Volumetric Reconstruction of the Alveolar Ridge after Marginal Resection of the Anterior Part of the Lower Jaw: Clinical Case

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Abstract

Segmental resection of the mandible leads to a violation of its continuity and, as a consequence, to pronounced cosmetic: changes in the contours of the lower zone of the face and functional problems: speech disorders, chewing, swallowing, which significantly reduces the quality.[1,2] The loss of a small fragment of the lower jaw leads to a violation of the integrity of the dental arch, therefore, an untenable bite and aesthetic disorders of various levels.[3,4,5] Reconstructive treatment of patients undergoing resection of the mandible of the alveolar part of the mandible is an urgent problem for dentists. [6,7]

Evaluation of the effectiveness of the use of customized titanium frame membranes during guided bone regeneration (GBR) in the area of previously performed marginal resection of the anterior part of the lower jaw.

After GBR the height of the alveolar ridge in the area of greatest atrophy was restored by 7.39 mm, the width in the area of the alveolar ridge at the top was 11.5 mm.

The reconstruction of the alveolar part of the mandible after marginal resection of the mandible, including primary soft tissue plastic surgery with the formation of keratinized gums and subsequent GBR using an individualized titanium skeleton membrane, demonstrated high efficiency, expressed in the formation of a sufficient volume of bone regenerate for the installation of dental implants, as well as successful and time-stable osseointegration of placed implants.

Case report (J Int Dent Med Res 2024; 17(1): 382-386)

Keywords: Marginal resection of the mandible, reconstruction of the mandible, guided bone regeneration, framed titanium membranes.

Received date: 04 December 2023 **Accept date:** 20 February 2024

Introduction

Patients undergoing segmental resection of the mandible, the reconstruction of masticatory functions, speech defects and aesthetic defects is a difficult task.[8,9] Dental implants help cardinally to solve the above tasks, but conditions must be created for dental implantation, a sufficient amount of bone tissue for their stable installation and their correct positioning. Various bone plastic surgeries are performed to create the necessary amount of bone tissue in the area of the jaw defect.[10,11,12]

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The correct choice of a bone-plastic surgery to replace a mandibular defect is a difficult task and depends on many factors: the history of the disease and previously used treatment methods, the histological structure of the neoplasm, the shape, localization and prevalence of the defect, the stage of the tumor process, the prognosis of the disease, the presence of a soft-tissue defect (oral mucosa and skin), conditions for subsequent dental implants placement.[13,14,15] It is also necessary to take into account the viability of the donor bed, the motivation of the patient himself and the general condition of the patient.[16,17] This article presents a clinical case of reconstruction of the alveolar ridge after marginal resection of the anterior mandible.

Patient I., born in 2004, applied to the dental clinic. Patient's complaints about the absence of teeth on the lower jaw, an aesthetic defect of teeth, a speech defect. Anamnesis of the disease: 17.08.2018. biopsy of the lower jaw

mucosa on the right, Histological examination: Undifferentiated carcinoma, 11.09.2019. The presence of a formation on the mucous membrane of the lower jaw on the right. Histological examination: Giant cell (reparative) granuloma. Marginal resection of the anterior part of the lower jaw on the right was performed. Conclusion from 04/20/2020: at the time of the study, data on the presence of pathological tissue with hypermetabolism were obtained. Radioactive pharmaceuticals along the edges of the mandibular resection and in the submandibular l/node on the right with negative dynamics - the changes should be differentiated between tumor and inflammatory. No other active pathological foci were detected. Conclusion from 23.10.2020: Condition after surgical treatment. There are no convincing data for relapse. It is recommended to consult a dental surgeon for teeth extraction 4.5, 4.1. When examining the oral cavity and studying cone-beam computed tomography (CBCT) the absence of teeth is determined 4.2, 4.3, 4.3, 4.4, pronounced defect. The width of the alveolar ridge according to the CBCT data in the area of greatest atrophy of the alveolar process was 11.2 mm (Pic.1), distance to the mandibular canal is 2.81mm.. The bone tissue in the area of the missing teeth of the lower jaw corresponds to the type D2. Diagnose: K08.1, K08.2. Patient's medical history and CBCT results determined the choice of the method of reconstructive treatment. It was decided to carry out soft tissue plastic surgery and tooth extraction as the first stage 4.1, 4.5, and after guided bone regeneration (GBR) with the use of an individualized titanium skeleton membrane and delayed dental implantation. Table 1 shows a timeline reflecting the dynamics of treatment and the patient's recovery process after surgery from the moment of its implementation to the present.

23.10.2020	10.06.2021	10.09.2021	15.03.2022	14.09.2022
Treatment of the patient I., clinical and CBCT check. Surgery planning	Soft tissue plastic surgery	Bone grafting of the alveolar part of the lower jaw in the area of teeth 4.5, 4.4,4.3,4.2, 4.1, 3.1 by GBR method using individual frame membrane	Implantation in the area of the performed GBR	Manufacturing of a permanent prosthesis on placed implants

Table 1. Timeline.

