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CLINICAL APPLICATION OF 3D TECHNOLOGY FOR PLANNING DENTAL AUTOTRANSPLANTATION SURGERY

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Abstract:

Digital technology has become an integral part of both the social and medical components of modern life. Dentistry, as a branch of medicine, most actively uses the capabilities of additive manufacturing to achieve a successful outcome, ensuring the coincidence of the expected and final treatment results, minimizing the risk of conflict situations, litigation procedures and unfavorable outcomes. New opportunities are offered by digital technology in the planning of dental autotransplantation and replacement of defects arising after tooth extraction. The developed algorithm for creating a personalized dental model increases the efficiency of the transplantation surgery, restores the integrity of the dentition and prolongs the graft's service life and physiological functioning of the graft. To achieve this goal, a comprehensive digital planning with the 3Diagnosys computer software (Italy), being presented as a tool for visualization, diagnostics and 3D modeling.

In addition, we carried out the visual examination of the oral cavity, index assessment of the state of periodontal tissues, structural analysis of the bone tissue of the donor and recipient zones using computed tomography, the formation of a virtual image of the graft and its digitization, followed by objectification using 3D printing technology using resin polymers used for work in the oral cavity. The ultimate goal of creating a template is the formation of the spatial parameters of the tooth bed at the site of the defect to be replaced with the subsequent immersion of the transplanted tooth. Long-term results demonstrate the absence of pain and inflammatory reactions, stability in the transplantation area allowing us to recommend this algorithm as an improved method of autotransplantation surgery. This technique is the method of choice in a particular clinical situation and can be used depending on the indications.

Key words: Digital technologies, autotransplantation, dental rehabilitation

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INTRODUCTION:

At present, additive manufacturing technology (AMT) is becoming more widespread in all areas of medicine, and the dental industry using these digital technologies in the routine work very is no exception.

AMT implementation remains optimal in the algorithm of diagnostic procedures, as well as in planning rehabilitation measures in order to ensure the most predictable treatment result, reduce the degree and possibility of adverse event occurrence and prevent conflict situations between the patient and the physician.

This digital technology is considered as innovation in this field. Preserving the natural teeth is one of the most important indicators of dental health, which can be checked with the Dental & Oral Health Test. The number of teeth extracted annually in medical institutions of Russia is steadily growing and, in turn, the number of requests for orthopedic care for secondary adentia is also increasing. [1-2]

The major reasons for the extraction of teeth: low compliance and motivational activity of patients to the treatment of complicated forms of dental caries, ineffectiveness of conservative treatment, insufficient preventive measures. [3-4]

A good alternative to dental implantation and traditional prosthetics is dental auto transplantation allowing to solve many problems of restoring dentition at a higher scientific and practical level, and, ultimately, improving the patient's life quality. [5]

A fairly large number of authors in their works argue that this rehabilitation technique, when properly applied in compliance with all protocols, makes it possible to obtain predictably good and stable results in the long term. [5-8]

Purpose: to develop of a technique for obtaining a precision model of a personalized graft to increase the efficiency of autotransplantation at the stages of surgical preparation for orthopedic treatment

Our tasks included:

1. Virtual selection of a digital copy of the graft from a three-dimensional X-ray scan.
2. Development of a mechanism for transferring the virtual configuration of the tooth to its analog copy
3. Formation of a precision bed of the alveolar socket of the future recipient zone 4. Carrying out an autotransplantation operation

MATERIALS:

1. The tooth to be removed
2. Cone beam computed tomography of the required area
3. Computer programs for digital planning of surgical operations and processing of three-dimensional objects

RESEARCH METHODS:

1. Clinical method - diagnosing of the clinical situation and treatment planning
2. X-ray method - three-dimensional X-ray examination
3. Analytical method - evaluation of the results of computed tomography
4. Digital - virtual planning, processing of an object (tooth 1.8) in 3D Diagnosis and Exocad programs followed by printing a model of tooth 1.8 of a polymer using a 3D printer and the CHITUBOX program
5. Surgical method - auto transplantation surgery

