Federal State Budgetary Educational Institution
of Higher Education
"NORTH OSSETIAN STATE MEDICAL ACADEMY"
of the Ministry of Health of the Russian Federation

Department of Dentistry No. 2

METHODOLOGICAL RECOMMENDATIONS FOR STUDENTS

MODULE

"GENERAL ISSUES OF DENTAL IMPLANTOLOGY"

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Topic: GENERAL ISSUES OF DENTAL IMPLANTOLOGY

The purpose of the training: coverage of the history of development, theoretical and practical aspects of dental (dental) implantology, study of the main methods of dental implantology, types of dental implants.

Issues to be studied:

1. The main historical milestones in the development of dental implantation.

2. The formation of domestic dental implantology.

3. The main methods of dental implantation, depending on the ratio of the implant to the jawbone and the gum covering it.

4. Methods of dental implantation in relation to the moment of tooth extraction.

5. Methods of creating artificial supports for fixing dentures.

6. Materials and technologies for the manufacture of dental implants.

7. Types of dental implant designs.

HISTORY OF DENTAL IMPLANTATION

Since ancient times, attempts have been made to replace lost teeth with their artificial analogues. Ancient Egyptian manuscripts contain references to the "implantation" of animal teeth and teeth made of ivory to man. Dental implantation structures of ancient times were found during excavations in China.

The Harvard University Museum has a fragment of the Inca mandible dated to the VI century BC, which preserved implants made of the shell of sea mussels in the holes of 31,41 and 42 teeth. An Inca skull, about 1200 years old, with 32 teeth made of quartz and amethyst, is on display in one of the museums of Peru.

Dental implantation was also performed in ancient Europe - in France, the skull of a 30-year-old woman who lived in the I century AD was found with a metal implant in the hole of the upper canine. The history of the early Byzantine Empire includes a dental implant discovered in 1991 in Anatolia (Turkey), carved from stone and installed to a patient in the middle of the VI century AD.

However, then followed the general decline of European culture. In the period from the VI to the XVIII century, doctors, if they were engaged in odontoplasty, it was mainly reduced to dental transplantation. Only in the Renaissance there is an indirect mention of dental implantation - G. Bauer's treatise on the history of medicine, published in 1556, reports on the use of implants made of metal in Sicily.

The consistent development of medicine in the XIX century revived the idea of dental implantation. An active surge of attention to this problem began in the 1880s. So, J.

Magillo [1886] installed a one-stage gold implant in the alveolus in place of the removed tooth and attached an artificial crown to it. J. Edmuns and N. Harris [1886, 1887] proposed using a porcelain implant on a platinum frame and an implant made of lead with a rough surface. S. Perry developed a method for surgical formation of holes in the jaw bones for the introduction of implants.

In Russia, the founder of dental implantology is a private associate professor of the Medical Faculty of Moscow University Nikolai Nikolaevich Znamensky (1856-1915). In 1885, he headed the first university course on dental diseases in our country. The most important historical milestone was the work of N.N. Znamensky entitled "Implantation of artificial teeth", reported in St. Petersburg at the IV Pirogov Congress of Doctors in early January 1891 and published in the same year in the journal "Medical Review".

N.N. Znamensky owns a number of discoveries in dental implantology. He was one of the first scientists in the world to understand the preference of implantation before dental transplantation and began to apply the introduction of an implant into a bed artificially formed in a whole bone. His achievements include the manufacture of implants with recesses and subsequently with through holes on the intraosseous part, as well as the technique of inserting implants into the bone "with strain". He also proposed the terms "implant" and "implantation" for professional Russian.

On November 13 (26), 1890, N.N. Znamensky performed the first dental implantation operation in Russia. In the area of the upper left lateral incisor, removed 1.5 months ago, a new cell was "drilled", made even deeper. A porcelain implant was installed in the created bed and attached with silk threads to the adjacent teeth. Following this, in November-December 1890, Znamensky conducted experiments on three dogs, which were injected with 2 porcelain and 3 rubber implants, followed by morphological examination of the surrounding bone tissue.