Diagnostic evaluation

Preoperative diagnosis included the collection of the patient's medical history, clinical examination, CBCT analyze, blood condition analysis (general clinical analysis, biochemical analysis, blood coagulation analysis, serological examination). Tooth 3.1– destroyed, root dentin softened. The study of CBCT revealed periapical changes at the tooth 3.1, tooth 4.5 of the 4th degree of mobility. View in the oral cavity.

Surgical intervention

At the first stage of dental treatment, teeth extraction 4.5,4.1 and soft tissue plastic surgery were performed in the area of missing teeth of the lower jaw. Under local anesthesia Sol. "Ultracaini" (3.4 ml, 1:200000) teeth were extracted 4.1, 4.5. A trapezoidal incision was made to the depth of the mucous membrane without affecting the periosteum in the area of missing teeth 4.2, 4.3, 4.3, 4.4. The wound was healing by secondary tension.

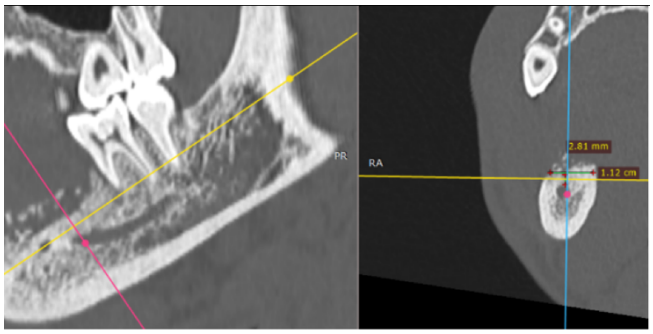

Figure 1. CBCT before surgery. A transversal section in the projection of the missing tooth 4.5. The width of the alveolar ridge is 7.8mm. Distance to the mandibular canal 2.81mm. before treatment 06.07.2020.

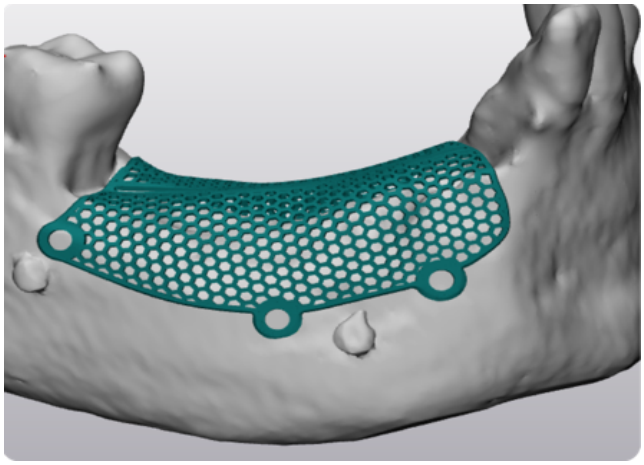

Figure 2. 3D model of a customized membrane on a jaw model.

Computer aided planning of customized titanium scaffold membrane

The results of the CBCT study were obtained DICOM files. Further, in the ViSurgery program (Russia), after processing the CBCT research data, we obtained STL model of the jaw. B EXOCAD Dental CAD program simulated the volume of bone reconstruction and restored the contours in the corresponding area of the jaw.

The following anatomical formations were taken into account when planning the boundaries of the individualized skeleton membrane and when choosing the locations of the fixing elements: the mental foramen, the undercurrents of the jaw and the projection of the mandibular canal. The level of reconstruction was determined by the cervical bone level of distal and mesial located teeth (Pic.2), 3D model of a jaw fragment with a defect and a frame membrane in natural dimensions were printed on a 3D printer Engineer V2 (3DExperts.ru, Russia) method of layer-by-layer fusion of plastic (FDM). A frame membrane was fitted to the jaw model, the exact marginal fit of the membrane was checked. All adjustments were made on plastic models, after which changes were made to the frame membrane modeling program. An individualized titanium frame membrane was manufactured using direct layer-by-layer fusion technology (Direct Metal Laser Sintering, DMLS) in a laser printer made of titanium alloy powder (Grade 5 (Russian equivalent VT-6).

Directed bone regeneration using an individualized titanium skeleton membrane

Under infiltration anesthesia Sol. Ultracaini 1:200000 3.4 ml a linear incision was made along the alveolar ridge in the area of missing teeth 4.5, 4.4, 4.3, 4.2, 4.1, 3.1. The muco-periosteal flap was detached and the alveolar ridge of the lower jaw was skeletonized. A 0.5 mm thick cutter was used to perforate the cortical layer of the alveolar bone, which promotes revascularization of bone regenerate. A bone scraper was used to take bone chips from a branch of the lower jaw HU-Friedy (Bone Scarper Buser 4/5mm). An individualized titanium frame membrane was stored in the oral cavity and the edges were checked for the bone defect, places for fixing screws, after which the membrane was filled with a bone mixture, which consists of 50% autosbone and 50% bovine bone (Bio-Oss Geistlich, Switzerland). Then the individualized titanium membrane was fixed to the lower jaw (Pic.3) with a step-down handpiece (W&H WS-75 L G 20:1) and fixing micro screws (Conmet, Russia). The wound was sutured tightly with continuous stitches Prolen 4.0, 5.0. OPG after GBR.