RESULTS:

The study was conducted on the basis of a private dental clinic, where the necessary digital technology of modern dentistry is presented. Additional training programs in the additive technology for dental staff allow to improve existing technology and adapt them to the conditions of the clinical situation. In this particular case, the concept of our research is associated with the development of a method for effective preparation of the recipient zone for auto transplantation using digital technology at the stages of surgical rehabilitation of complex orthopedic treatment. The technology consisted in extracting a digital 3D object from a three-dimensional X-ray scan of the head, corresponding in size and spatial characteristics to the transplanted tooth using the 3Diagnosis program. The digital copy of the tooth was modified and corrected in the EXOCAD program This programme is designed to work with three-dimensional objects. Objectification was carried out on this digital layout using 3D printing thanks to the Chitubox slicer program. Finally, this template was used as a copy of the transplanted tooth, being safe and atraumatic for the graft and accurate and congruent for preparing the recipient zone.

The step-by-step use of the planning protocol makes possible ensuring a high degree of accuracy to simulate a virtual model of a transplanted tooth by developing a method for converting its digital model to an analog copy. This mock-up serves as a template for preparing the receiving bed in the area of the planned transplant, it must repeat exactly the configuration of the graft roots.

The algorithm of the proposed technology includes a number of step-by-step actions using digital and additive technology:

1. Conducting an examination and diagnostic tests to determine the possibility of using a tooth as a graft. (Determination of the level of oral hygiene (Green-Vermillion), periodontal tissue state assessment - PHP, PMA, CPITN indices, determination of the degree of tooth mobility) (Fig. 1)

Figure 1.

2. Analysis of the results of cone beam computed tomography in the area of the planned surgical intervention (KaVo OP300 Maxio Ceph) (Fig. 2)

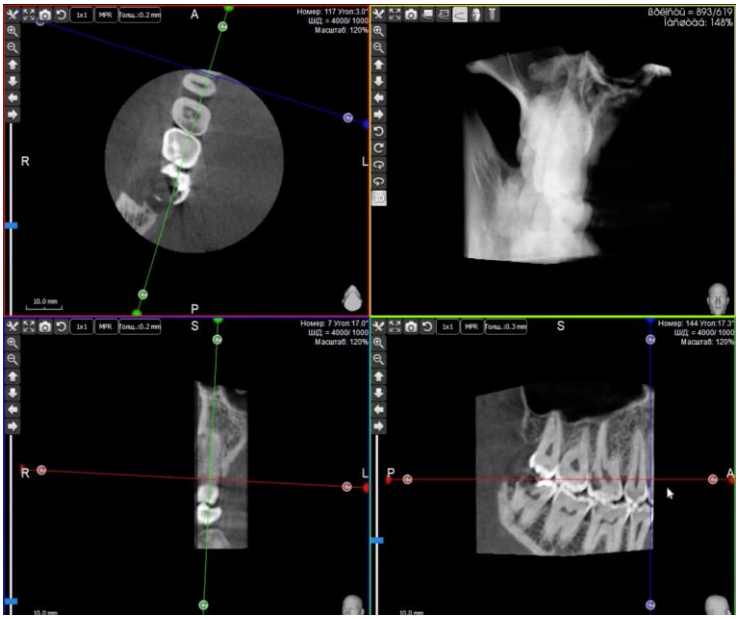

Figure 2.

3. Loading the DICOM computed tomography files into 3 diagnosis program (Fig. 3)

Figure 3.