N.N. Znamensky formulated the key conclusion of his work as "the fact of a strong mechanical accretion of an artificial tooth in a bone cell," and the implant "perfectly fulfills its purpose when chewing food and does not irritate the surrounding tissues at all."

Further research work was carried out in the direction of improving the material and design of dental implants. A. Hartmann reported on the method of fixing an artificial crown to the implant using a screw. R. Pajme [1901] used a silver implant in the form of a tube. U. Greenfield proposed to perform a platinum implant in the form of a basket with fixation of its crown part by means of a special lock.

However, all attempts at dental implantation remained short-lived until A. Strock achieved a successful result for the first time in history. In 1938, he placed an implant in a fresh post extraction alveolus that had served the patient for 17 years, and another implant turned out to be functioning for more than 40 years.

In the works of A. Stroka, success was ensured by three fundamental innovations. Firstly, he used a screw implant design, the prototype of which was a threaded implant invented by R. Adams [1937]. Secondly, A. Strock used a new generation of cobalt-chromium-molybdenum steels, in particular the Vitallium alloy, developed in 1936. Thirdly, this specialist was one of the first who began to use bone-plastic impact during dental implantation: he applied auto structure by placing it around the implant.

The possibility of stable functioning of intraosseous implants as supports for dentures was proved by M. Formiggini. In the 1950s, U. Pasqualini, during experiments on dogs, established the abutment of the jaw bone tissue to a functioning implant without the formation of a connective tissue capsule, but with the formation of a thin layer of collagen fibers starting in the bone matrix.

Domestic dentists E.Ya. Vares [1955] and S.P. Mudry [1956] defended the first dissertations on dental implantation in our country, and histologist V.G. Eliseev published the first article about implants in the central journal "Dentistry" [1956, No. 1, p. 50]. It is interesting that in these works the continuity of the Russian scientific school was manifested: the theme of the work

E.Ya. Vares was proposed by A.I. Evdokimov, who was a student of G.I. Vilga, and he, in turn, had N.N. Znamensky as a mentor.

The studies of E.Ya. Vares, S.P. Mudryi and V.G. Eliseev concerned the replacement of teeth with plastic implants. However, due to the imperfection of materials and techniques, attempts to use them in patients were not successful enough, and this method of treatment was banned in the USSR since 1958.

The "golden age" of dental implantology began in the 1960s. The founders of this period were L. Linkow and P.-I. Branemark. Their work was the two origins of the "new era" of the use of implants for prosthetics.

Starting in 1961, L. Linkow, V. Henrich, I. Roberts and R. Roberts independently developed implant designs that for the first time differed from the shape of the tooth and were acceptable for insertion into atrophied areas of toothless jaws. In 1967, L. Linkow proposed a plate design with holes (blade-vent implant) and founded a method of its application. The implantation was performed in one stage, the technique was simple and convenient and allowed to complete the prosthetics in a short time.

It was with L. Linkov that the widespread introduction of dental implants into dental practice began. N. Grafelmann played an important role in popularizing dental implantation, who organized annual international courses for teaching the method from 1969 to 1989. In 1970, G. Grafelman created and until 1986 headed the famous German Society of Dental Implantology (DGZI), which played a huge role in the worldwide spread of implantation.

For the development of the second source of modern dental implantology, an important role was played by the beginning of the use of titanium as an implantation material - in 1951. Of great importance was the gradual improvement of the design of the intraosseous screw implant - S.

Since 1952, P.-I. Branemark has been conducting vital microscopy studies using titanium optical cameras at the University of Gothenburg (Sweden). In the course of experiments on toothless dogs, the phenomenon of a direct and strong connection of bone tissue with the surface of an implant installed in a precisely and atraumatically formed bed was discovered. In 1965, a collapsible two-stage intraosseous titanium screw implant was constructed, and its clinical application began in the same year.

Based on deep and carefully conducted experimental morphological work, as well as taking into account the accumulated large and clearly documented clinical material, in 1977, Professor Branemark's group called the type of interaction between the implant and bone osseointegration, and this concept was the foundation of the scientific justification of modern implantology.