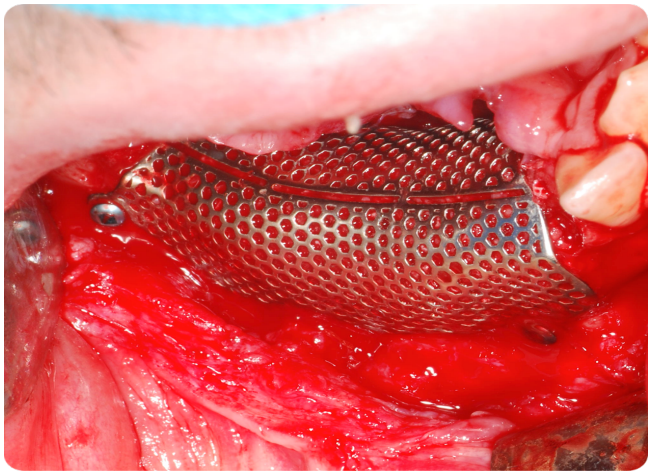

Figure 3. Fixing the titanium membrane with microscrews.

Dental implantation in the area of previously performed guided bone regeneration.

6 months after GBR (Fig. 4) implantation surgery was performed.

Under infiltration anesthesia Sol. Ultracaini 1:200000 3.4 ml a linear incision was made in the mucous membrane along the top of the alveolar ridge in the area of missing teeth 4.5, 4.4, 4.3, 4.2, 4.1, 3.1. The mucoperiosteal flap is detached. With step-down handpiece (W&H WS-75 L G 20:1) the locking screws were unscrewed. The removal of the individualized titanium frame membrane was carried out using a sickle-shaped ironer. Before performing dental implantation on the basis of CBCT a surgical template was made for guided drilling. Dental implants IRIS were placed in the area of: 3.1-4.0x10, 4.3-4.0x10, 4.5-4.5x10. After six month after the dental implantation, a temporary metal-acrylic bridge prosthesis on implants was made. 7 months after dental implantation, a zirconium permanent prosthesis on implants was made (Fig. 5).

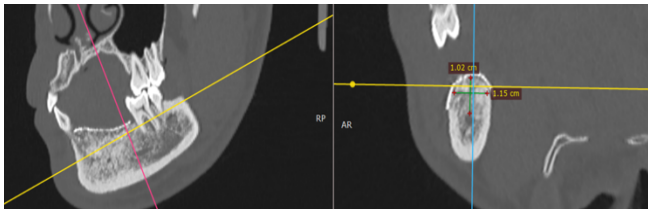

Figure 4. CBCT after GBR 6 months follow up.

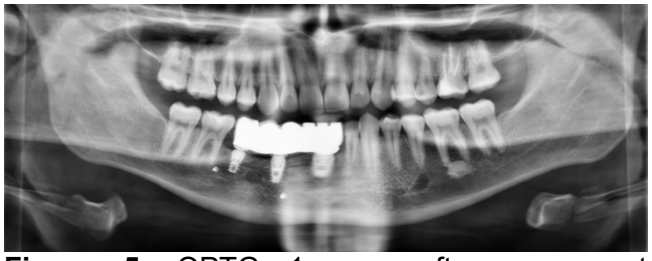

Figure 5. OPTG 1 year after permanent prosthetics 14.09.2023.

Results

After GBR the height of the alveolar ridge in the area of greatest atrophy was restored to 7.39 mm, the width in the area of the alveolar ridge in the apex was 11.5 mm. 3 IRIS dental implants were successfully placed.

Conclusions

Step-by-step reconstruction of the alveolar part of the mandible, including primary plastic surgery of soft tissues with the formation of keratinized gums and subsequent GBR using an individualized frame titanium membrane, has demonstrated high efficiency, expressed in the formation of a sufficient size of bone regenerate for the installation of dental implants, as well as successful and stable over time osseointegration of placed implants.

In this clinical case, there was no premature exposure of the titanium mesh; we attribute this to two factors: 1 – before bone grafting, a keratinized gingiva was formed, in the center of which access was subsequently created during bone grafting. Due to the fact that keratinized gingiva is thicker and stronger than the mobile mucous membrane, it holds the sutures more reliably, maintaining the tightness of the wound. 2 – an individualized membrane, unlike a bendable titanium mesh, has a smooth surface and smoothed edges, which also prevents it from cutting through the mucous membrane, which lies on the surface of the membrane and is under tension. Thus, we propose to change the sequence of tissue reconstruction in the area of bone defects of the alveolar bone: first, form soft tissue with keratinized gingiva and then perform bone grafting. This sequence differs from the usual approach, when the formation of soft tissue in the implantation area is carried out after the placing the implants.

Further application of the proposed step-by-step approach on sufficient clinical material will provide statistical data confirming its effectiveness.

Funding

Strategic Academic Leadership Program of RUDN University.

Declaration of Interest

The authors report no conflict of interest.

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