Case Study

The use of Digital Technologies in Implant Prosthetics (Extract from the Case History)

Bulycheva Elena Anatolyevna¹, Trezubov Vladimir Nikolaevich², Chikunov Sergey Olegovich³, Rozov Roman Aleksandrovich⁴, Parshin Yuri Valerievich⁵, Bulycheva Daria Sergeyevna⁶

¹Professor, Pavlov First State Medical University, Russia
²Head of the Orthopedic Dentistry and Materials Science department, Pavlov First State Medical University, Russia
³Professor, Sechenov First Moscow State Medical University, Russia
⁴Associate professor, Pavlov First State Medical University, Russia
⁵Assistant professor, Pavlov First State Medical University, Russia
⁶General dentist, Pavlov First State Medical University, Russia

*Corresponding author: Parshin Yuri Valerievich, Assistant professor, Department of Orthopedic Dentistry and Materials Science, Pavlov First State Medical University, Leo Tolstoy str. 6-8, St. Petersburg-197022, Russia. Tel: +7 (931) 352-70-20; Email: duvip@yandex.ru

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Abstract

**Background:** Implant prosthetics proved in clinical practice as a reliable way to restore the masticatory and speech apparatus. An extract from a dental history case is a good example where complex rehabilitation of a patient with a complicated clinical case in which modern methods are pragmatically used.

**Case Presentation:** Patient details, Gender: male; 74 years old; complained of deformed appearance, chewing and biting food. His old wearing out dentures also proved the patient's sensitive experiences. Digital diagnostic methods were used as prosthetic preparations: computed tomography and automated implant planning. The last one allowed to choose the implant’s model, type and size. Also the data of computed tomography, three-dimensional models of dentition, wax modeling of dentition and the place selection of implant insertion were compared in the program. It was decided to remove the remaining teeth due to the decompensated possibilities of their periodonts. It was planned to replace the missing teeth with implant prostheses. The first stage was the removal of the teeth on the upper jaw with simultaneous implantation. After that, the day of surgery, the impression was carried out to create the preliminary denture expendable. The final prosthesis was performed 6 months after the surgery with fixed all-ceramic structures on screw fixation. Long-term results are stable; the patient notes a high level of life quality.

**Conclusions:** The use of digital technologies as well as navigational surgical template increases the efficiency, accuracy and quality of implant prosthetics providing the successful use of aesthetically high-quality fixed replacement structures in complete loss of teeth. Such implant prostheses are a new type of replacement structures—“full fixed prostheses”.

**Keywords:** Implant prosthetics, Digital technologies.

**List of Abbreviations:** CBCT: Cone-beam computed tomography; NST: Navigational surgical template.

**Case Study**

Implant prosthetics has established itself in clinical practice as a reliable way to restore the masticatory and speech apparatus. Certain rules of practice were made to increase the degree of implants preservation with a positive outcome [1-4].

An extract from the clinical case is good example which helps to analyze the complex rehabilitation of a patient with a complicated clinical situation with pragmatic modern methods. Patient: gender: male; 74 years old; complained of deformed appearance, chewing and biting food. The result
between his teeth and under the intermediate parts of his bridges, as well as unpleasant smell in his oral cavity.

To ensure the proper quality of prosthetics, the first stage was a comprehensive examination of the patient with the use of the optimal diagnostic resource, including photo pictures, clinical and x-ray examinations of the patient, the study of photos, diagnostic models of the jaws, their analysis in the articulator.

The patient's face (Figure 1) and dentitions (Figure 2 (a), (b)) were photographed. Registration of the patient's appearance is important for obtaining the information for the doctor and dental technician. Photos play a great psychotherapeutic role when the patient takes information about treatment planning.

In addition to the general photo of patient's face, pictures of the lower part of the face were taken in the quite state, in the functional rest and in the widest possible smile.

In the oral cavity of patient S. there are old metal-plastic soldered bridges with support for 1.3-1.6, 2.3-2.6, 3.3-3.7, 4.4-4.6 teeth, which he's been using for about 20 years (Figure 3). The prostheses are covered with partially erased titanium nitride. At the same time, the gray-silver metal shines through. The condition of polymeric linings and high mobility of prostheses confirms the duration of their use. When probing, deep periodontal pockets are noted, the maximum of which, on the distal surface of the 2.6 tooth, was more than 8 mm deep. There is a small included defect of the upper dentition due to the loss of 2.1 teeth, as well as carious cavities on 1.2, 1.1 and 2.2 teeth, dental deposits and signs of enamel erosion.

