as mandibular symphysis, mandibular ramus, external oblique ridge, iliac crest, proximal ulna, or distal radius, which are good sources of cortical and cancellous bone [13]. Autograft harvested from the mandibular ramus is associated with fewer complications, with the risk of inferior alveolar nerve damage [14].

Bone augmentation using the Khoury technique involves the harvesting of a bone block from the mandibular retromolar area, the external oblique line, and the creation of cortical bone plates, with a thickness of 1 mm. With the help of these bone plates, the bone defect is reconstructed in 3D [15]. Thin cortical lamellae, as a rigid wall, are fixed with screws at a distance from the bone crest, and the space created is filled with bone sawdust and/or bone substitutes. The thin bone block prevents the transmission of movements caused by the mucosa to the graft, allows faster postoperative tissue adhesion (due to the autogenous nature of the graft) and inflammatory complications, as well as leads to obtaining a bone bed of higher quality than allogeneic or xenogeneic grafts. Another advantage of the Khoury technique is the fact that the donor area regenerates completely in case of reimplantation of half of the bone block in the original position [16].

MATERIAL AND METHODS

Patient R.D. aged 66, female, presented herself in the dental office for a specialist consultation. Anamnesis and exo- and endooral clinical examination were performed. The reason for the patient's presentation was the discomfort caused by halitosis and dental mobility at the level of teeth 3.5 and 3.8, abutment teeth of a metal fixed partial prosthesis. These teeth suffered from root caries, periodontal pockets and grade III tooth mobility. The first stage of the treatment proposed and accepted by the patient was the ablation of the prosthetic work with the extraction in the same session of the pillar teeth (3.5 and 3.8) after the prior hygiene of the oral cavity with descaling.

After 10 days the patient performed a CBCT investigation (Figure 2) at the level of the left mandibular hemiarch. On section 12 (Figure 2) at the level of the post-extraction alveolus of 3.5 the ridge has an adequate width. Posteriorly, the edentulous ridge begins to narrow drastically, on section 19 a width in the upper part of only 2 mm can be observed (which is insufficient to satisfy the principle that the implant body must be bounded vestibulo-oral by at least 1-1 .5 mm of bone). The height of the ridge is sufficient, around 10 mm while maintaining a distance of 1-2 mm from the mandibular canal and the lower alveolar vasculo-nervous bundle.

As a treatment option, after the patient's consent, bone augmentation using the Khoury technique was chosen, this being a more suitable treatment option for the clinical situation. One hour before the start of the surgical treatment, the patient was administered 2000mg of Augmentin.

A PRF membrane was prepared, obtained from the patient's blood (Figure 3). Venous blood was collected in test tubes (a membrane will result from each test tube) and placed in the centrifuge in symmetrical pairs to swing the centrifuge. Centrifuge for 12 minutes at 1400 revolutions per minute. Due to the contact of the blood with the wall of the test tube, the coagulation cascade is activated and at the end of the program we will have a coagulum in each test tube. The lower part, consisting of red cells, is removed and the upper part is pressed with a special tool so that the acellular plasma is removed from the clot (consisting of 95% platelets) and a thin, biological membrane is formed.

