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THE STUDY OF STRUCTURAL CHANGES IN BONE TISSUE OF ALVEOLAR PROCESS OF JAWS IN EXPERIMENTAL ANIMALS AFTER IMPLANTATION OF A NEW CONSTRUCTION OF DENTAL IMPLANT FROM TITANIUM BT-1.00 DEVELOPED IN UZBEKISTAN

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ABSTRACT

The widespread introduction of dental implant in the dental practice will determine progress and the future of prosthetic dentistry. At the same time, like any new direction dental implantation has generated a lot of questions and unsolved problems. On many of these issues and problems can be answered only by using morphological methods. Therefore, after the development of a new construction of the dental implant one of the main issues was the question of its interaction with the jawbone and soft tissues of the oral cavity.

We performed the experiment on 24 long snout dogs of both sexes, weighing 30-35 kg, with normal bite, at the age of 20-24 months. Animals were divided into 2 groups, according to samples of screw dental implants used in the experiment: basic group - 12 dogs in which were used samples of the new construction of dental implant “Implant.uz” (Uzbekistan); control group – 12 dogs in which were applied screw dental implant system “Dentium” (South Korea). Terms of derivation of animals from experiments were 1, 3, and 6 months.

By using morphological techniques were studied implants “Implant.uz” from medical titanium BT-1.00 brand, their interaction with bone of alveolar ridge. “Implant.uz” did not cause pathological changes in the bone tissue of alveolar ridges of jaws and could be an alternative to known dental implants.

UDC CODE & KEYWORDS

■ UDC: 612.8 ■ Dental implant “Implant.uz” ■ Morphological studies ■ Alveolar ridge ■ Bone tissue

INTRODUCTION

The use of implants from medical titanium BT-1.00 brand in orthopedic dentistry, as well as in other sections of clinical medicine, has shown their good compatibility with biological tissues. Titan is a ductile metal, which responds well to machining: cutting, drilling, milling, grinding. Making from it different constructions as not harder as from stainless steel. Titanium is a nonmagnetic material having a low electrical conductivity that is particularly valuable because it can be used in physiotherapy of patients who have titanium constructions in the body. All this makes titanium a very promising for widespread use in medicine (Steinemann, 2000).

However, long standing comprehensive studies demonstrate that titanium is an inert metal with respect to the biological environment that is very important. Constructions from titanium alloys are well tolerated in the human body, covered by bone and muscle tissues. Metal practically does not corrode in aggressive environments of the human body, and the structure of tissues surrounding titanium do not changed for a long time (Buser et al., 1991; Ivanov, 2000). By chemical indifference titanium exceeds not only all stainless steels, but also recently widely used “vitallium” - cobalt-based alloy. It is valuable that technically pure titanium contains much less impurities than other alloys used in medicine (Volozhin, 2010).

Currently, orthopedic stomatologists of Uzbekistan use imported implants, mainly of “Dentium” company (South Korea). Their relatively high cost identified the need to establish domestic dental implants with lower cost but high quality.

To implement them into daily practice is necessary to study features of the structure of surface of these implants and their interaction with oral soft tissues, especially with bone tissue of alveolar processus. Carrying out this type of study is only possible under the experimental conditions (Paraskevich, 2002; Nikolsky, 2005).

In this study, we studied the interaction of «Implant.uz» with bone tissue of alveolar ridge of jaws for the first time. This led to conduct relevant morphological studies. Carrying out these morphological studies was permitted by the Ethics Committee of the Ministry of Public Health of the Republic of Uzbekistan (Extract No.07/08 of the Protocol of meeting No.06 of the Ethics Committee of the Ministry of Public Health of the Republic of Uzbekistan).

The aim of our study was to investigate the interaction of a new construction of dental implant, developed in Uzbekistan, with bone tissue of alveolar processus of jaws and to comparatively evaluate with the results of dental implant “Dentium” (South Korea).

Materials and Methods

The experiment was performed on 24 long snout dogs of both sexes, weighing 30-35 kg, with normal bite, at the age of 20-24 months. Animals were divided into 2 groups, according to samples of screw dental implants used in the experiment: basic group - 12 dogs in which were used samples of the new construction of dental implant “Implant.uz” (Uzbekistan); control group - 12 dogs in which were applied screw dental implant system “Dentium” (South Korea). Operation was carried out under aseptic conditions. After the treatment of a surgical field, under intravenous injection of 2% solution “Rometar” and local anesthesia of 0.5% solution of “Novocainum” in the operating area implants were installed in the area of missing tooth after preparation of bed with special titanium cutters. On implants were fitted plugs and the wound sutured. Pets were

derived from the experiment by introducing lythical dose of inhalation anesthesia “Izofuran”. Terms of derivation of animals from experiments were 1, 3 and 6 months. As a result of the experiment, we prepared and studied 24 units of jaws from experimental animals and 168 histological sections.