4. Using the "master" function of this program, select the area with tooth 1.8 (the need for a clear definition of the tooth boundaries in all projections in order to get full compliance with the tooth anatomy with its future virtual analogue should be mentioned) (Fig. 4)

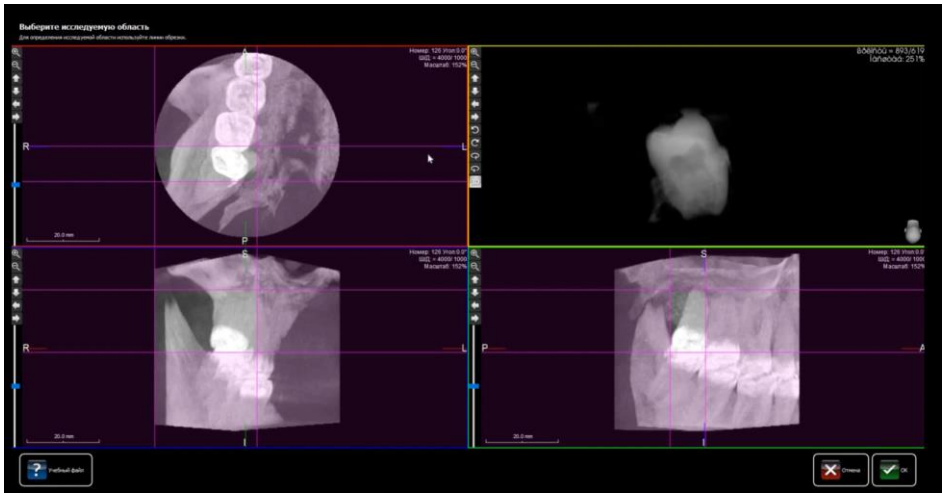

Figure 4.

5. Then you need to select the parameters of visualization of the structures of dental hard tissues using computed tomography manually(Fig. 5)

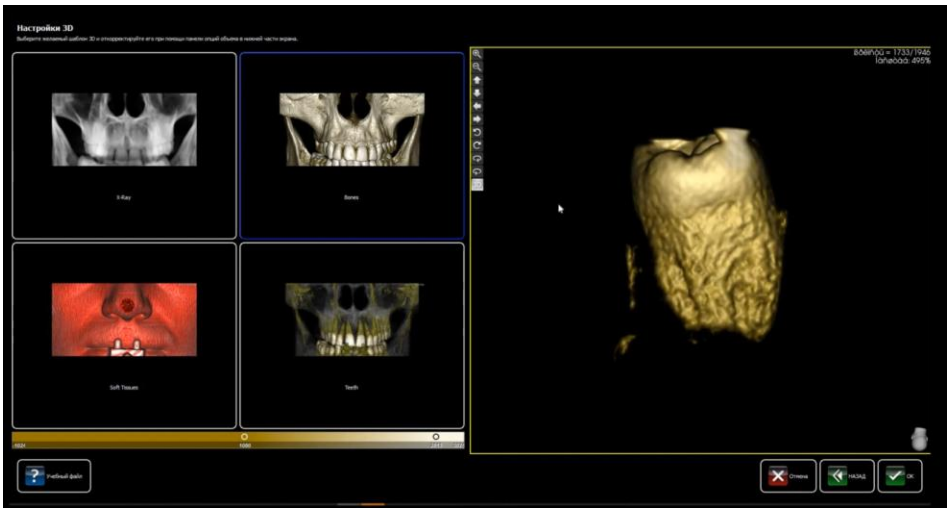

Figure 5.

6. Using the function "generate surface" create a three-dimensional object in STL file format. It should correspond to the area selected in the previous steps (Fig. 6)