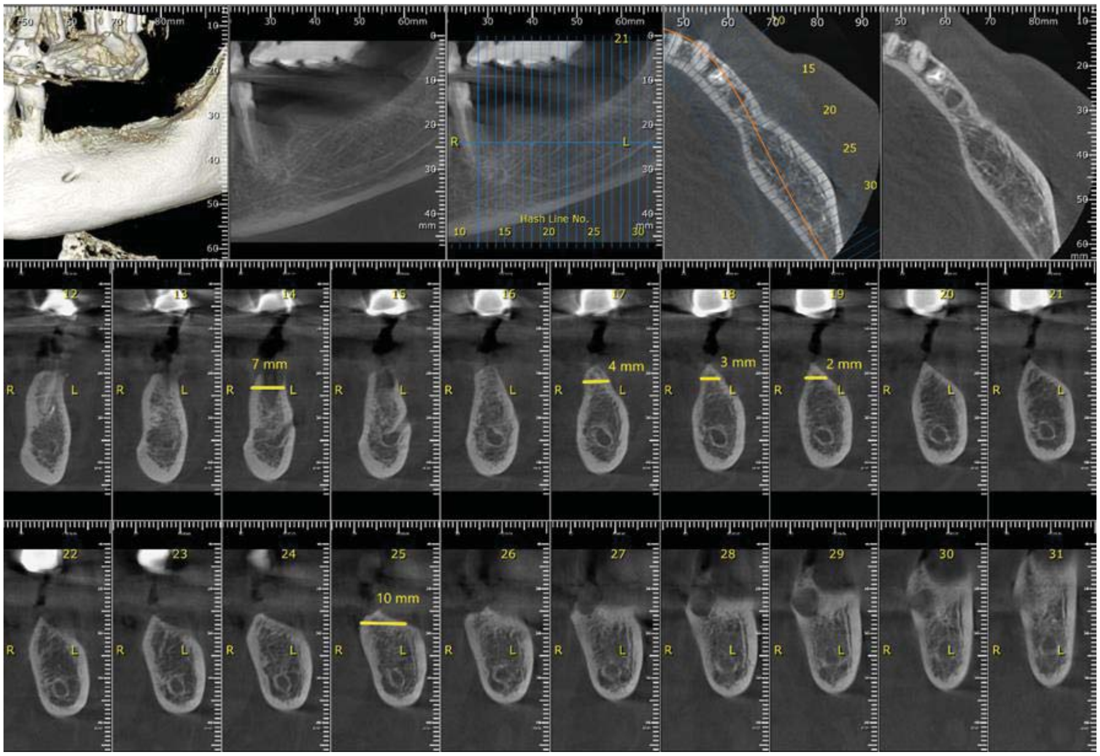


Figure 2. CBCT at the level of the left hemimandible

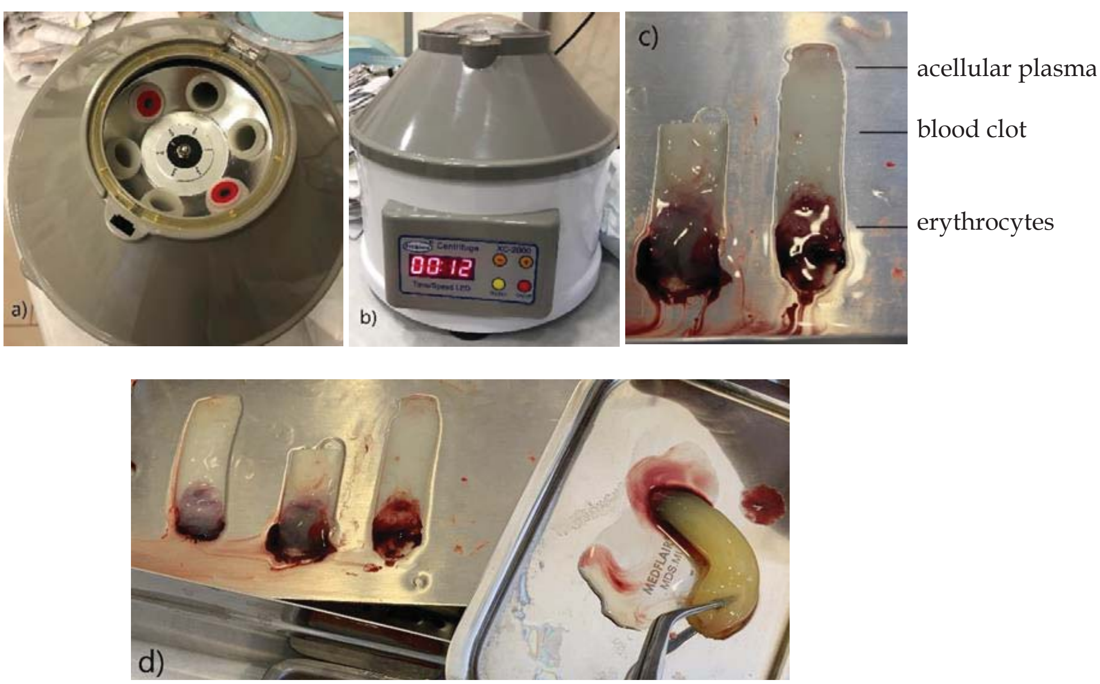


Figure 3. Preparation of the PRF membrane; a) Placing the test tubes symmetrically; b) Centrifugation for 12 minutes at 1400 RPM; c) Blood clots; d) Pressed PRF membrane

To anesthetize the surgical territory, 2 carpules of Ubistesin Forte (4% articaine with adrenaline 1/100,000) were administered through the Spix spinal anesthesia technique, supplemented with buccal nerve anesthesia.

A mucoperiosteal incision and detachment was made distal to the most posterior tooth and continued through the retromolar trigone to mid-height of the ascending ramus. It was completed posteriorly with an oblique unloading incision up to the buccinator muscle, and anteriorly with an incision in the vestibular sulcus at the level of the first premolar.

