The Innovative Approach to the Treatment of Total Edentulism and Advanced Alveolar Atrophy

Abstract
This article describes the surgical preparation and prosthodontic treatment of total edentulism and advanced bone atrophy followed by alveolar reconstruction with tibial autografts and the insertion of Anthofit implant-supported removable prosthesis on telescopic crowns and a zirconium framework (with the use of CAD/CAM technique and galvanoplasty).

Key words: Alveolar atrophy, Implantation, Tibia bone grafting, Galvanoplasty, Telescopic prothesis, Zirconium dioxide.

Introduction
According to statistics, 20% of Russia's population under age 60 suffer from total edentulism. The quality of life of totally edentulous patients is significantly decreased. Edentulism inflicts a severe psychological injury on patients, and for many of them is associated with the loss of self-esteem because of embarrassment and discomfort. Edentulism results in pronounced esthetic disturbances: the height of the facial lower third decreases, occlusal relations are compromised, the labial muscle tone decreases, the lips become narrower, and the face looks senile and unhappy. TMJ disorders and speech disturbances develop or exacerbate.

Traditionally, patients with total edentulism have been treated with removable prosthesis. In 2003-2006 the percentage of cases treated with removable prosthesis, compared to other treatment modalities, was as high as 50 to 70% in the Moscow region, according to the Moscow regional dental clinic. However, the performance of complete removable prosthesis has fallen short of desired; for example, virtually every prosthesis required repair and adjustments after 1 year of service, and the average longevity was less than 3 years. Removable prostheses further promote jaw bone atrophy and worsen the anatomical conditions. Traditional mandibular prostheses get often dislodged when buccal and hyoid-glossal muscles contract, therefore the teeth tend to be placed not in anatomically favorable position, but in neutral zones to stabilize the prosthesis. As bone atrophy advances, the height of the facial lower third decreases, and traditional removable prostheses serve, to increasingly larger extent, to maintain facial contours, thus they become bulkier and, as a consequence, less functional, less stable, and less retentive.

In recent decades, implant-supported prosthetic restorations have proven to be a reliable, predictable, and effective treatment modality. Over the last 10 to 15 years, the survival rate for implants and implant-supported restorations has reached as high as 96 to 98%. Being inserted in jaw bone, the implant prevents bone atrophy and serves as a reliable abutment for a prosthesis. With the use of implant-supported prostheses, teeth can be set as required to fulfill esthetic and speech considerations. Implant-supported prostheses not only restore facial contours, but also provide stability, reproducible centric relation, excellent retention and masticatory efficiency. Masticatory proprioception doubles, and bite force increases by 85%. Speech improves, and clicking sounds typical for a traditional removable prosthesis user disappear.

Thus, implant-supported prostheses in patients with total edentulism have indisputable advantages over traditional removable prostheses. However, edentulism is associated with advanced bone atrophy, which counteract implant insertion without surgical preparation, which, in turn, can be very extensive. To perform alveolar reconstruction prior to implant insertion, many grafting techniques have been suggested (for example, tibial grafts, calvarium grafts, iliac grafts).

A fixed prosthesis has clear advantages (in terms of psychology and convenience of use). However, with advanced alveolar atrophy associated with total edentulism and the development of false ‘senile’ prognathism, fixed prosthesis has a number of disadvantages, such as lack of buccal and labial soft tissue support, speech disturbances, implant care difficulties, the development of frontal cantilever, poor load distribution, and long unaesthetic crowns.
Implant-supported removable prosthesis possess a few advantages, but in general patients like these prostheses less than fixed ones. In many respects, this is associated with the prosthesis mobility in the oral cavity.

This article presents an innovative approach to the fabrication of esthetic, comfortable, hygienic and light removable prostheses on telescopic crowns and zirconium frameworks and galvanic caps. With good retention, simple care and maintenance, and the precise fit of the components, a patient feels this prosthesis as fixed one.