In 1975, N. Tatum-Jr. from the American city of St. Petersburg, for the first time, he began to perform bone augmentation operations in the area of the bottom of the maxillary sinus (sinus lift).

In 1978, a Conciliatory conference "Implantation: Benefits and Risks" was held at Harvard University, organized by the US National Institutes of Health (NIH). The 4 most commonly used implantation systems at that time were presented: flat Linkov implants, subcostal, transmandibular and implants made of vitreodentin in the form of a tooth root. This forum was an important step to overcome distrust of the effectiveness of dental implants on the part of both practitioners and dental management bodies.

In 1982, at a conference in Toronto, P.-I. Branemark proved that the method of osseointegration guarantees the long-term success of dental prosthetics on implants. This determined the widespread introduction of its implantation system by official dental institutions.

In 1978, at a meeting of the Ministry of Health of the USSR, A.I. Evdokimov raised the problem of dental implantation and justified the need for its development. Overcoming the stagnation of Soviet medicine, in 1981 in Kaunas a group of Professor S.P. Chepulis, which included the SS. Surov and A.S. Chernikis, the beginning of the clinical use of implants. In 1983, they opened the first implantological institution - an Experimental laboratory of Dental Implantation and Prosthetics. In 1984, these authors published guidelines on dental implantology for the first time in Russian.

The scientific and practical activities of M. 3 Mirgazov in Kemerovo and other Siberian cities were of great importance for the recognition of implantology in our country.

In 1984, this scientist proposed the concept of indicators of the functioning of implants, which still remains the most adequate system for assessing their condition. In Ukraine, under the leadership of S.I. Krishtab, V.V. Los defended his dissertation on the topic "The use of implants in prosthetics of end defects of dentition" in 1985.

The central dental structures - MMSI and TSNIIS -, for their part, carried out long and painstaking preparations for the official recognition of dental implantation, a lot of work was done to familiarize themselves with foreign experience in the field of dental implantology. As a result, on March 4, 1986, the Ministry of Health of the USSR issued Order No. 310 "On measures to introduce into practice the method of orthopedic treatment using implants." This document opened the way for the active development of dental implantation on the scale of the entire domestic dentistry.

In May 1986, the Department of Implantology of TSNIIS was opened under the leadership of A.I. Matveeva. In 1987, guidelines were written. In the same year, V.I. Olesova's first PhD thesis "Experimental clinical and biochemical substantiation of the choice of implants in the clinic of orthopedic dentistry" was published in a new, state—legitimate era.

In 1987, dental implantation was recommended by international dental organizations (FDI and ADI) for wide application in clinical practice. The second conference of the National Institutes of Health (NIH) of the USA, held in Washington in 1988, summarizing the world achievements of dental implantology, recognized that the latter is no longer considered as a "scientific method under development", but is a reasonable method of dental treatment.

At the present stage of development, foreign specialists T. Albrektsson [1994], Ch. Babush [2001], M. Block [1997], D. Buser [1993], K. Donath [1991], J. Hahn [2000], J. Kent [1990], P. Ledermann [1998] have made a great contribution to the development of dental implantation], U. Lekholm [1999], C. Misch [1994], Szmukler-Moncler [2000], H. Jr. Tatum [1993], Ch. Weiss [2001], P. Worthington [1992] and G. Zarb [1991]. In Russia, the year 1993 turned out to be particularly fruitful. After the Founding Conference, held on April 20, 1992, in 1993, the Dental implantation section at the Dental Association of Russia was officially organized, headed by Professor M.Z. Mirgazizov. This scientist also created the first educational literature in this field of dentistry — a chapter in the "Manual of Orthopedic Dentistry", published in 1993. In the same year, the first doctoral dissertations were defended in Moscow, Omsk and Samara (Matveeva A.I., Olesova V.N. and Trofimov V.V.) and the first monograph was published (Surov O.N.). Since 1993, regular scientific and practical seminars have been held in St. Petersburg under the patronage

