

## Dental Implantation After Jaws Resection in Oncopediatrics

Dudaeva A.A.<sup>1\*</sup>, Markov N.M., Grachev N.S., Vorozhtsov I.N., Babaskina N.V., Krasnov A.S., Demenchuk P.A., and Gorokhova E.K.

<sup>1</sup>Dmitry Rogachev National Medical Research Center of Pediatric Hematology, Oncology and Immunology

<sup>2</sup>Department of Pediatric Oncology and Surgery

<sup>3</sup>Laboratory of Maxillofacial Rehabilitation and Orthodontics

### \*Corresponding Author

Anna Dudaeva, OMFS, Researcher, Dmitry Rogachev National Medical Research Center of Pediatric Hematology, Oncology and Immunology, Russia.

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### Abstract

**Resume.** The purpose of the work. Improving the technique of dental implantation in the area of free vascularized fibular flap in the projection of the jaws in adolescents who underwent jaw resection.

**Materials and methods.** In this study, 9 patients with jaw neoplasms who underwent jaw resection aged 12 to 18 years (average age 13.4; 5 girls, 4 boys) were treated, including 6 patients with malignant tumors and 3 patients with benign jaw formations.

**Results.** Based on digital planning, it was possible to improve the technique of dental implantation in the projection of a free fibular flap in adolescents who underwent jaw resection. This made it possible to reduce the risks of complications of dental implantation in the projection of a free fibular flap in adolescents who underwent jaw resection. Also, digital planning optimizes surgical intervention in the volume of dental implantation.

8 patients were fully rehabilitated by the time of adulthood (prosthetics was performed on dental implants in the area of a free vascularized fibular graft in the projection of the jaw) and 1 patient, due to the failure of the fibular flap, was rehabilitated using removable prosthetics.

**Conclusions.** Based on the results of the study, the algorithm of rehabilitation of patients after jaw resection in oncopediatrics has been improved by means of using digital planning during dental implantation.

**Keywords:** Dentistry, Dental Implantation, Pediatric Oncology, Implantology, Microsurgical Reconstruction, Rehabilitation after Jaw Resection, Prosthetics, Head and Neck Tumors, Maxillofacial Surgery.

### 1. Introduction

According to the Global Cancer Observatory (GLOBOCAN), 890 thousand new cases of head and neck cancer were registered in the world in 2018. By 2030, the incidence is projected to increase by 30%, to 1.08 million new cases per year [1]. It is estimated that 476,125 people worldwide were diagnosed with oral or oropharyngeal cancer in 2020 [2]. Children with jaw defects after tumor resection have serious functional and aesthetic disorders that doctors around the world are trying to cure [3]. Over the past 30 years, the method of simultaneous removal of a jaw tumor with microsurgical reconstruction with a fibular flap has been a key method [4]. Restoration of the integrity of the jaws with the help of microsurgical reconstruction with a fibular flap has acquired

special importance in oncopediatrics [5]. However, the issue of rehabilitation of patients who underwent reconstructive plastic surgery of the jaw with restoration of integrity with the application of a free fibular flap is still an urgent problem all over the world.

However, after restoring the integrity of the jaws, we still have an open question of restoring the functions of chewing, swallowing, speech, as well as improving aesthetic results and socialization of the patient [6]. To date, the problem of rehabilitation of children's patients after jaw resection for the treatment of cancer is an urgent and acute problem. Rehabilitation activities are carried out by related specialists, such as oncologist, maxillofacial surgeon, orthodontist dentist, orthopedic dentist, dental surgeon, radiologist