**Case Study**

A 56 year-old male patient presented himself at our clinic on the 31st of January, 2008. The patient was a non-smoker and medically fit. In the maxilla, 3 remaining teeth exhibited mobility (grade III) and were extracted. In the mandible, both canines were preserved. In the maxilla, the alveolar process had division C and D atrophy (according to 1985 Misch & Judy classification). In the mandible, division B atrophy was observed. Jaw relationship in the sagital plane was classified as pseudo-class III malocclusion. The alveolar arch shape was flat (Figs. 1, 2).

After physical/lab examinations, preliminary wax-up and computerized exam, the tooth roots were extracted and 8 Anthofit implants were inserted in the mandible to seat a fixed ceramic-to-metal prosthesis. During the implant insertion, Kazanjian Vestibuloplasty was performed in the anterior mandible. (The prosthesis was fabricated 4 months later (Fig. 17)).

To perform implant insertion in the maxilla, alveolar reconstruction with tibial cortical grafts (in the form of bone blocks and chips) and bilateral sinus-lifts with Bio-Oss grains were performed. The bone augmentation was performed only in perspective insertion sites, which reduced the extent of the surgery and the amount of grafted bone. For augmentation, the vestibular approach with elements of tunnel technique was used. The recipient and donor sites healed with primary intention (Figs. 3-5).

In the maxilla, 6 implants were inserted to seat a dental prosthesis on telescopic crowns. Due to the flat shape of the alveolar arch, anterior implants were inserted in the positions of missing canines. During implants insertion, the repaired bone had good vascularization and no signs of resorption (Fig. 6). Repaired bone morphology stained with hematoxylin-eosin showed that grafted bone tissue was viable; it contained viable osteoblasts and osteocytes. At the periphery of the grafted bone young bone rods were being formed (Fig. 7). 4 mm Anthofit implants with internal octagonal connection were inserted in positions 13, 15, 23, 25 and 5 mm in positions 17 and 27 five months after grafting (Fig. 8). On tibial X-rays 6 months later complete bone repair was noted (Figs. 9,10).

The implant exposure was performed 4 months later using free palatal epithelial flap split in the shape of mesh, consequently, implant abutments were surrounded with dense attached keratinized gingiva (Fig. 11). Four weeks after the uncovering surgery, prosthodontic part of the treatment in the maxilla began.
For the provisional prosthesis, interim abutments (implant carriers) with external hexagonal connections were used. The fabricated removable prosthesis was adapted to the inserted abutments. Due to provisional restoration, the patient received fixed interim prosthesis soon after the uncovering (Fig. 12). During the fabrication of final prosthesis, the patient was rehabilitated prosthodontically.

For the final restoration, straight “Tin-plus” abutments with a collar height of 1 mm were used. To select abutments, orthopedic platform switch technique was used. The abutments were machined in a surveyor. Zirconium frameworks for the implant abutments were fabricated and machined with a dental turbine in the surveyor with an angle of 2° (Fig. 13).

In “AGC Micro Weiland” machine, galvanic caps for zirconium frameworks were fabricated (Fig. 14). A tertiary framework
made of chromium-cobalt-based alloy was fabricated to place on the galvanic caps. The zirconium frameworks were cemented on the implant abutments with “Fuji+” cement. The tertiary framework was fixed to the galvanic caps with “Nimetic Cem” 3M Espe (Fig. 15). The centric relation was determined. The restoration was checked in the oral cavity. Then, the final prosthesis was fixed (Figs. 16-19).

Conclusions and Discussion
The treatment of total edentulism is a medical and social problem that is expected to remain in the future due to the increase in life expectancy. Prosthetic treatment of the elderly patient with traditional removable restorations doesn’t allow us to restore completely the functions of the stomatognatic system and results in a significant compromise in patients’ quality of life. The prosthetiologic treatment of edentulous patients is more effective, but is complicated by a number of factors, where advanced bone atrophy and changes in oral mucosa associated with edentulism are the most important. For this reason, further development and refinement of bone reconstruction and soft tissue management are very topical. Very promising, in our view, is the use of tibial cortical grafts to perform alveolar reconstruction. The use of tibial grafts has some advantages over other techniques in that it permits a greater amount of grafted tissue, has lower morbidity, uses less invasive surgical technique, is performed in an out-patient setting, permits a bone repair of good quality and complete and quick donor site restoration of bone tissue.