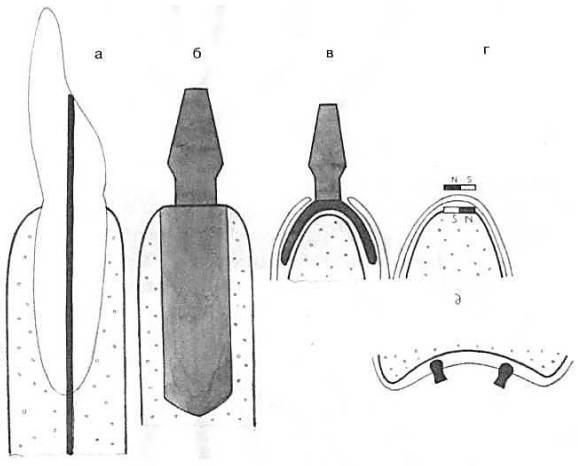
of L. Linkov and the President of the European Association of Implantologists, Professor X. Byurkel.

At the turn of the millennium, there is a real flourishing of dental implantology in our country. Of great importance were the dissertation works of A.A. Kulakov on surgical aspects of dental implantation [1997], F.F. Losev on directed regeneration of the jaw bone in connection with the use of implants [20001 and V.P. Tlustenko on periimplantitis [2003]. The works of A.A. Nikitin and I.M. Fedyaev show the position and role of implantology in the system of maxillofacial surgery. A lot of various studies are carried out under the guidance of S.Y. Ivanov. All these and many other Russian scientists are the successors of the work of N.N. Znamensky for the benefit of Russian healthcare.

To teach dental implantation in Russian universities, an implantology course was organized at MMSI in 1990. Since 1995, the corresponding section has been officially included in the curriculum for the training of dentists. Currently, the Department of Faculty Surgical Dentistry and Implantology and the Research Institute of Dental and Maxillofacial Implantology established there in 2003 are functioning at MGMSU.

METHODS OF DENTAL IMPLANTATION

There are several basic surgical methods for creating artificial supports for fixing dentures, depending on the location of the implant relative to the jawbone and the mucous membrane covering it (Pic. 1).



Pic. 1. Methods of dental implantation: a – endodonto-endossal; b – intraosseous; c – subcostal; d – submucosal; d – intraosseous

Intraosseous (endossal) implantation - involves the placement of the main, supporting element of the implant – the body in the thickness of the bone tissue of the

jaw. Another element of the implant - the neck passes through the mucous membrane into the head (abutment), which serves to fix the artificial crown. This method in the historical aspect was the very first and was the most common throughout the development of dental implantology.

Subcostal (subperiosteal) implantation. The main part of the implant resembles a kind of frame that exactly repeats the external contours of the surface of the jaw bone, and the neck and head are similar to those of the intraosseous method. Subcostal implantation is usually carried out in 2 stages. At the first stage, an incision of the mucous membrane is made, the muco-periosteal flap is peeled off and an impression of the external cortical plate of the jaw is taken. Then a model is made, and in laboratory conditions an implant of a certain shape is made according to an individual impression. The second surgical stage consists in placing the implant on the surface of the jaw bone tissue. This method of treatment was proposed by the Swedish dentist N. Dahl in the early 1940s. For subperiosteal implantation, modern computer technologies are successfully used, which make it possible to produce a fairly accurate three-dimensional model of the prosthetic jaw.

Transosseous (transmandibular) — performed with a sharp atrophy of the lower jaw. One part of the implant in the form of an arched plate is placed in the anterior part of the mandibular bone under its base. Two pins are connected to this plate, which pass through the thickness of the bone tissue and are removed into the oral cavity, where they serve to fix removable prostheses. For the first time such an intervention was performed by I.A. Small (1968), subsequently it was improved by Dutch maxillofacial surgeons N. Bosker and L. Van Dijk.