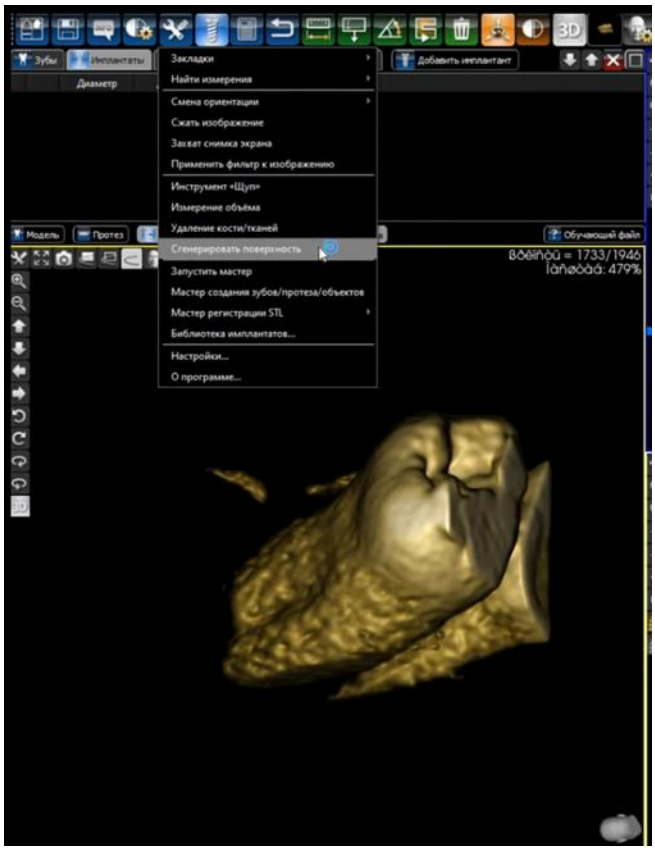

Figure 6.

7. The threshold value corresponding to a certain tissue density is visualized by computed tomography (tooth 1.8 and surrounding tissues) to minimize artifacts should be selected empirically. (Fig. 7)

Figure 7.

8. Then we exported the generated object in STL format to the hard drive (Fig. 8)

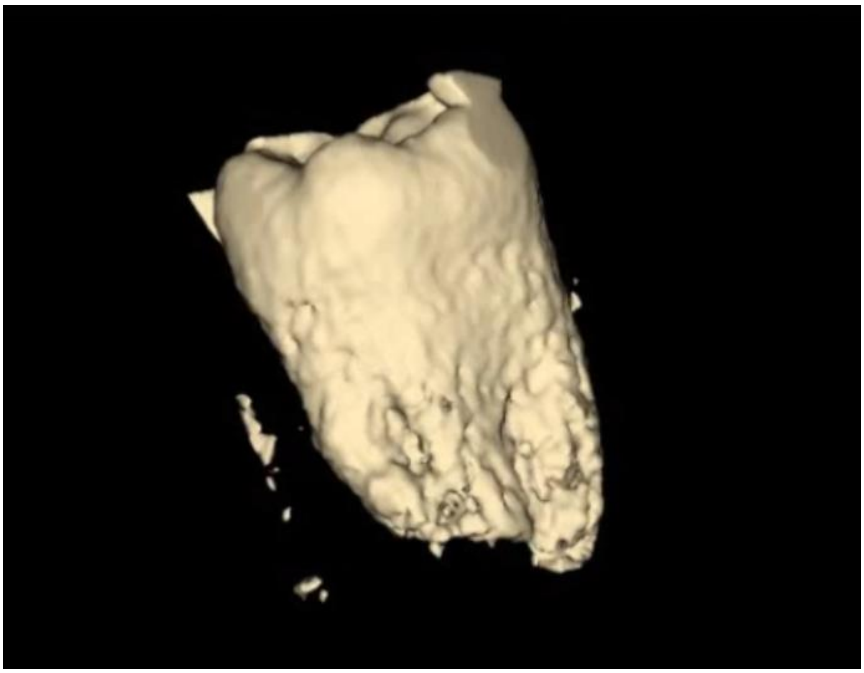

Figure 8.

