

RESTORATION OF ALVEOLAR DEFECTS USING ALLOGENIC BONE BLOCKS

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SUMMARY

Dental manipulation is often associated with the placement of implants in patients with partial or complete tooth loss. Before implants are placed, the dental surgeon is most often faced with a bone deficit in the alveolar ridge area. With any technique, the main disadvantage of autologous bone extraction is the additional trauma to the patient. Reducing the invasiveness of the surgical steps is particularly relevant in elderly patients with comorbidities [1,2,3]. In this article, the authors propose to use bone blocks of allogenic origin when restoring defects of the alveolar ridge of the jaw bones.

KEY WORDS: allomaterial, alveolar ridge restoration, alveolar ridge defects, bone alloblocs, implants.

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Introduction

Bone deficiency in the maxillofacial region is a situation that the dental surgeon encounters on a daily basis in his office. Such conditions as: bone atrophy in the maxillary sinus area, alveolar ridge, intraosseous defects of the jaws, cortical plate defects in the form of dehiscence and fenestration, furcation defects require some kind of bone augmentation [4,5,6,7,8,9].

We conducted a retrospective analysis of the treatment and rehabilitation of patients with partial and complete tooth loss in the conditions of alveolar bone deficiency. We analyzed 62 sources on the use of alloblocs for bone augmentation, published for the period from 2001 to 2018. This allowed us to summarize the information on this issue.

According to the classification of Cawood J. I. & Howell R. A. 1998 Grade 4–6 alveolar ridge atrophy requires bone augmentation not only horizontally, but also vertically.

To date, a variety of forms and types of bone replacement materials have been proposed for the reconstruction of bone defects. For hard tissue replacement, in addition to autotissues, materials of other origin are used. Allostomy, xenograft (denatured bovine or porcine bone), bioactive glass (coral structures), synthetic bone substitutes such as hydroxyapatite, tricalcium phosphate are possible alternative materials for use in hard tissue augmentation.

Although the use of the aforementioned bone substitutes is a routine procedure, it has become commonplace to write and say that autologous bone is the «gold standard» in bone augmentation.

Either extra-oral or intra-oral donor sites are used for autologous bone donation. Typical extra-oral donor sites include

iliac crest, parietal bone, tibia, and rib. On the one hand, the extra-oral donor sites allow for large bone acquisition, but on the other hand, such operations require general anesthesia and hospitalization, which makes it impossible to use such technologies in outpatient dental practice.

Bone harvesting from intraoral donor areas does not usually require anaesthesia and is performed on an outpatient basis. The best known intraoral donor sites are the mandibular symphysis, the zone of the external oblique line of the mandible, the zygomatic-alveolar counterfort and the maxillary cusps. But taking from these areas involves a number of difficulties. A complication in taking bone from the region of the submandibular symphysis can be impairment of the tactile sensitivity in the chin region and cosmetic defects. Bone extraction from the area of the external oblique line is associated with the risk of mandibular nerve damage; in addition, the block itself is usually homogeneous, containing only cortical bone, which significantly limits the use of such a block. When bone is taken in the area of the zygomatic-alveolar buttress, the surgical risk is minimal, but the volume is small for the reconstruction of defects longer than two teeth. The volume of bone taken in the cusp area is very limited and can only be used for small bone defects. In addition, taking bone in the cusp area leads to a deformation of the alveolar ridge in this area.

With any technique, the main disadvantage of autologous bone sampling is additional trauma to the patient. Reducing the invasiveness of surgical steps is especially relevant in elderly patients with comorbidities.



Fig.1. Condition of the dentures in the area of the upper jaw.



Fig.2. Condition of the dentures in the region of the mandible.

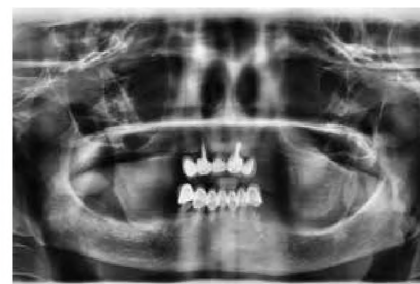


Fig. 3. OPTG of patient X. at the time of referral.