The submucosal (submucous) method is carried out more often with prosthetics of a completely toothless lower jaw and consists in using a pair or several pairs of magnets. One of them is inserted into the thickness of soft tissues above the crest of the toothless alveolar process between the periosteum and its own plate of the mucous membrane. The second is placed in the plastic base of the removable prosthesis. The mutual attraction of magnets contributes to the retention of the prosthetic structure in a given prosthetic bed. This method was proposed by N. Popov in 1973.

In case of *intra-mucosal or insertion implantation*, the bone tissue of the jaw is also not involved. It is usually used to improve the fixation of a complete removable upper jaw prosthesis. On the inner surface of the base, small button-shaped implants are placed in two rows - along the alveolar ridge and in the recess between the alveolar and palatine processes. Spherical boron in soft tissues, according to the location of the implants, make depressions and install a prosthesis. The patient wears it, almost without removing it, for three days. During this time, the mucous membrane heals, repeating the contour of the implants. The idea of creating the described method belongs to N. Nordgren [1940].

Combined variants of dental implantation have also been developed - for example, the endosubperiosteal method, in which part of the implant body is installed in the thickness of the bone tissue of the jaw, and the other part remains on the surface of the bone. For the first time this method of operation was used by De Grodi [1958].

Another peculiar variant of implantation is considered a kind of intraosseous method, but differs in that part of the implant attachment is made in such places of the jaw bone that are not the place of projection of the dentition. The method is intended for interventions on the atrophied lower jaw and involves the use of an implant in the form of an arched plate, the processes of which are immersed in the bone in three areas - in the chin and branches. This principle was proposed by N. Roberts in 1970.

A special type of dental implantation should be considered *the endodonto-endoosal method*, since it serves not to compensate for the lost tooth, but to preserve the existing one. It can be used after resection of the top of the root of the tooth and to strengthen teeth with affected periodontitis. The essence of the method is that a pin is inserted through the root canal into the underlying bone. An increase in the length of the supporting part of the lever of the corresponding tooth and the insertion of the pin into the intact and dense bone tissue provides an increase in the stability of the dental organ. This type of treatment was first used by M.S. Strock [1943].

It should be noted that of all the listed methods of dental implantation, with the help of which the restoration of removed teeth is carried out, only with the intraosseous method of insertion, implants are installed in the jawbone similarly to natural teeth. This fact of the greatest anatomical and functional adequacy of endossal implantation fundamentally distinguishes it from other options for creating artificial supports for dentures.

Intraosseous dental implantation has a dominant position in modern dental practice. All other methods of using implants in dental prosthetics are used relatively rarely. For these reasons, this teaching manual is mainly devoted to various aspects of the endossal method of dental implantation

For intraosseous insertion of implants, the fundamental issue is the relationship with the moment of tooth loss, depending on this feature, first of all, direct dental implantation is distinguished (synonym: immediate implantation). This method is performed simultaneously with tooth extraction, that is, the implant is installed in the newly released dental well after its appropriate preparation. This principle is the most natural, it was with him that the history of dental implantology began.

The method of direct implantation has important advantages: it promotes the rapid restoration of the implant instead of the removed tooth, and also makes it possible to preserve the original contours of the bone tissue and adjacent gums, However, the direct introduction of implants immediately after tooth extraction has its limitations and difficulties: the method is contraindicated in acute phases of the causal pathological process and inflammatory odontogenic complications, when removing

teeth due to chronic processes, the influence of residual infections, there is an incongruence of the alveoli and standard forms of implants, it is difficult to determine the optimal level of the implant location due to the unpredictability of the process of marginal bone resorption.

Implantation performed in the jawbone after the completion of reparative regeneration processes is more favorable from the point of view of the predictability of the prognosis of treatment. However, under optimal conditions, the complete healing of the bone well after tooth extraction takes from 6 to 12 months. During this period, atrophy of the alveolar process of the jaw occurs, secondary occlusive deformities and other pathological processes in the dental-maxillary apparatus begin. The combination of these changes creates suboptimal conditions for performing dental implantation. The introduction of an implant into the jaw bone later than a year after tooth extraction is called late implantation.