9. The next step is to create a new project in the "Exocad" program and import the STL file (Fig. 9)

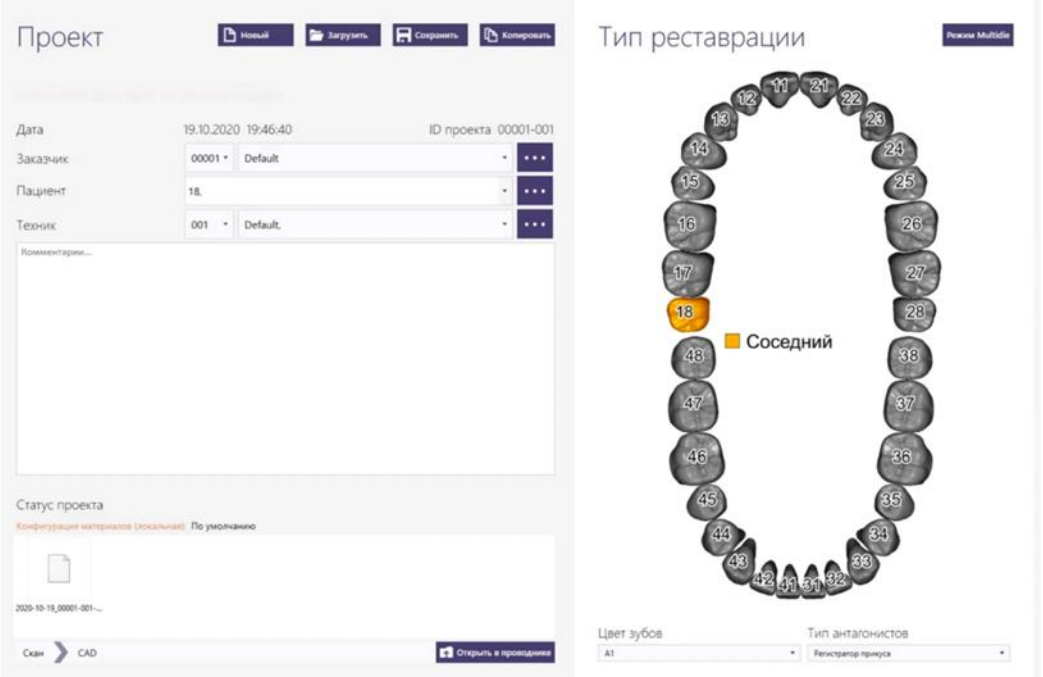

Figure 9.