Fragments of jaw with implant and the adjacent intact teeth were excised and dissected for further morphological studies.

For light microscopy, samples of soft tissues were fixed in 10% solution of formalin in phosphate buffer. Paraffin sections were stained with hematoxylin and eosin. Bone tissues after fixation in 800C alcohol were washed with water and decalcification using EDTA by Freiman was carried out. For that 5% aqueous solution of EDTA was adjusted with sodium hydroxide to a pH of 6-6.5. Demineralization was carried out at first 24 hours at the temperature of 400C and then at room temperature with regular monitoring and changing EDTA until 24 days. Further processing and coloring was the same as for soft tissues.

Light optical stereomicroscopic study of implants and native preparations (without filling and fixation) was performed using a stereomicroscope SMP-1 with increasing.

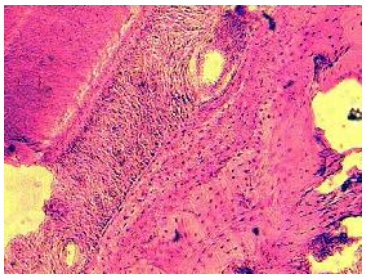
For scanning electron microscopy (SEM), tissue was fixed in 2.5% glutaraldehyde solution in phosphate or cacodylate buffer with further fixation with osmium tetroxide in phosphate buffer. Then tissue was dehydrated in alcohol-acetone and was dried by the critical point method in the device HCP-2, was sputtered with gold in the apparatus IV-2 and was viewed in the electron microscope Hitachi-S405. Samples were photographed from the monitor screen with a digital camera Canon.

Samples of implants were studied and photographed using a stereoscopic microscope. Light optical microphotographs were obtained on a microscope Axioscop 40-ZEISS conjugated with digital camera and computer.

Results and Discussion

Our studies of bone tissue of jaws of experimental animals and their alveolar ridges on decalcified sections showed certain peculiarities. Unlike tubal bones where Haversian canals are oriented predominantly along the long axis of bone, there is no such unidirectional orientation in the jaw bones, especially in their alveolar processes, serving bed for the roots of teeth. In the lumen of the Haversian canals are located blood vessels with red blood cells in their lumen. Haversian canals are surrounded by the main substance of bone with numerous osteocytes. Periosteum, which is formed by fibers and fibroblast-type cells oriented parallel to the surface of bone, closely fits to the external surface of the alveolar bone, not contacting with the tooth root (Figure 1).

Figure 1: Bone tissue of alveolar ridge in contact with tooth root. Control H-E 10x10



Source: Authors

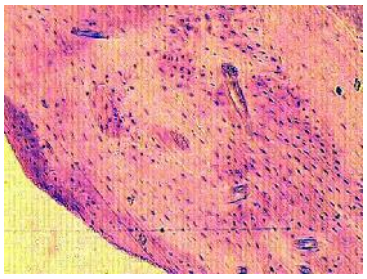
Bone of the alveolar ridge in contact with the implants, both domestic (Uzbekistan) and the firm “Dentium” (South Korea), even in the early period of observation was not exposed to any significant morphological changes.

At one month after implantation of domestic implant Haversian canals with blood vessels in them were clearly determined. Bone basic substance and osteocytes were the same as those.

The similar picture was seen after implantation of implants of “Dentium” firm.

At later periods of observation (3-6 months), bone tissue of alveolar ridge, which was in direct contact with domestic implant, was not changed. Numerous osteocytes with unidirectional orientation were around Haversian canals in the bone basic substance (Figure 2). In the lumen of Haversian canals were blood vessels with enhanced lumen containing red blood cells and other blood cells.

Figure 2: Bone tissue of alveolar ridge at 3 months of implantation of “Implant.uz”. H-E 10x10



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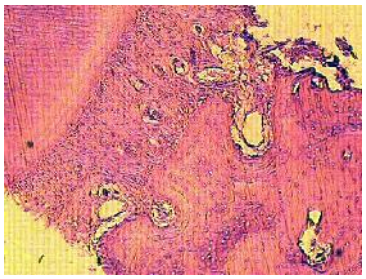
The state of the alveoli with normal tooth adjacent to the implant indicated that domestic implants did not have any pathological effect on alveolar bone. Along with unchanged alveolar bone, there was the normal state of structure of the periodontal ligament, all layers of cement and dentin of the tooth. The collagen fibers of the periodontal ligament, merging through periosteum and contacting with its structures, penetrate as Sharpeevski fibers to border areas of alveolar bone (Figure 3).