If we analyze what happens in the process of reparative osteogenesis during the year after tooth extraction, it turns out that 2 months is the earliest variant of the formation of primary coarse-fibrous bone in the dental well. In the average clinical case, by this time, the outer part of the alveoli (about 1/3) remains not filled with mineralized tissue. Dental implantation performed up to two months after tooth extraction is designated by us as early.

The earliest term for the completion of reparative osteogenesis of tissues is 6 months. In real practice, by this time, the alveolus is usually filled with immature, poorly mineralized bone tissue, and in many patients, bone formation in the marginal part of the dental well has not yet been completed. We apply the term primary-delayed implantation to the method of placing the implant in the well in the interval from 2 to 6 months after tooth extraction.

In the period from 6 to 12 months, implantation is carried out, which we call secondary-delayed. It is at this time that the completion of reparative regeneration is achieved. A reliable sign of this can be considered the formation of an external cortical plate over a bone wound.

The third section of the classification of dental implantation methods is determined by the ratio of the implant installed in the jaw with the integumentary soft tissues and the period before its inclusion in the function. Taking into account this feature, it is necessary to distinguish fundamentally between single-phase and two-phase methods of dental implantation.

Historically, the first is the method of single-phase operation. It was the method of single-phase implantation that was improved and put into widespread practice by L. Linkov [1967]. The main distinguishing feature of this method is the use of one-piece, non-removable implants, which are otherwise called non-submersible. After the introduction of such a structure into the jaw bone, part of it (the head) is immediately located in the oral cavity, above the gum. This method involves the

manufacture and fixation of a dental prosthesis a short time after surgery - on average 2-4 weeks.

The merit of developing and justifying the use of the principles of two-phase dental implantation belongs to P.-I. Branemärk [1965, 1977]. The essence of this method is that collapsible, submersible implant designs are used, which are installed in the bone tissue of the jaw and covered with a muco-periosteal flap, which ensures hermetic separation of the bone wound and the oral cavity. Then comes the period of tissue adaptation to the implant, which is not subjected to functional load.

According to the classical works of Branemark, the duration of the period necessary to achieve full-fledged osseointegration is 3-4 months on the lower jaw and 6-8 months on the upper. Then a hole is re-made in the gingival integument and, ultimately, its head is fixed to the implant body, on which an artificial crown is subsequently placed.

Single-phase dental implantation is easier for patients to perceive, as it reduces the overall duration of treatment and the number of surgical interventions. However, statistical analysis of a large number of clinical cases with long follow-up periods shows a greater number of favorable treatment outcomes after the use of two-phase implantation, especially in difficult anatomical conditions.

Since the mid-1980s, the so-called open implantation method has been distinguished, based on the principles of the two-phase method. It differs significantly in that after the implant is installed for the period of achieving Osseo integration, a temporary element is inserted into it, located at the level of the mucous-periosteal cover. This structural part is accessible from the oral cavity and at the second stage of implantation, it is not necessary to open the mucous-periosteal cover to access the implant.

MATERIALS AND TECHNOLOGIES FOR MANUFACTURING DENTAL IMPLANTS

The success of dental implantation is largely determined by the quality of the material from which the implant is made, since it must be adequate to the tasks of prosthetics. J. Osborn [1980] divided all implantation materials used in medicine into bio tolerant, bio inert and bioactive, depending on the characteristics of their biocompatibility.

Biotolerant materials are not able to provide a direct physicochemical connection with the bone matrix. When they are introduced into the bone, a connective tissue capsule is always formed. This group of materials includes stainless steel, chromium-cobalt alloys and plastics, which are practically not used in modern dental implantology.

Bioinert materials are characterized by the ability to enter into a physico-chemical compound with the substance of the bone matrix. An important property of these materials is that they are not included in the metabolism of bone tissue and the body does not receive biochemical information about them, therefore there are no immune reactions to the implant. Currently, representatives of this group are considered as the main materials for dental implantation.