10. Using the 3d object editor, we cut off the artifacts that were saved when selecting this STL file (Fig. 10)

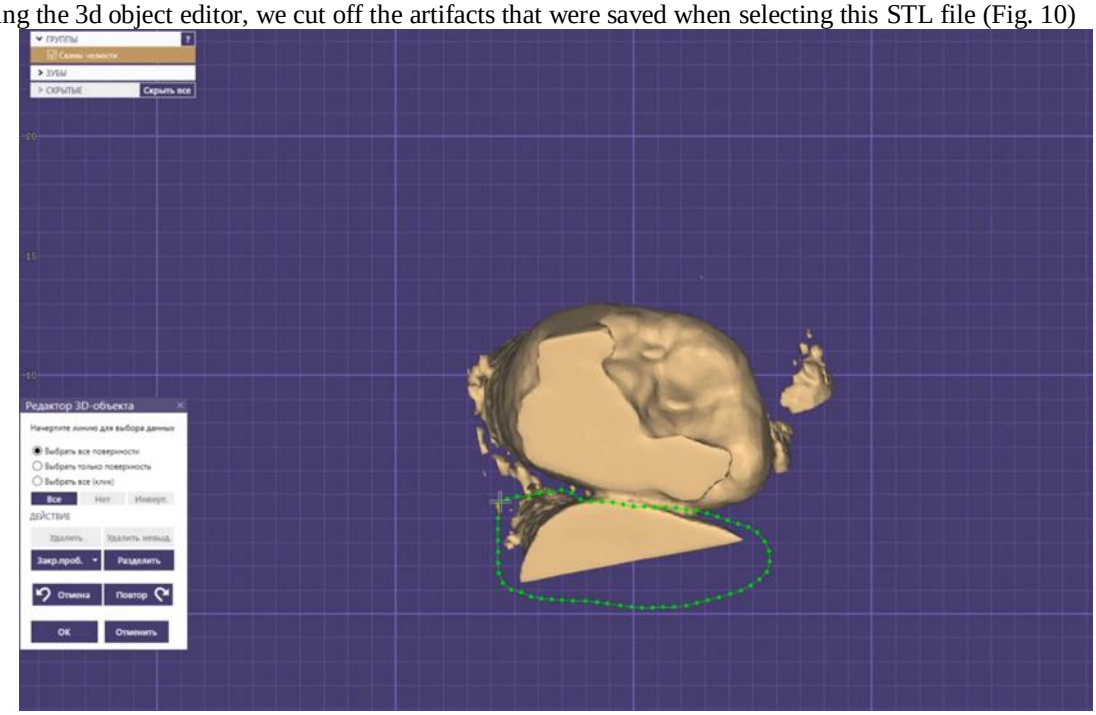

Figure 10.

11. We modify the surfaces of the object by smoothing them without violating the spatial dimensions of the future tooth model (Fig. 11)

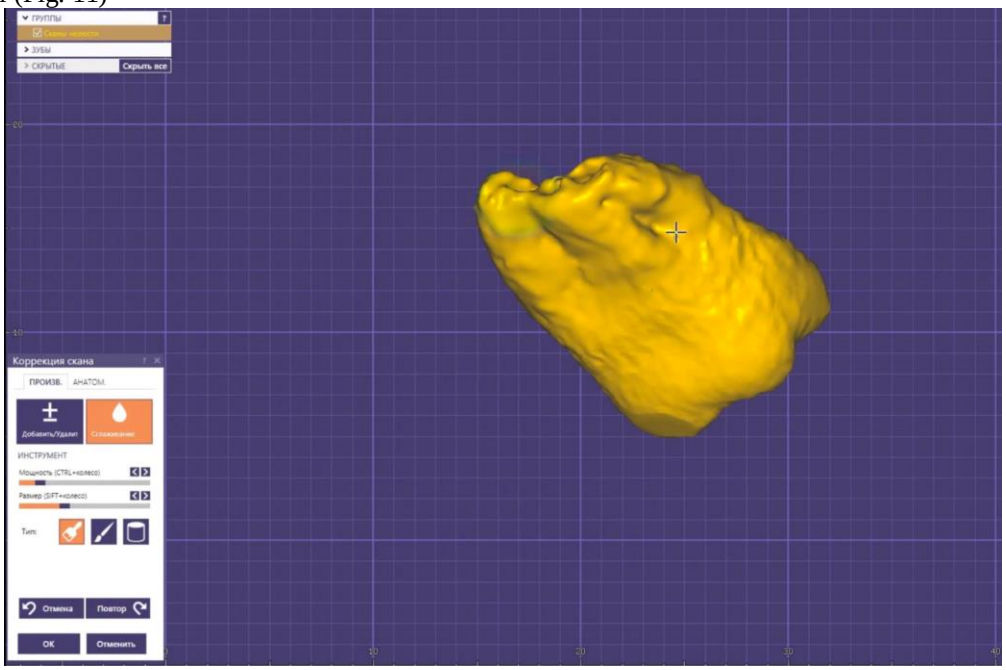

Figure 11.