The aim of our work is to demonstrate the potential of allogenic bone blocks for jawbone reconstruction in the rehabilitation of patients with partial and complete tooth loss.

Materials and methods of the clinical study.

This study was based on a clinical analysis of the results of allogeneic bone blocks of 8 persons (4 men and 4 women) from 2010–2014.

The age of the patients ranged from 52 to 68 years. The patients suffered from one or another somatic pathology. In all cases, we used alloblocs in conditions of grade 4 alveolar ridge atrophy (according to Cawood J. I. & Howell R. A classification). There were 4 patients with complete tooth loss, 2 patients with partial tooth loss, and 2 patients with single tooth loss.

In the preoperative period, clinical and laboratory examination of the patients was performed. X-ray examination of the teeth and jaws was performed (targeted intraoral pictures, orthopantomograms, computer tomograms with three-dimensional image reconstruction).

The size of the used block was decided based on the simulation of the situation dictated by the conditions in the oral cavity and the condition of the bone tissue of the implant bed. For this purpose, the size and topography of the alveolar ridge defect, the degree of atrophy of the alveolar process, the type of bite, the shape of the occlusal surface, etc. were determined using models. In addition, the following parameters were evaluated during the examination with CT scanning:

- the height and thickness of the alveolar processes of the jaws;
- condition of the alveolar process of the maxilla in relation to the floor of the alveolar bay of the maxillary sinus;
- condition of the alveolar process of the lower jaw in relation to the upper wall of the mandibular canal bottom;
- condition of the marginal regions of the alveolar process around the retained teeth;
- the shape of the elements of the temporomandibular joint.

In the preoperative period, a thorough sanitation of the oral cavity and the necessary prosthodontic preparation were performed. In this case, the future location of the implant and its superstructure was taken into account and it was performed by the same team (orthopedic-dental technician) that performed prosthetics after the dental implant surgery.

After the investigations and determination of the diagnosis, a treatment plan was drawn up, including bone augmentation surgery, implantation followed by prosthodontic treatment.

Total and subtotal tooth loss is often accompanied by marked atrophy of the alveolar ridge. Bone loss in periodontitis or when the supporting teeth are overloaded with dentures is particularly intense.

As an example, we present the following clinical case. Patient X, aged 63 years, came to us with complaints of loss of masticatory teeth in the lateral parts of both upper and lower jaws, mobility of the remaining teeth in the frontal parts of both jaws, failure of removable and fixed dentures. Tooth loss occurred during 30–35 years of life due to complicated forms of caries and periodontitis. Past medical history – the patient suffers from hypertension II–III stages.

On examination: there is a bridge structure on the upper jaw with 1.3 to 2.2 teeth with supports on teeth 1.2 and 2.1. Partial removable plate denture. Mobility of teeth 1.2 and 2.1 of grade III.

On the lower jaw, from 3.3 to 4.4 teeth with all teeth supported by a bridge. Partial removable plate prosthesis. Degree II–III tooth mobility, crown destruction of teeth 3.3, 3.2 under the crowns (Fig.1, 2).

The study of alveolar ridges revealed a complete absence of alveolar ridge in the area of maxillary and mandibular molars, which corresponds to degree 5 of atrophy, the ridge width of 2–3 mm in the area of maxillary premolars – degree 4 of atrophy, in the area of remaining teeth bone deficit in the area of the walls of cavities.

Diagnosis: Partial tooth loss, terminal unlimited defects of all teeth, periodontitis II–III degrees, chronic periodontitis 3.3, 3.2 teeth. Alveolar ridge atrophy of the maxilla and mandible of 4–5 degrees (Fig.3.). Hypertensive disease II–III degree.