Most of the bioinert materials themselves or their surface are chemically considered to be the simplest ceramics, which are based on metal and oxygen compounds. An example is alumina (corundum) ceramics in the form of a poly- or monocrystalline Al2O3 structure. From metals to bioinert include titanium and some of its alloys, as well as zirconium. Oxygen is absorbed from the air on their surface and an oxide film is spontaneously formed. In addition, the properties of bioinertness are inherent in glass carbon and some other substances.

Bioactive materials have a chemical affinity with bone tissue and form the closest contact with it. These substances enter into ion exchange with the bone matrix and are included in its metabolism, which leads to partial or complete replacement of the implantation material with newly formed bone. The listed features are distinguished by calcium phosphate ceramics, hydroxylapatite and bio-glass.

Titanium has found the greatest use for the manufacture of dental implants. In its technically pure form, this metal was obtained in 1950 and in the early 1970s it became a priority material in dental implantology.

Titanium optimally combines the three main requirements for implantation materials: 1) corrosion resistance, 2) mechanical reliability, 3) no toxicity and carcinogenicity. In addition, titanium has a low density (light), high elasticity (5 times higher than that of bone), a small thermal conductivity coefficient, and is not magnetic. Titanium is widespread in nature and makes up 0.44% of the earth's crust. In a small amount, it is present in the body of all animals and plants.

Numerous experimental studies have proved the possibility of the formation of living highly differentiated bone tissue on the surface of titanium implants by direct contact and adhesive mechanisms. In medicine, not a single case of an allergic reaction to titanium has been registered.

The highest purity is characterized by domestic brands VT1-00, VT1-0 (the sum of all impurities does not exceed, respectively, 0.3 and 0.5%). In this form, titanium is used for the manufacture of Russian VNIIMT implants. Close analogues are foreign grades of titanium ISO 5832-II and Grade 1, as well as Grade 2, containing, respectively, 0.5 and 0.6% impurities. These materials are used in implantation systems "IT Straumann" (Switzerland), "Astra Tech." (Sweden), "Branemark" and "Steri-Oss" (both - the company "Nobel Biocare", formerly Sweden, now - USA). Often implant manufacturers in our country and abroad use the Grade 4 brand with

the amount of impurities up to 0.8% — in particular, the company "Konmet" (Russia).

A special position among titanium alloys is occupied by titanium nickelide NiTi. Dental implants with through porosity and shape memory effect are made of it, which can behave in the body like living tissues. The priority of the development and substantiation of these materials belongs to domestic scientists led by M.Z. Mirgazizov and V.E. Gunter.

Recently, zirconium, which is located in the periodic table in the same row with titanium, has been used for the production of implants. The two metals differ in that titanium is 1.5 times lighter than zirconium and has higher strength and plastic characteristics. At the same time, zirconium is characterized by a record low neutron capture cross-section, higher corrosion resistance and increased bioinertness, although its cost is 2 times higher. Domestic "Divadent" implants are made of zirconium.

The following technological processes are used for the manufacture of specific sizes of metal implants. Milling is the most common, which does not significantly affect the physico-chemical properties of the metal, so its biofunctional properties do not change. However, when milling, the surface of the material becomes dirty, and subsequently additional measures are required for its adequate cleaning. With the use of milling technologies, axisymmetric structures are mainly produced.

The second common process is the processing of materials by pressure, which can be produced in the form of stamping or plastic deformation. The latter technology is carried out under the action of friction-rolling of a special roller, while ensuring high accuracy and surface cleanliness, and, unlike stamping, the mechanical properties of titanium are improved.

Methods of powder metallurgy (sintering of titanium powders) make it possible to obtain implants with through porosity, which significantly increases the degree of their connection with bone tissue. Casting makes it possible to obtain products of any shape that are relevant, for example, during subperiosteal implantation. However, the strength of an implant made by casting is difficult to control due to the changed structure of the metal, on which its mechanical characteristics depend.