With a surgical piezotome, three osteotomies were made: two horizontal (superior and inferior) each with a length of approximately 8 mm and one lateral and vertical, approximately 20 mm, each osteotomy penetrating the cortex (Figure 4a). A fourth osteotomy line, medial and vertical, was highlighted with a bone bur penetrating approximately 2 mm, thus remaining in the cortex and creating a fracture line that facilitates graft removal.

The graft was removed with a surgical hammer and chisel (Figure 4b), acting along the fracture line. The thickness of the monobloc graft was approximately 1.5 mm.

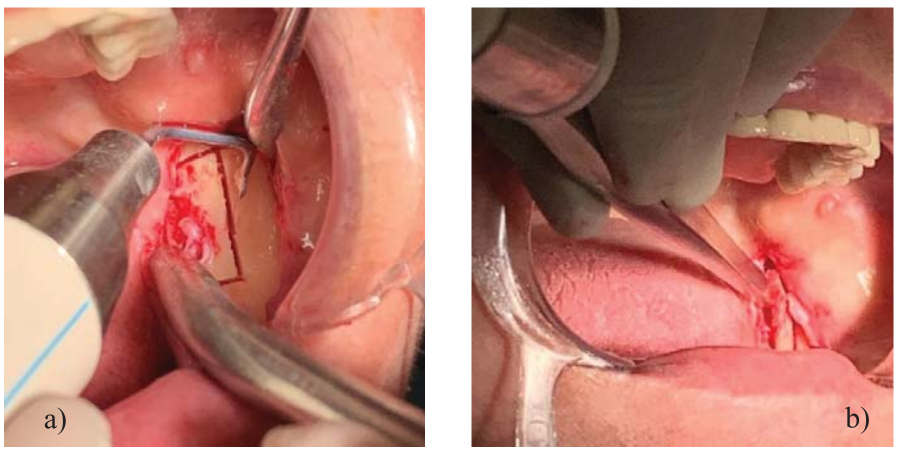


Figure 4. Harvesting the bone block; a) The three osteotomies performed with a piezotome; b) Removal of the block with a surgical hammer

A sufficient amount of bone particles (cortical bone and a small amount of trabeculated bone) was collected with a bone harvester/"safescraper" by scraping (Figure 5a).