and others [7]. One of the main methods of restoring the dentition after reconstruction with a free fibular flap is dental implantation, due to the possibility of direct load on the bone graft, which prevents a decrease in the volume of bone tissue in the rehabilitation period. The possibility of non-removable prosthetics allows to rehabilitate the patient in more comfortable conditions for him [8]. When planning dental implantation in children with oncological diseases of the jaws, it is necessary to take into account the conduct of chemoradiotherapy and the presence of growth potency. The success of surgical rehabilitation measures directly depends on the total focal dose of radiotherapy received by the patient [9]. According to the world literature, dental implantation is one of the key techniques in patients who have undergone jaw resection with further reconstruction with a fibular vascularized flap, it should also be noted that the presented technique allows using a fibular flap, subjecting it to a "physiological load" to prevent bone atrophy. The manufacture of a removable prosthesis is an ineffective technique, since there is no necessary load on the graft, which leads to atrophy of the free fibular flap. Previously performed treatment with removable prostheses is low functional, unaesthetic, and as a result, especially young patients avoid wearing these prostheses [10]. According to the evaluation of the data of the study devoted to the analysis of the results of dental implantation with a direct load on the free fibular flap, a favorable result of osseointegration was confirmed in patients who underwent radiation therapy. The median osseointegration of dental implants ranged from 74.4% to 97% [11].

## 2. Materials and Methods

In the period from 2017 to 2023, as part of the rehabilitation of patients after partial resection of the jaws with subsequent reconstruction with a free fibular flap, oral surgical rehabilitation in the volume of dental implantation in the projection of the lower and upper jaws was provided to 9 patients aged 12 to 18 years (average age 13.4; 5 girls and 4 boys) (Table 1). All patients in the preoperative and postoperative periods underwent a standard examination protocol, including: computed tomography (3 studies for 1.3 years); orthopantomogram (3 studies for 1.5 years); photo documentation; blood tests; electrocardiography. Patients were fitted with dental implants made by Dentium (South Korea) with an implant length of 8 mm and the diameter of the implant neck varied from 4.3 to 4.5 mm. A benign tumor of the jaw was histologically verified in 3 patients and a malignant tumor of the jaw was histologically verified in 6 patients. The lesion of the upper jaw was observed in 2 patients, the lesion of the lower jaw in 7 patients. Patients with a history of radiation therapy were not included in the study data. Based on gender, location of the defect, histological verification of the tumor and age, the patients were divided into 2 groups.

Group I – patients with pathology of the upper jaw from 12 to 18 years with benign and malignant neoplasms of the jaws.

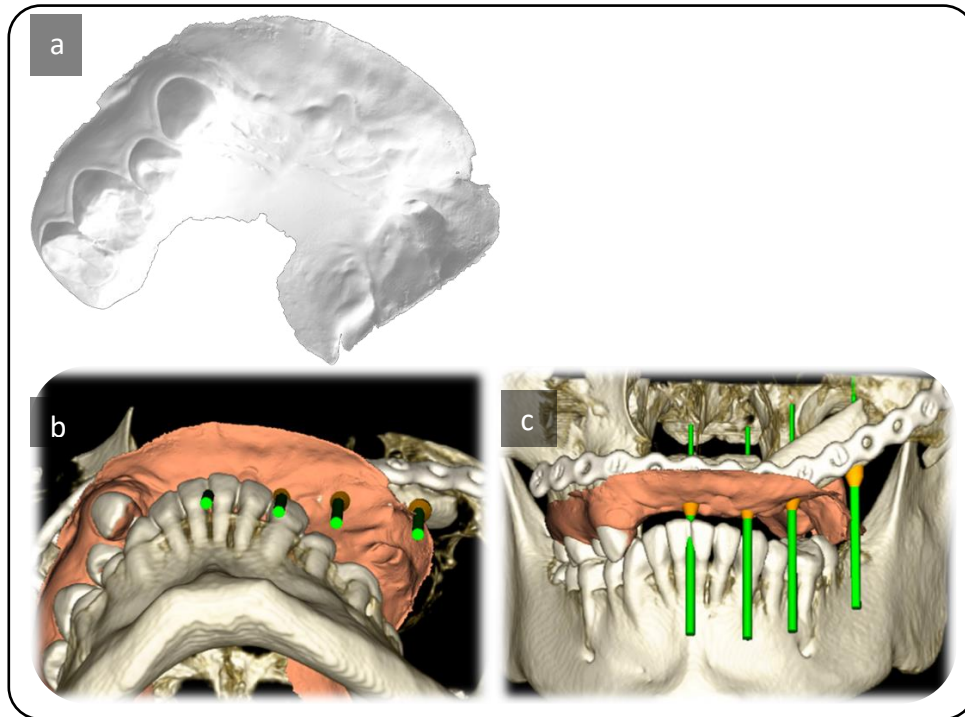
Group II – patients with pathology of the lower jaw from 12 to 18 years with benign and malignant neoplasms of the jaws.