12. The next step is to load the processed model of the tooth for transplantation into the chitubox slicer program, where we orient the 3D object relative to the 3D printer table, arrange the supports and add a platform (Fig. 12)

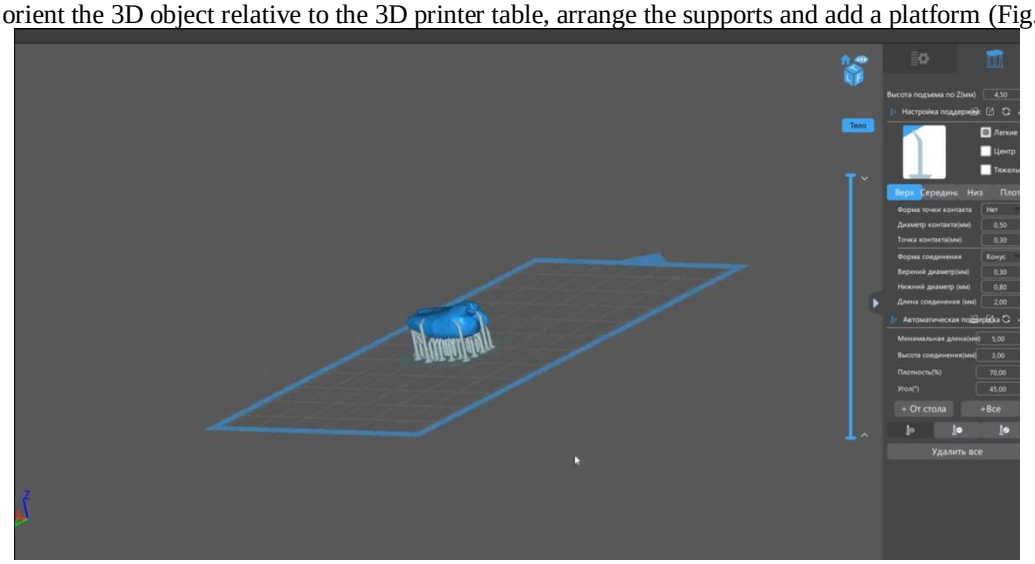

Figure 12.

13. Then we print this template on a 3D printer. And as a result, we get a ready-made tooth model 1.8 for the subsequent autotransplantation operation. (Fig. 13)

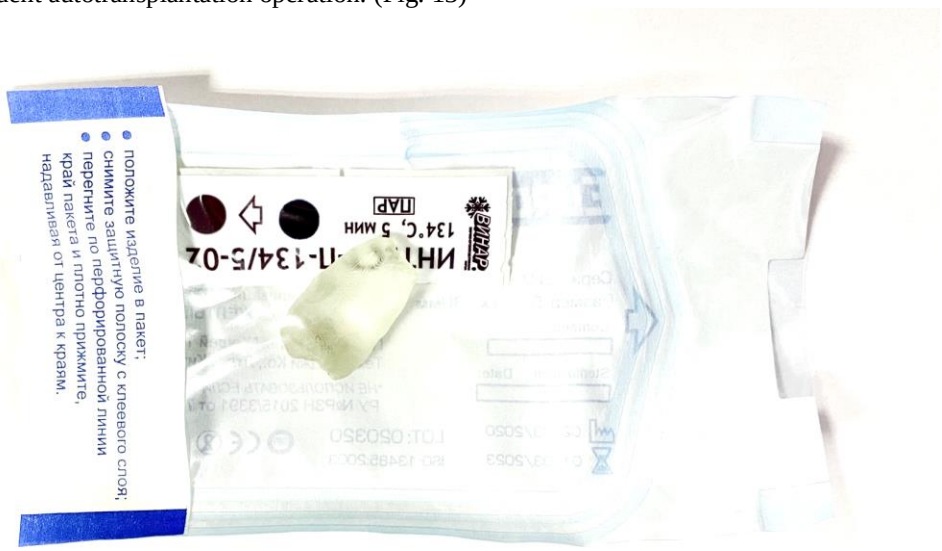

Figure 13.