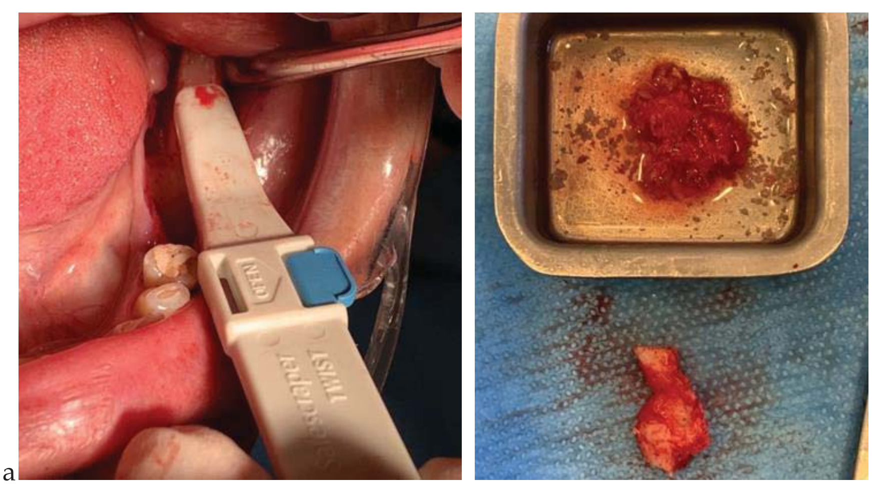
a  b

Figure 5. Harvesting bone particles; a) Cleaning the site with a "safescraper"; b) Bone particles (top) and bone block (bottom)

The donor site was covered with a PRF membrane obtained from the patient's blood.

After rounding the sharp edges and rounding the edges of the bone block, it was fixed at a distance of about 5-6 mm from the vestibular cortex of the donor site by means of two titanium screws (Figure 6), specially designed for bone augmentation by bone grafts (1.3mm x 11mm).

To the scraped bone particles was added the plasma (Figure 5b) removed after pressing the blood plugs in the manufacturing step of the PRF membranes. This is basically a physiological serum of its own, which mixed with the bone particles, will help to handle them more easily. The particles were condensed in the newly created space (Figure 7).