Group	n	Gender	Age	Number of impl	Complications
I	5	F/M		6	2
II	8	F/M		23	0
<b>Total</b>	13		13,4		2

**Table 1: Distribution of patients by localization, age, gender, average number of installed dental implants and complications**

At the first stage, for the possibility of dental implantation in the area of a vascularized free fibular graft in the projection of the jaws, preoperative planning was carried out for patients, including: digital modeling of dental implantation using the results of computed tomography (studies done no longer than 3 months before the planned operation); taking casts and manufacturing STL

models; also used 3-D teeth scanner. Comparing the volume of the mucosa and bone structure using the STL model and the 3-D model of the jaws gave us the best results in planning implantation both in terms of bone volume and the volume of the oral mucosa for more accurate installation of dental implants and further prosthetics. (fig.1.1)



a – STL – jaw model

b – Combining the results of a computed tomography study and an STL model for more accurate planning of dental implantation

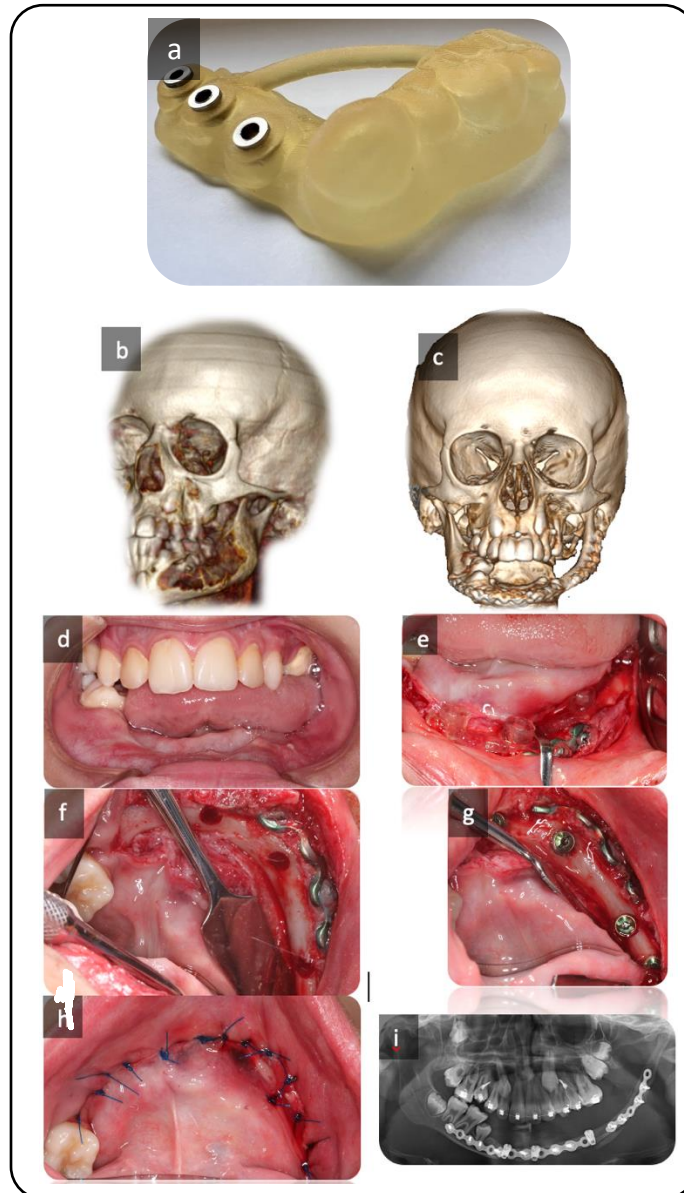
c – Digital planning of dental implantation taking into account the volume of bone tissue and oral mucosa

**Figure 1.1:** Digital planning of dental implantation

During digital planning, a retrospective analysis of bone density and the volume of the trabecular bone in the projection of a vascularized free fibular flap was carried out by means of computed tomography. The study involved 9 patients who subsequently underwent dental implantation. The time median between CT scans was 1.3 years. The process of adaptive changes in bone tissue was studied in the area of the jaw adentia. When examining the results of computed tomography after surgical treatment in the volume of reconstruction with a free fibular flap and control computed tomography, an average of one year and three months before dental implantation revealed a tendency to decrease the volume of the cortical layer and the trabecular bone of the free fibular flap by an average of 25%.