The overall level of risk according to the SAC system (ITI recommendations, 2009), was considered by us to be high (Table 1).

Due to the presence of concomitant general somatic pathology, the treatment plan was developed according to the principles of reduced invasiveness of surgical stages.

The following treatment plan was formulated:

Stage 1

- In the upper jaw area:
- Extraction of the teeth 1.2, 2.1.
- Placement of permanent implants in the area of the teeth 1.1 and 2.1.

Table 1
Assessment of the overall risk level in patient M.

Risk level	Low risk	Medium risk	High risk
Aesthetic expectations of the patient	Low	Medium	High
Somatic factors	Healthy patient	Patient with chronic diseases in remission	Patient with manifestations of somatic diseases
Smoking	Doesn't smoke.	Less than 10 cigarettes per d	More than 10 cigarettes w/o
Length of area of tooth loss	1 tooth > 7mm	1 tooth 6–7mm	1 tooth < 5.5mm 2 teeth or more in the frontal area
Smile line	Low	Medium	High
Crown shape	Rectangular		Triangular
Orthopaedic status of adjacent teeth	Inactivated	Restoration composites	Crown restoration
Infection in the area of the planned implantation	Not available	Chronic	Spicy
Gingival biotype	Fat	Medium	Thin
Soft tissue anatomy	Intact		There is a defect
Bone level in the area of the adjacent teeth	< 5 mm to the contact point	5.5–6.5 mm to the contact point	> 7 mm to the contact point
Bone anatomy	Inactivated	Thickness defect	Height defect

- Placement of provisional implants in the area of the teeth 1.3 and 2.3.
- Bone grafting of the alveolar ridge from zone 1.4 to zone 2.4.
- In the mandibular region:
- Removal of all the teeth.
- Placement of permanent implants in the area of the teeth 3.1, 3.4, 4.1 and 4.4.
- Placement of provisional implants in the area of the teeth 3.3 and 4.3.

Stage 2

- Prosthetics with prosthetic constructions.

Stage 3

- In the upper jaw area:
- Placement of permanent implants in the area of the teeth 1.4 and 2.4.

Stage 4

- Opening of implants, prosthetics with permanent structures.

All operations were performed under local anaesthesia. An incision was made on the upper jaw from the area of tooth 1.5 to the area of tooth 2.5. The mucosal-periosteal flaps were detached. A visual assessment of the bone defect was carried out. Measurements during surgery showed an alveolar ridge width in the area of the



Fig. 4. Placement of a permanent implant in the area of tooth 1.1, provisional implant in the area of tooth 1.3.



Fig. 5. Digiscence in the apical part of the implant area of tooth 1.1.



Fig. 6. View of an allogeneic bone block impregnated with autologous blood.

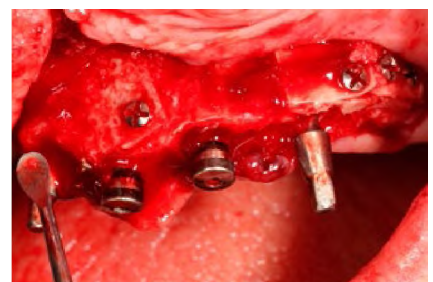


Fig. 7. Fixation of the bone block fragments in the areas of teeth 1.1 and 2.3, 2.4.

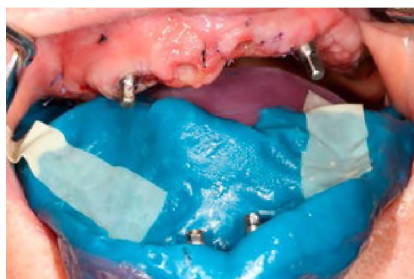


Fig. 8. Impression of a provisional denture.