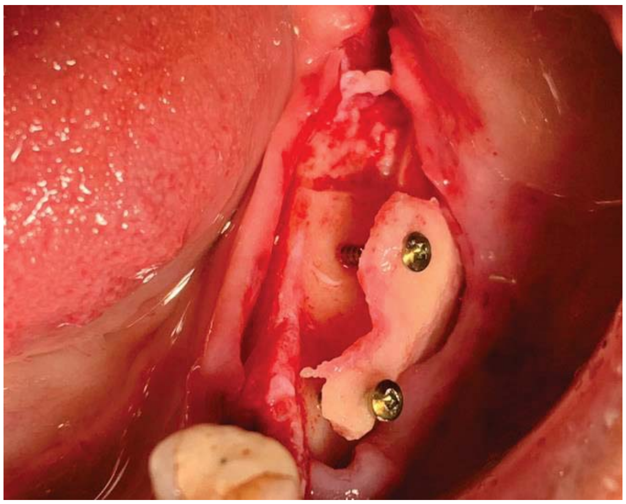


Figure 6. Bone block fixed in position

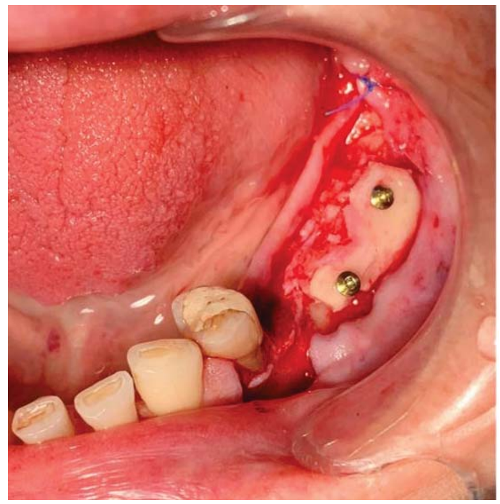
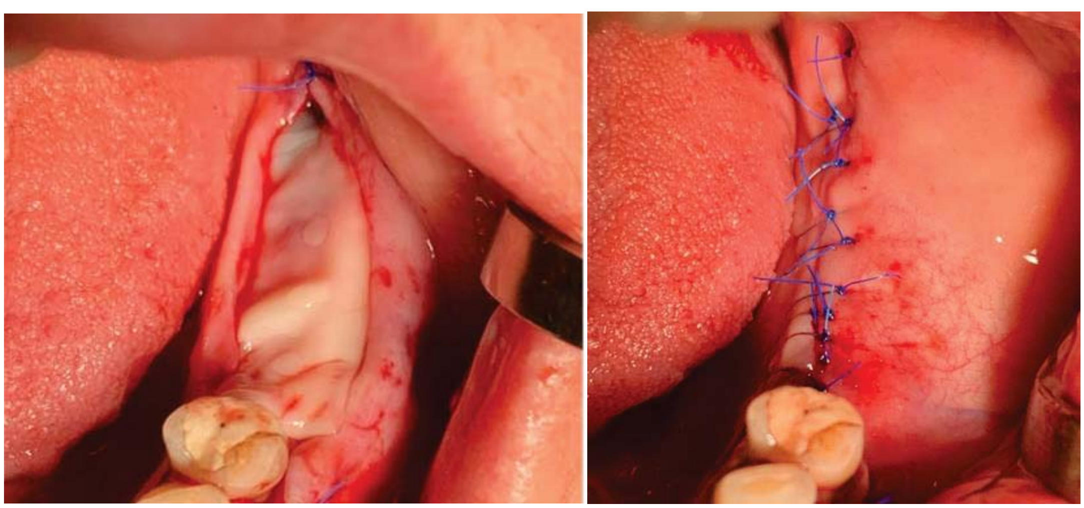


Figure 7. The space between the graft and the site donor, loaded with bone particles

After a periosteal detachment from the rest of the flap (for lengthening and detensioning) was performed, it was sutured at the anterior-superior key point to avoid tensioning the flap and its unsightly healing, the surgical site was examined, then covered with a pericardial membrane of bovine origin (Figure 8a), a barrier against connective and epithelial tissue, which will create a favorable environment for subsequent bone regeneration. The final suture of the flap is performed (Figure 8b).



a b

Figure 8. Final suture; a) Pericardial membrane above the surgical site; b) Suture line

RESULTS

After 5 months, a control CBCT was performed (Figure 9). It can be seen that the screws have engaged both cortices, giving excellent primary stability to the bone block. Criteria for graft survival were met: absolute immobilization, minimally invasive surgical technique, and early revascularization. After the healing period (4 to 6 months), a flap is raised, the screws can be removed and the implants can be placed for prosthetic rehabilitation.