With this X-ray picture, the risks of complications of osseointegration of dental implants increased and planning of dental implantation became more complicated due to the deterioration of optimal conditions for the installation of dental implants.

At the time of dental implantation, the titanium plate fixing the vascularized fibular flap was not removed in 3 patients, and therefore it was decided to produce a navigation implant template based on the results of computed tomography and STL models of patients. (fig.1.2)



- a- Individual navigation template for dental implantation
- b- 3-D reconstruction of computed tomography of a patient with a verified tumor of the mandible
- c- 3-D reconstruction of computed tomography of a patient after resection of the tumor and reconstruction with a free fibular flap
- d- Photoprotocol of the oral cavity before dental implantation
- e- Access to the bone part of the mandible, in the area of adentia, was performed. The positioning of an individual template with screw fixation was performed for the most accurate placement of implants
- f- A bone bed for dental implants is made with the help of special cutters
- g- Dental implants are installed
- h- The wound is sutured with a non-absorbable thread
- i- Conducting a control orthopantomogram after surgery

**Figure 1.2:** (a-k) Clinical example of using a navigation template for dental implantation

At the second stage, surgical intervention in the volume of dental implantation was performed. A standard surgical protocol proposed by the manufacturer was used for dental implantation. For

dental implantation, dental implants with a length of 8 mm and a diameter of 4.3-4.5 mm were installed in the area of the free vascularized fibular flap, a plug was installed in the dental implants,

and mucosal suturing was performed.

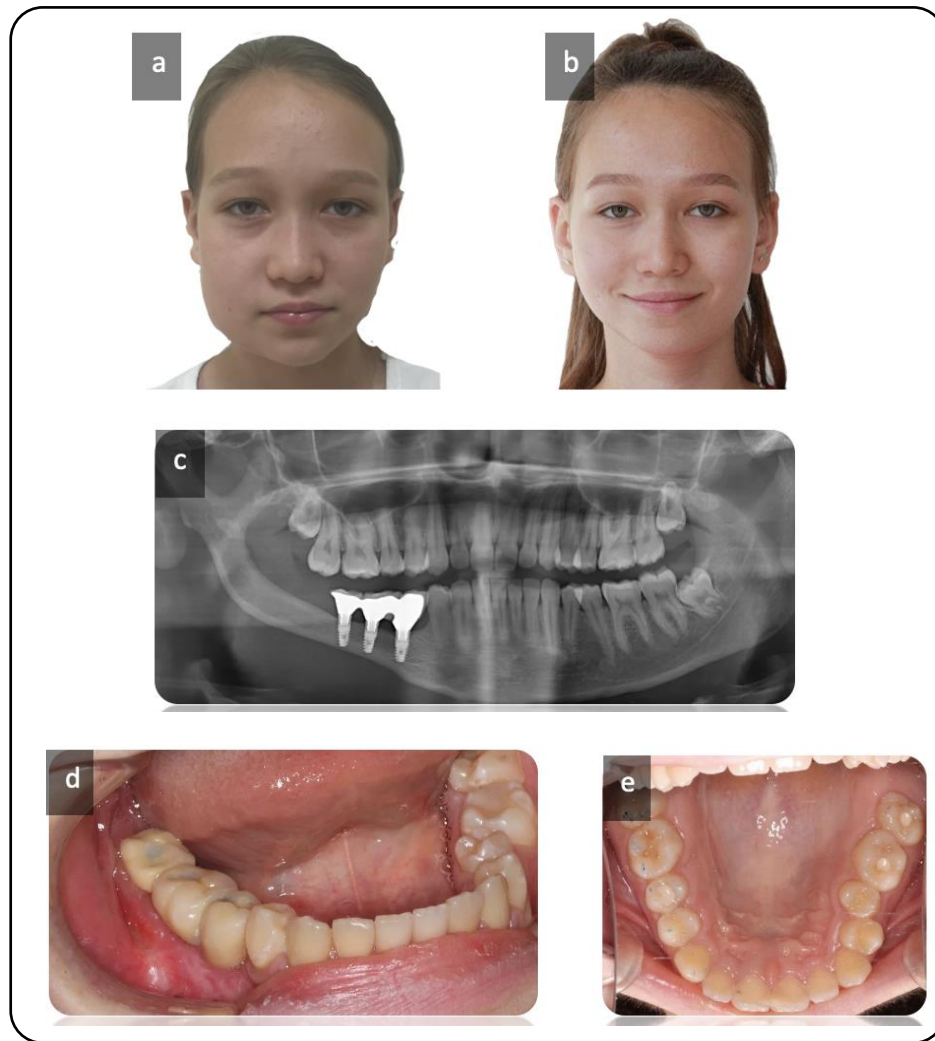
At the third stage, patients underwent orthopedic treatment with a delayed load on dental implants. Prosthetics on dental implants were performed no earlier than 3 months after the installation of dental implants. Also, it is necessary to assess the complexity of prosthetics on dental implants in the projection of a free vascularized graft, due to the vertical discrepancy between the fibular flap and the jaw body and the large volume of the movable mucous membrane of the oral cavity. To plan orthopedic treatment on dental implants in the projection of the lower jaw, an elastopositioner was made to prevent secondary deformation of the jaws, after 3 months, when implants were implanted, a temporary