When fabricating implant-supported prostheses in general and removable prostheses in particular, it is vital that the dense gingival tissue be placed around the implants. “The masticatory mucosa” (as the keratinized gingiva is sometimes referred to) protects the osseointegration zone and prevents inflammatory complications. The dense keratinized gingiva is capable of self-cleaning, which is very important to patients with limited hygienic skills in older age groups.

In spite of psychological advantages and convenience of use, an implant-supported fixed prosthesis to treat total edentulism or advanced bone atrophy has a number of disadvantages. The first disadvantage is the complicated hygiene. Both self care and professional care are prerequisites for long term function of an implant-supported prosthesis. Sometimes it is extremely difficult for patients, especially the elderly, to clean a fixed prosthetic restoration on all sides. However, the possibility to remove and clean the restoration and gain access to implant abutments to clean them is the primary prevention of mucositis and peri-implantitis and, consequently, implants loss as a result of inflammatory complications. The above described prosthetic construction combines the advantages of a fixed prosthesis; due to a very precise fit, the patient feels the prosthesis as a bridge or his own teeth. At the same time, the patient can take it out and provide hygienic care for the prosthesis and implants. The second disadvantage of fixed implant prosthesis, such as FP-3 (fixed prosthesis which replace crown, part of the root & part of the gingiva) according to Misch classification, is speech disturbance. Too long tooth crowns and loose contact between a framework and the palate impede the pronunciation of sibilants and some vowels. In contrast, a removable prosthesis on telescopic crowns closely fits to the palate and doesn’t cause such problems. To fabricate an implant-supported fixed prosthesis, 8 to 10 implants are required. A prosthesis on telescopic crowns can function, at least, on 4 implants in the presence of other favorable factors.

Removable telescopic prostheses are as good as ceramic-to-metal prosthesis. In addition, they are significantly lighter than ceramic-to-metal prosthesis, whose framework often weighs more than 40 g (in either arch) in such clinical situations. They are also lighter than a screw-retained metal-plastic hybrid prosthesis whose metal framework is by far bulkier and heavier than a tertiary framework of a removable prosthesis on telescopic crowns.

The important advantage of this prosthesis is the possibility to repair as well as the possibility to splint teeth and implants (taking into account prosthesis biomechanics), which permits the preservation of proprioceptive sensibility of natural teeth, which, in turn, protects the prosthesis from overloading. In the described clinical case, we managed to retain two opposing natural teeth in the mandible. In addition, change in jaw position in the sagittal plane inevitably occurs in total edentulism, and the so called senile prognathism precludes the fabrication of a fixed prosthetiologic restoration.

CAD-CAM technology to fabricate a primary prosthesis framework and galvanic caps by means of galvanoplasty provides the high precision of the component fit. Passive glue fixation in the oral cavity sets off possible inaccuracies of the tertiary prosthesis framework. A galvanic cap and zirconium framework machined by a special cutter in a water-cooled dental turbine ideally fit each other and provide smooth and unimpeded movement of the cap on a primary framework during insertion and removal of the prosthesis. Due to passive fixation of the tertiary prosthesis bone tissue around the implants doesn’t experience strains that can occur after fixation of the traditional metal-cast framework that splints several implants.

Thus, the innovative approach to surgical preparation and prosthetiologic treatment of patients with total edentulism allows us to perform oral rehabilitation of patients with such a condition in shorter terms and in out-patient setting and fabricate implant-supported removable prosthesis on telescopic crowns made with CAD/CAM technology and with reliable prosthesis fixation, ease, high esthetic qualities and convenience of use.

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References