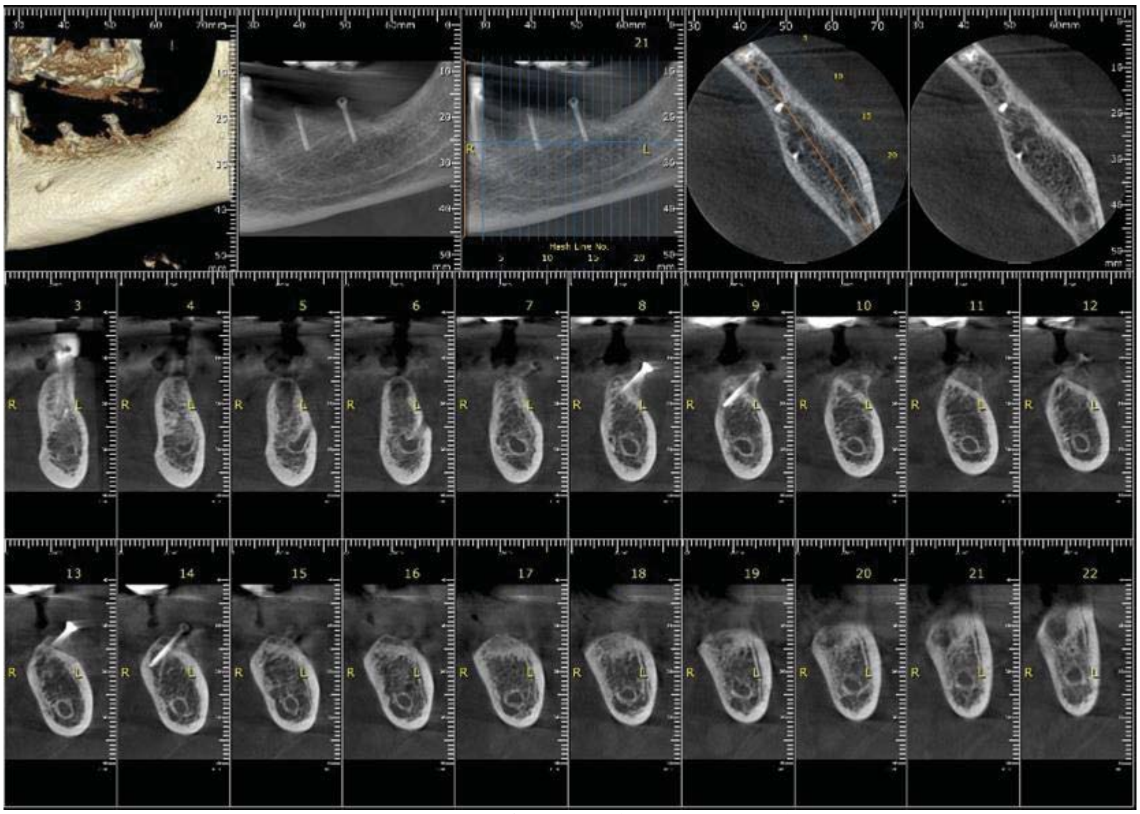


Figure 9. CBCT after 5 months postoperatively

DISCUSSIONS

The problems raised by autogenous full block transplants reported in the literature are resorption rates of 21%-25% [16-18].

The technique described by Khoury in 2007, which involves the interposition of thin cortical plates harvested from the ascending ramus with cancellous bone harvested from the same site, has proven effective in achieving alveolar ridge augmentation in horizontal bone defects, up to 5 mm [19-21].

Unlike cancellous grafts, block grafts take longer to integrate [22]. In these situations, a staged surgical approach is recommended, as opposed to placing the implants simultaneously with the bone graft [23,24].

When autologous bone is obtained, trauma occurs at the donor site. The Khoury technique should be avoided in cases with limited donor sites or risk of nerve injury. In these situations, the use of membranes is the complementary option. The Khoury technique does not use exogenous materials that can induce host responses, potentially affecting the results of the regenerative act [25-27].

The use of PRF in bone augmentation plays an important role in the stabilization of clots, preventing the migration of non-osteogenic tissues into the area. The main growth factors of PRF are: vascular endothelial growth factor, transforming growth factor-1, bone morphogenetic proteins (BMP-1), platelet-derived growth factors and insulin-like growth factors [22,28].

Another problem that arises in this surgical technique of bone augmentation is the restoration of soft tissue defects. In certain clinical situations, soft tissue grafts have given good aesthetic results in soft tissue restoration and prevention of peri-implant marginal recession [29].

CONCLUSIONS

Rehabilitation of the atrophic mandible is a challenge when there is a severe loss of bone mass. A general recommendation for the best way of treatment cannot be given, the decision of the treatment option also depends on the skills and surgical experience of the dentist. Khoury technique involves harvesting only cortical bone laminae, thus avoiding the possibility of damaging the underlying neurovascular structures.

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