prosthesis was made to restore functions, aesthetics and prevent secondary deformation.

### 3. Results.

In total, 29 dental implants were installed in 9 patients (on average, 3 dental implants were installed in each patient) with a length of 8mm and a diameter of 4.3-4.5 mm. Two patients had rejection of single implants (each patient has 1 implant) without signs of inflammation. Microflora crops were taken from the implant bed, no signs of pathogenic microflora were detected.

Clinical examples before dental implantation and after dental implantation are shown in Figures 2.1 - 2.2.



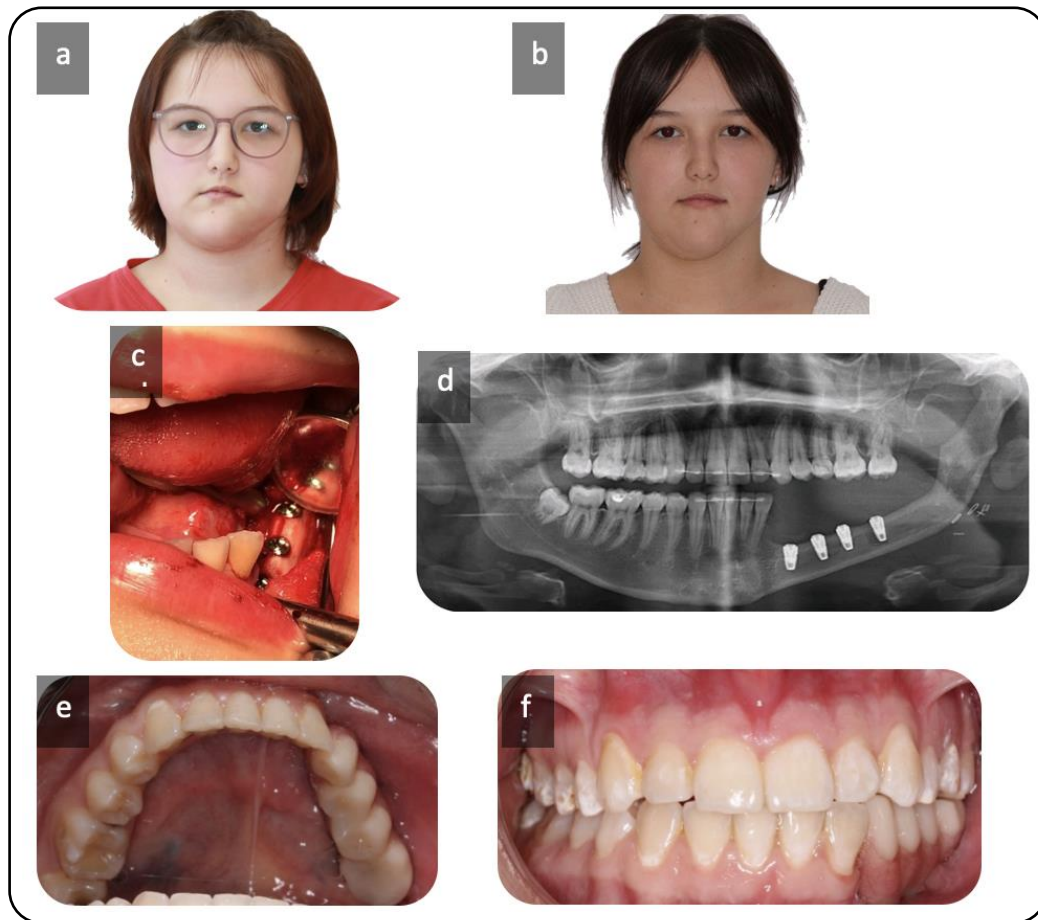
**Figure 2.1**

a- Patient G., 15 years old D.S.:Osteosarcoma of the lower jaw T1N0M0 low grade 1A stage. Appearance before the treatment of the underlying disease.

b- Appearance before the treatment of the underlying disease.

c- Control orthopantomogram after the installation of dental implants and prosthetics

d, e -Photoprotocol of the oral cavity after prosthetics on dental implants.



**Figure 2.2**

- a- Patient P. 16 years old. D.S. Osteosarcoma of the angle of the lower jaw on the left T3N0M1. The appearance of the patient before the treatment of the underlying disease
- b- . Appearance after treatment of the underlying disease.
- c- Photo protocol during surgical treatment in the volume of dental implantation
- d- Control orthopantomogram after the installation of dental implants
- e, f -Photoprotocol of the oral cavity after prosthetics on dental implants.

The difficulties we encountered in the management of children's patients after dental implantation into a vascularized free fibular flap is unsatisfactory hygiene. Neglect of recommendations for oral care after dental implantation and installation of gum shapers leads to the proliferation of granulation tissue around the gum shapers. (fig.2.3).



**Figure 2.3**

Figure 2.3 – photoprotocol of the oral cavity with the growth of granulation tissue in the mucosa area after the installation of gum shapers after 1 week.

