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Application of TiNi Dental Implants with Permeable Porosity in Patients Rehabilitation with Different Adentia Options

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Abstract

The results of the dental prosthetics based on intraosseous implants made of porous nickelid titanium in 650 patients aged 15-75 years have been presented. The atrophy of the alveolar processes was eliminated by means of the osteogenic tissue grown in the iliac crest thickness having the structure between the hyaline cartilage and coarse-fibered bone tissue. Satisfactory functioning of the orthopedic constructions within 7-8 and more years was observed in 496 (76,3%) patients, the advantages of this treatment methods have been specified.

1 Introduction

The effectiveness of rehabilitation measures in patients with the partial or complete absence of teeth is considerably associated with introducing into the clinical practice the implantation of the artificial dentures supports into the jaw bones providing more complete restoration of masticatory efficiency, fast

adaptation, high aesthetics of the used structures if compared with other kinds of orthopedic correction. By the present moment the theoretical concepts and techniques have been developed in this direction, the extensive clinical experience of using different methods with the application of various types of implantable structures which are as a rule made of titanium (the materials that do not exhibit the lag effect) has been gained [1-13]. The results of implantation and the subsequent dentures don't always satisfy the patients and clinicians due to not long-lasting dental prostheses and implants functioning. The most frequent complication of dental implantation is the disharmonious interaction of the implantable structures with the recipient area tissues resulting in their loss. It can be caused by the osteogenesis disorders which are associated with the bone wound suppuration, insufficient blood microcirculation in the jaw bones, immunological body disorders, excessive trauma during the surgical intervention, etc. as well as in major cases the lack of biocompatibility of the applied implantable materials with the body tissues.

The problem of dental implantation in patients with multiple teeth missing and pronounced symptoms of the alveolar processes osseous tissue insufficiency is of particular relevance nowadays. The indicated condition impedes and drastically limits the use of the intraosseous implants. The developed techniques of subperiosteal and transosseous implantation are not widely used due to low efficiency. To restore the anatomical and functional capacities of dental-maxillary apparatus in this category of patients, it is necessary to include the reconstruction of the lost bone structures into the complex of rehabilitation measures. A vital role in dental implantation success play the qualitative characteristics of the perceiving bone tissue affecting directly the regenerative function such as the trabecular bone volume, the volume density and the osteoid thickness, the apposition and mineralization rate, the resorptive activity. These characteristics are reduced in patients with osteogenesisimperfecta, metabolic disorders of bone tissue, osteosisdeformans, different variants of osteoporosis as well as in older patients and the elderly.

Objective: to increase the efficiency of patients' rehabilitation with adentia on the basis of new medical technologies of dental implantation development using the shape memory materials.

2 Experimental

The work is based on the treatment experience of 650 patients aged 15-75 years with complete or partial adentia which is characterized by the absence of one or more teeth. To diagnose, to determine the treatment tactics, the volume of surgical intervention and the constructive dentures' peculiarities, the analysis of immediate and remote results, all the patients underwent the clinical examination including the condition assessment of maxillofacial area in general, dentitions, jaws, a mucous membrane of the oral cavity, the study of X-ray images of the dental-maxillary apparatus. Besides, general health was evaluated (presence or absence of the internal organs pathology, blood rheological properties, immune status).

The complex of therapeutic measures in patients with somatic pathology in addition to the local influences included general therapy as well aimed at its elimination, the correction of rheological properties of blood and immune system which could cause a disease and/or negatively affect the reparative processes course in the surgical wound. After the body's physical data normalization the surgery was performed on the jaw bones.

The dental implantation was carried out with the application of structures based on porous-permeable nickelid titanium (Fig. 1) developed at Research Institute of Medical Shape Memory Materials and Implants (Tomsk) adapted to the biological systems. Biochemical and biomechanical compatibility with the body tissues, the presence of through permeable porosity ensured their harmonious interaction with the recipient's bone bed and long-term functioning of the orthopedic construction as an integral part of the restored dental-maxillary apparatus structure.

In patients with the alveolar processes' osseous tissue insufficiency the reconstruction of the latter was performed before implantation using the osteogenic tissue grown in the iliac crest thickness having the structure between the hyaline cartilage and coarse-fibered bone tissue (Patent of the Russian Federation №2180812). Due to the high content of poorly differentiated bone cells of mesenchymal origin as well as the properties of the diffuse nutrients, apposition and interstitial growth and anaerobic glycolysis this tissue in the defects wasn't resorbed and its cells were actively involved in the processes of reparative osteogenesis forming the organotypic regenerate in the bone wound.