Figure 3: Bone tissue of alveolar ridge in contact with tooth root at 6 months of implantation of “Implant.uz” into the next alveolus. H-E 10x10



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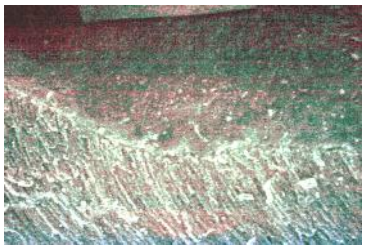
Scanning electron microscopy (SEM) demonstrates the absence of negative influence of domestic bone implants on bone tissue of alveolar process around the implant and teeth adjacent to the implant.

At 3-6 months after implantation, tooth root cement and dentin had characteristic structure (Figure 4).

Figure 4: Unchanged three-dimensional structure of dentin and dentinal tubules at 6 months of implantation “Implant.uz” into the neighboring alveoli. SEMx200



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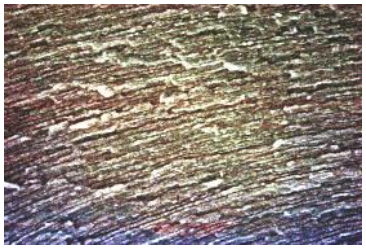
Dentinal tubules were flat, lied parallel to each other (Figure 5).

Figure 5: Unchanged three-dimensional structure of dentinal tubules at 3 months of implantation “Implant.uz” into the neighboring alveoli. SEMx400



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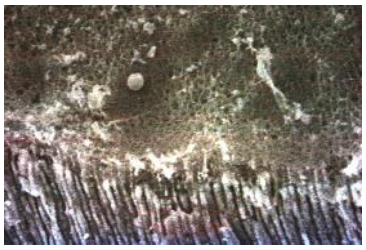
There were no any inclusions in the lumen of dentinal tubules (Figure 6).

Figure 6: Unchanged three-dimensional structure of dentinal tubules at 6 months of implantation “Implant.uz” into the neighboring alveoli. SEMx1000

Source: Authors

Pulp chamber had equal around mouths of dentinal tubules (Figure 7).

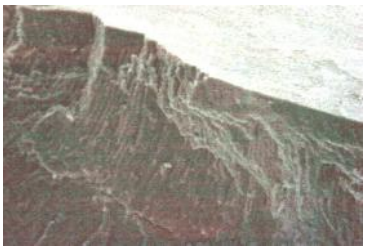
Figure 7: Mouths of dentinal tubules in pulp chamber at at 6 months of implantation “Implant.uz” into the neighboring alveoli. SEMx600



Source: Authors

The enamel surface was smooth, without any defects, enamel prisms had typical tortuosity (Figure 8).

Figure 8: Unchanged enamel prisms and enamel surface at 6 months of implantation “Implant.uz” into the neighboring alveoli. SEMx600



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Conclusion

The experiments performed on laboratory animals have proved that implantation of a new construction of dental implant “Implant.uz” (Uzbekistan) allows the formation of a full set of “implant-bone” and has no pathological effects on bone tissue of alveolar processes of jaw-like implants of “Dentium” firm (South Korea). After implantation of a new construction of dental implant “Implant.uz” (Uzbekistan), bone adheres tightly to the implant in the early period of observation (1 month). At the same time, on the surface of the implant, it is quite smooth, without extraneous inclusions and overlays. In this regard, discrete particles are revealed on the surface of the implant that constitute the bone fragments (crumbs) arising as a result of implants separation from the main body of the jaw bone. After some time of observation (3 months), the interaction between the implants and the jawbone is not significantly different from that observed during the previous period of observation. The bone is tightly adherent to the metal surface of the implant. There are no foreign inclusions, overlays and cavities in the contact zones. The implant itself is not subject to any change as well. During the latest observation period (6 months), the picture is similar to that observed during the earlier observation periods. Bone surrounding implant bonds tightly to its surface. On the surface of the bone, inclusions or overlaps are not seen between the implant surface and the bone; no cavity can be detected. However, on the implant surface, the above discrete particles are found, which are fragments of the jaw bone, splinter during the selection of the sample.

Thus, dental implant “Implant.uz,” made from titanium BT-1.00 brand is completely bioinert for the body enabling its application in dental implantation.

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