These growths were sent to the department of pathological anatomy for histological studies, fragments of granulation tissue were indicated with a microscopic description, cells with atypical and specific morphology were not detected. It is worth noting that if you remove the gum shapers, install plugs in dental implants, suturing the wounds, the granulation tissue was lysed and the mucous membrane in the postoperative area acquired a physiological color without signs of inflammation and the presence of granulation tissue. Also, in one patient, due to poor hygiene, an overgrowth of granulation tissue under the orthopedic structure was revealed after the end of rehabilitation. In one patient, due to the failure of the free fibular flap, dental implants were silenced and a removable prosthesis was made.

#### 4. Conclusions

During the improvement of the dental implantation protocol, the algorithm for planning dental implantation in the field of free vascularized fibular graft in oncopediatrics was improved by means of maintaining a digital protocol at the preoperative stage. The integration of dental implants amounted to 95.1%, complications after dental implantation amounted to 4.9% in the form of the absence of osseointegration of the dental implant in a free vascularized fibular flap. In all patients, the functions of chewing, swallowing and speech were restored, as well as aesthetics were improved [1-12].

The choice of the method of restoring the masticatory function and aesthetic component after reconstruction with a free fibular flap is dental implantation. With a favorable prognosis after the reconstruction of the jaw with a free fibular flap and its complete vascularization, it is advisable to carry out dental implantation no later than one year after the operation, which is associated with a decrease in the volume of bone tissue in the projection of a free fibular flap. For the best functional and aesthetic results, it is necessary to apply digital planning, which includes computed tomography studies done no later than 3 months before the planned operation and an STL model. In conclusion, I would like to note that for each patient, based on the proposed algorithm, it is necessary to draw up a personalized treatment plan based on anamnesis, clinical picture and age.

**Competing interest declaration:** The authors declare no competing interests.

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