In order to enhance the reparative capabilities of the recipient bone tissue before inserting the intraosseous implant parts, the fibrous nickelid titanium of the 30-40 microns thick filament yarn was placed in the formed burr holes in the jaw bones thickness (Fig. 2). In individuals with the poriferous bone structure by analogy fine-grained porous nickelid titanium with the particles size 1-500 microns was used (Fig. 3). To prevent the formation of bone pockets around the implants necks during the orthopedic constructions functioning, the alveolar process before the wound suturing was covered with thin-profile textile nickelid titanium (Fig. 4).

The orthopedic measures were carried out after 3-4 months from the implantation. The treatment outcomes were assessed on the basis of clinical observation and X-ray at the earliest date and up to 8-10 or more years after the dental prosthetics.

Fig. 1. Porous-permeable dental implants

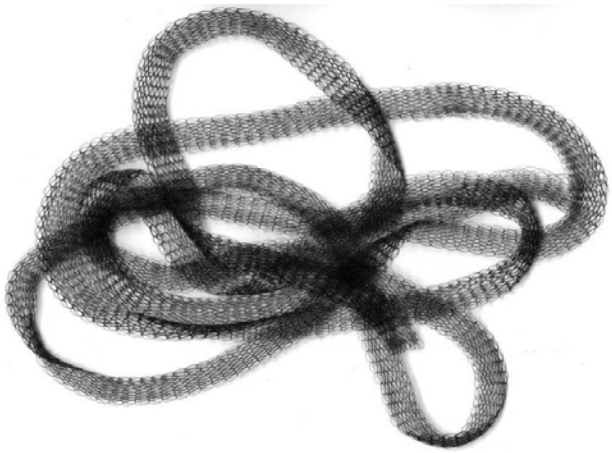

Fig. 2. Textile thin-profile nickelid titanium

Fig. 3. Textile thin-profile nickelid titanium under the dental implants in the surgical wound

Fig. 4. Textile thin-profile nickelid titanium

3 Results and discussion

In 574 patients (88,3%) the primary wound healing was observed. In 36 (5,5%) cases the complications were marked in the form of partial suture line disruption and secondary wound healing in the projection 1 (1,3%), 2 – (2,2%) or 3 (2,2%) implants during the next 2-2,5 weeks. In 40 patients (6,2%) the flaccid inflammatory reaction of tissues in one or several implants' projection was detected that subsequently led to their loss and required reimplantation or manufacture of the orthopedic structure taking into consideration the remaining implants.

Adaptation to the orthopedic structures proceeded from 7 to 14 days after which the patients reported the satisfactory functional state of the dental-maxillary

apparatus. In all cases the satisfactory aesthetic outcome was obtained. The subsequent clinical observations didn't reveal any functional disorders, the dentures reports were satisfactory. The X-ray analysis in the remote period after the treatment (8-10 years) enabled to make a conclusion about the absence of bone tissue signs resorption in the dental implants projection and on the part of the prosthesis bed in 496 (76,3%) patients. After 2-3 years the partial resorption of the bone tissue in the area of one or several implants was detected in 25 (3,8%) patients, 3–4 years – in 34 (5,2%), 4–5 years – in 26 (4,0%), 5–6 years – in 29 (4,5%), 6–8 years in 40 (6,2%) patients.

Fig. 5shows a radiographic picture of a 63-year-old patient with the complete maxillary and mandibular adentia as well as the alveolar processes atrophy after the unsuccessful dental implantation rehabilitation with the titanium structures in the thickness of the mandibular body chin section and removable dentures. In post-rehabilitation period due to the continued atrophy of the alveolar part, there was the localization of the mandibular neurovascular bundles under the mucous membrane. The reconstruction of the alveolar processes by osteogenic tissue and dental implantations using porous-permeable cylindrical nickelid titanium structures was performed with the subsequent dentures.

a b

Fig. 5. A radiographic picture of a 63 year-old patient: a – before; b – 36 months after the dental prosthesis based on dental implants

4 Summary

Thus, porous-permeable dental implants of alloys based on nickelid titanium enable to create a secure base for removable and fixed orthopedic structures. Biocompatibility of nickelid titanium with the organism tissues provides the bone tissue ingrowth on the part of the recipient areas through the porous implants'

structure and their long-term functioning. 25-year-old experience, the positive outcomes regarding the reconstruction of alveolar processes using the osteogenic tissue and dental implantation as well as the consequent orthopedic treatment allow to make a conclusion about the high efficiency of the developed technology including the clinical situations which earlier were not considered perspective for this rehabilitation type.

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