Fig. 9. Oral view, primary healing, no signs of inflammation in the area of the implants.

missing tooth 2.1 to 1.5 to 2 mm, in the area of the missing tooth 23 to 5 mm. In the first segment, a provisional implant was placed in the area of tooth 1.3 and a provisional implant in the area of tooth 1.1 (Fig. 4). Because the alveolar ridge was hourglass-shaped, there was a digression in the apical area (Fig. 5).

In the second segment a provisional implant was also placed in tooth 2.3 and a permanent implant in tooth 2.3. The alveolar ridge was augmented in the first and second segments using fragments of allogenic bone blocks that were fixed with mini screws (Fig. 6, 7).

The gaps between the graft and the bed were filled with allo- and autograft. The augmentation area was closed with a collagen membrane and sutures were applied. In the postoperative period, there was a moderate swelling of the soft tissues, analgesics were used for not more than 2 days, the patient felt satisfactory. One week after implant placement, a provisional fixed metal acrylic prosthesis was fabricated (Fig. 8).

Three months after augmentation, clinical and radiological signs of bone engraftment and osseointegration in the implant area 1.3 and 2.3 were observed. (Fig. 9,10).

Permanent implants were placed in the area of teeth 1.4 and 2.4. During implant placement, good engraftment of the bone block was observed with preservation of the volume and shape of the augmentation. Mini screws were removed during this operation (Fig. 11,12).

After an additional 3 months of osseointegration (Fig. 13), the implants in areas 1.4 and 2.4 were opened and a permanent bridge supported on implants 1.4, 1.1, 2.1 and 2.4 was placed.

Conclusions

The use of allogenic bone blocks is indicated in cases of pronounced atrophy of both the upper and the lower jaw.

The use of allogenic bone blocks significantly reduces the pain and duration of surgical intervention due to the absence of the need for donor bone sampling.



Fig. 10. Radiological follow-up 3 months after surgery. Osteointegration in the area of the permanent implants is detected.

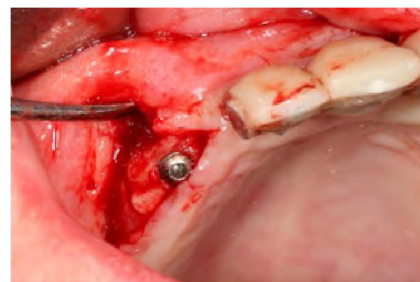


Fig. 11. Placement of the implant in the area of tooth 1.4.

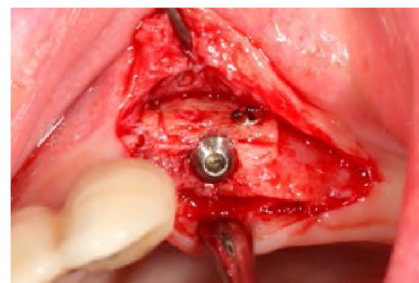


Fig. 12. Placement of an implant in the area of tooth 2.4, removal of the mini screw.



Fig. 13. X-ray radiogram taken three months after inserting the implants in areas 1.4, 2.4.

The use of allogenic bone provides an opportunity to form bone blocks of any shape, for any part of the jaw.

The use of allogenic bone material and collagen membrane prevents early resorption of alloblocs.

Recommendations

The use of allogenic bone blocks requires a surgeon with the appropriate manual skills and a thorough understanding of the principles of bone tissue regeneration.

The use of allogenic bone blocks requires careful preoperative planning.

Fixation of allogenic bone blocks should ensure their maximum stability and immobility in the augmentation zone.

Due to the probable resorption of the augmentate, it is necessary to introduce an excessive volume of particulated graft in the form of a mixture of allo- (xeno-) and autograft.

The mucosal-periosteal flaps should cover the augmentation area without tension.

It is categorically not recommended to subject the augmentation area to any kind of stress in the postoperative period.

Implants should preferably be placed using a delayed protocol for allogenic bone augmentation.

Conclusion

The use of alloblocs is the method of choice for rehabilitation of elderly patients with somatic diseases in alveolar ridge augmentation of the jaws in conditions of bone deficit.

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