14. The result of the clinical stage of surgical treatment (Fig. 14)

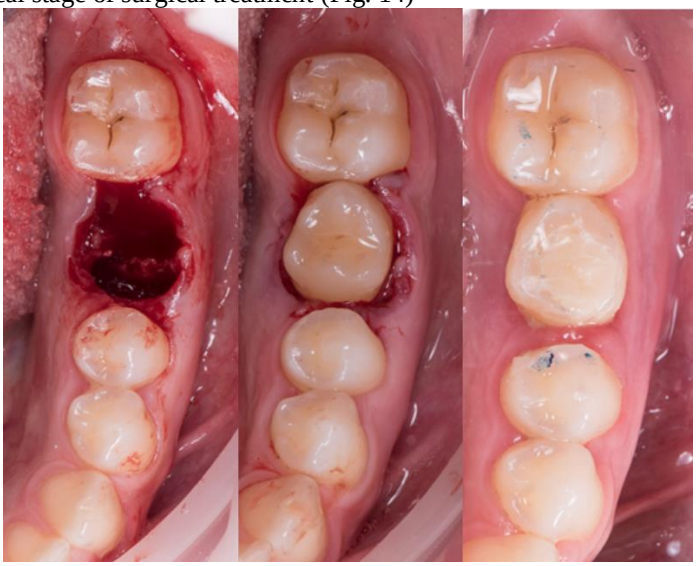

Figure 14.

The use of 3D technology makes it possible to use this technology for dental autotransplantation. The given clinical case of dental transplantation demonstrates the advantages and effectiveness of this method.

The generally accepted alternative method of replacing dentition defects is dental implantation, which is inferior to autotransplantation according to the following criteria: a longer rehabilitation period, the absence of a circular and periodontal ligament in the implant, the impossibility of its orthodontic movement, and the impossibility of proprioception. These advantages make it possible to recommend the autotransplantation technique as an effective alternative to classical implantation and opens up new prospects not only for dentists, but, first of all, for patients, ensuring the continuity of the dentition by using their own tooth as a graft.

CONCLUSIONS:

This technology allows:

1. Apply a personalized approach to planning and decision making 2. To shorten the time of treatment, optimize the stage of rehabilitation, restore the functions of chewing and speech and provide an aesthetic effect immediately after the autotransplantation operation.
3. To avoid postoperative complications and unfavorable outcomes.
4. Use it as a method of choice in a specific clinical situation
5. To achieve an effective and predictable result in the shortest possible time

REFERENCES:

1. Gazhva S.I., Pashinyan G.A., Aleshina O.A. Analysis of errors and complications in prosthetics using fixed orthopedic structures. Dentistry. 2010. T. 89. No. 2. S. 65-66.
2. Gazhva S.I., Shkarednaya O.V., Pyatova E.D. An integrated approach to the treatment of diseases of the oral mucosa in patients with chronic gastritis Dentistry. 2013. T. 92.No. 6. pp. 16-19.
3. Gazhva S.I., Stepanyan T.B., Goryacheva T.P. Prevalence of dental diseases of the oral mucosa and their diagnosics. International Journal of Applied and Basic Research. 2014. No. 5-1. pp. 41-44.
4. Arutyunov SD, Vertkin AL, Zayratyants OV, Pleskanovskaya NV, Naumov AV, Pshikhacheva MB Clinical and morphological relationships of bone mineral density loss in periodontal diseases against the background of somatic pathology // Institute of Dentistry. - 2008. - No. 2. - P. 88–91.
5. Tsukiboshi M. Autotransplantation of teeth: requirements for predictable success. DentTraumatol 2002; 157-180. #Blackwell Munksgaard, 2002.
6. Galeeva, Z.R. Morpho-functional characteristics of replanted teeth: author. thesis of Candidate of Medical sciences. - Kazan, 2002.19 p.
7. Iordanoshvili, A.K. Long-term results of replantation of teeth with chronic diseases of apical periodontitis // Healthcare of Belarus. 1991.No 9. pp. 62-63.
8. Linar, A.R. The degree of effectiveness of replantation and dental transplantation: author. thesis of Candidate of Medical sciences. - Riga, 1958. 24 pp.