Functional overload of tooth 3.7 periodonts led to its pathological mobility and bone resorption. There are signs of a violation of the prosthesis fixation with the destruction of hard tissues in the area of the supporting tooth 3.3. In the area of teeth 3.1, 4.1 sub-gingival dental lesions were observed. It is more than 50% loss of bone attachment length of teeth roots (the remaining teeth have pathological mobility of 3-4 degrees). A metal-polymer bridge prosthesis with a tooth 4.4 and a mesial root of 4.6 support (after hemi section); in an artificial crown of tooth 4.6 a cement fixing layer was destroyed. It is also worth noting that the artificial crowns of the lateral teeth had a flat chewing surface.

of rare preventive examinations and poor hygiene was the development of chronic spilled periodontitis of severe degree, accompanied by pathological mobility of the lower teeth of 3-4 degrees, as well as resorption of the alveolar parts. The patient's sensitive experiences also proved his old dentures to be wearing out. He complained of food retention
The Orthopantomograms supplemented the necessary information for a complete comprehensive diagnosis (Figure 4). It allowed to present a panoramic view of patient’s dental system. Cone-beam computed tomography (CBCT) was an additional and clarifying diagnostic method.

It was decided to remove the remaining teeth due to the decompensated possibilities of their periodonts. The replacement of the teeth loss with implant prostheses was planned.

Digital diagnostic methods were used in prosthetic preparations: computed tomography and automated implant planning. The last one allowed to choose the implant model, type and size (Figure 5, 6 (a), (b)).

In addition, the data of CBCT, three-dimensional models of dentition, wax models of dentition and the place selection of implant insertion were compared in the program. Computer planning allowed to avoid the damage risk of the maxillary and nasal cavities, the mandibular channel; to determine the volume of surgery and implant’s quantity, their type, size and location; determine immediate load on the implants, all of which were very important to reduce the period of disability of the patient after removing all teeth on the upper and lower jaws. Eight implants were planned to insert both in the upper and lower jaws (Figure 7 (a), (b)).

The conventional density of bone tissue was determined by CBCT software with Hounsfield’s scale unit volume. Bone density indices on the upper and lower jaws were different but corresponding to patient’s general and age status. After the confirmation of implant virtual plan of localization and...
Figure 7: Planning of implantation (location of implants) in the upper jaw (a) and in the lower jaw (b).
Figure 8: Performing the surgical stage of implant prosthetics in the upper jaw: (a) The state before the operation, (b) The state after the extraction of the teeth (except the supporting 1.1 and 1.6 teeth), (c) Implantation through a surgical guide.
The first stage was teeth extraction on the upper jaw with simultaneous replacement of implants. The punctuality of surgical templates differed depending on the type of tissue on which they were based. We used a combined template based on the mucous membrane and 1.1 and 1.6 teeth. The latter were saved for the duration of the operation to provide better stabilization and correct pattern overlay (Figure 8 (a), (b), (c)). After its removal teeth 1.1 and 1.6 were extracted.

The digital method of creating navigational surgical templates allows full replacement of the implantation, starting from the targeted preparation of the implant bed up to the inserting of implants due to the removable guide sleeves. In addition to the supporting soft and hard tissues of the oral cavity intraosseous pins were used to fix the template. Thus, complete immobilization of the template was achieved that is very important in cases with complex configuration of the alveolar tip, for example, in planning the implantation near important anatomical formations.
After the implantation in the day of surgery print making was performed to create the preliminary expendable denture of prolonged using. For that purpose, the impression adapters (transfers) were attached to the implants, and to avoid deformation and displacement, these parts were combined with a verifier of fast-hardening plastic or liquid compomer.

The surgical template also served as an individual impression spoon (Figure 9 (a), (b), (c)). Since the position of the implants is transferred in the day of the operation, it was possible to do without the impression mass to avoid the risk of postoperative complications. If the impression mass is used, it is usually polyester material, as the risk of postoperative complications is minimal. After that, the fixing intraosseous pins were removed, the screws of the impression transfers were untwisted and the template-impression was removed from the oral cavity.

Figure 10 shows the condition of the upper jaw after the implantation, to which the formers of gingival cuff were fixed, superimposed guiding sutures with fine suture material (6/0 Glycolon), that resulted in minimal scarring changes during the healing process. This is especially important in the front section.

The modeling of the patient's dentition with wax was carried out on the models of jaws (Figure 11). After that, auxiliary impressions were obtained from the models of the main silicone mass to create a preliminary prosthesis in the dental laboratory. An acrylic compomer with sufficient mechanical strength was chosen a prosthetic material, with such qualities as mechanical wearing resistance and well polishing.

After curing of the plastic prosthesis by its finishing, polishing and blending were carried out (Figure 12 (a), (b)). In implant prosthetics with defects of the dentition must be carefully checked up occlusion and articulation to avoid premature contacts, and prosthetics with full removable
dentures should be achieved multiple occlusal contacts, and smoother articulation movements in all kinds of occlusion.

The first control examination was carried out in the next day. The patient had no complaints. Oral hygiene was satisfactory, and soft tissues were in a stable condition. Edema was over after 3 days. On the 10th day, the sutures were removed, the remaining teeth and defective dentures on the lower jaw were removed and eight implants were inserted using a navigation surgical template (Figure 13 (a), (b), (c)).

Preliminary lower jaw prostheses were created by analogy with the upper ones. Control examinations were carried out: in a day and after other 9 days to remove the sutures. On examinations, the patient had no complaints. On the next visit after 3 months, complete healing of the soft tissues and jaw bones were noted. Additional polishing of preliminary prostheses, professional oral hygiene was carried out, articulation relationships were checked up for all occlusions.

The clinical picture in the day of making impressions after removal of temporary crowns. The final prosthesis was planned 6 months after surgery. Figure (14 (a), (b)) shows the condition of the soft tissues after the removal of the provisional prostheses. Thanks to the correct configuration and careful polishing of them, it was possible to achieve a satisfactory condition of the soft tissues. The color of the gums was pale pink, the gum was well keratinized and elastic. Formation of scallop in clinical practice is better when the prosthesis is fixed even in the process of tissue healing, and not by squeezing them when they have been already formed.

Removal of the traditional print was carried out by polyester mass, the plaster model was scanned in the laboratory. The design features of the final prosthesis were: milled frame made of zirconium dioxide, ceramic cladding, screw fixation.

Provisional prostheses were obtained individual spoon and occlusal impression in the final prosthesis print. The implant’s impression was attached by transfers for open spoon with the verifiers of the plastic Pattern-Resin. After hardening of the mass the impression transfers were removed from the spoon and impression was removed from the oral cavity. During the removal of the print, the preliminary prostheses were cleaned and polished in the dental laboratory. After receiving the print, they were returned to the oral cavity.

After next 2 weeks, the patient was given a final implant prosthesis of the upper jaw (Figure 15 (a), (b)). Patient’s wishes were also satisfied: to make the front teeth more streamlined and rounded in comparison with those of the preliminary prosthesis. The lower incisors were modeled with a slight tight position intentionally due to insufficient gap between his canines reminding the patient of his natural teeth. Furthermore, the lower prosthesis appeared to be more natural.
Light squeezing of soft tissues allows to achieve a good adaptation of the intermediate part, that helps to avoid invading the food under the prosthesis, as well as achieving good aesthetic aids. The technological holes of the fixing screws were closed. The flange of the screw was isolated with Teflon tape. The areas of ceramics adjacent to the mine were treated by (pre-sandblasting machine (50 micron’s sand, under pressure of 1 bar).

The surface of ceramics in this place was covered with soil-adhesive and the mine was sealed with a compomer. The material was induced in small portions with ten-second illumination to reduce the polymerization shrinkage of the material with final curing for 40 seconds. For cosmetic exit of “mines” on the occlusal surface was closed with filled light-curing composite (Figure 16).

The patient’s profile picture (Figure 17) shows the improving of his appearance.

The next appointment was made six months later for professional hygiene and a follow-up examination of the patient. Long-term results are stable; the patient notes a high level of life quality.

**Conclusion**

The use of digital technologies as well as navigational surgical template increases the efficiency, accuracy and quality of implant prosthetics providing the successful use of aesthetically high-quality fixed replacement structures in complete loss of teeth. Such implant prostheses are a new type of replacement structures—“full fixed prostheses”.

**Statement of Conflicts of Interest**

The authors declare no conflict of interest.

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