Ceramic implants are most often made of aluminum oxide. Depending on the purity and technology of execution, monocrystalline (implants "Sapphire", "Bioceram") and polycrystalline ("Kador", "Tubingen", "Biolox", "SHS", "Syntodont") modifications are possible. The clinical use of these types of implants is limited due to the unavoidable fragility of the material, as a result of which corundum ceramics are used only in the form of sufficiently massive structures. Such implants are mainly intended for insertion into the alveolus immediately after tooth extraction - for example, the Tubingen system (Germany).

The disadvantage associated with fragility also applies to implants made of vitreous or pyrolytic carbon. The positive properties of this substance are high biocompatibility and absence of corrosion, as well as biomechanical affinity of bone tissue, expressed by the proximity of elastic modulus.

Bioactive materials are mainly used in the form of coatings, one way or another applied to the surface of metal implants. Plasma spraying on titanium implants of hydroxylapatite and its derivatives is the most studied and widely used, which optimizes their osseointegration, especially when installed immediately after tooth extraction.

The latest developments in the field of bioactive coatings include the Pitt-Easy Bio-Oss FBR implants manufactured by the German company Oraltronics. Plasma spraying of phosphoric acid calcium (SaNRO4 * H2O) with a layer of 15-20 nm is applied to their surface, which purposefully ensures rapid regeneration of bone tissue to shorten the duration of treatment.

The principle of the osteotropic surface of metal implants made it possible to widely use various variants of the developed external microrelief. This characteristic of dental implants is called surface porosity. Moreover, it was found that the optimal pore size for the germination of bone tissue structures should be 100-200 microns.

The texturing of the implant can be created by mechanical processing and etching in acids. The best way to solve this problem is by plasma spraying on the surface of the implant of chemically pure titanium. The first and most famous example of titanium plasma-coated dental implants (TPS) is the Swiss system "IT Straumann".

In addition to the listed basic methods of surface design, the treatment of the intraosseous surface of titanium implants can be performed using physico-chemical methods. These include exposure to high-energy sources - powerful ion beams and the creation of bioactive coatings of electret type in the form of a layer of charged Ta2O5 film. Both innovations were proposed by the group of Professor S.Y. Ivanov and are used in the domestic implant system "LIKo".

The surfaces of the implantation structure in contact with the mucous membrane and protruding into the oral cavity should be carefully polished. The fact is that the smooth surface promotes better adaptation of epithelial cells and prevents the adhesion of pathogenic microorganisms. The purity of polishing at the level of the 10th grade is achieved by electrochemical polishing and plastic deformation.

The intraosseous parts of the implant can also be polished. An example is thin screw non-removable implants for bicortical installation - for example, "Bicortical" ("Oraltronics"). The smooth surface facilitates the insertion of the implant into dense bone to a considerable depth (18 mm or more). Long-term clinical observations of such structures have confirmed their achievement of osseointegration and its preservation when included in the chewing function. Postmortem morphological

studies in people who have used such implants for a long time have shown adequate adaptation of the bone tissue of the jaw to them.

TYPES OF DENTAL IMPLANT DESIGNS

All dental implants are divided into non-removable and collapsible. Non-removable implants are a single whole, that is, their intraosseous and periosteal parts form an integral connection. They belong to the first generation of structures that create artificial support for dentures, although some of these structures are successfully used at the present time - for example, screw implants with a diameter of less than 3 mm.

Collapsible implants are considered the most modern and promising. Their distinctive feature is that the main intraosseous and extraosseous structural elements are separate components. In addition, the complete set of the implant is supplemented with temporary auxiliary components: a plug screw, a gum shaper and others.

According to the shape of the body (intraosseous part), implants are divided into two groups: axisymmetric (in the form of a tooth root) and flat (lamellar). The first group includes cylindrical and screw structures, and the latter can be, among other things, self-tapping.

The general positive quality of axisymmetric implants is the possibility of simple and accurate preparation of the receiving bone bed, which contributes to optimal tissue integration of the implant.

Screw implants occupy the first place in terms of the number of manufactured items and the volume of clinical use (Pic. 2). Most often, the implant body is completely covered with thread, but there are variants of designs with partial coating. The thread can have a different pitch - from a very small one with a large number of turns to a large one when only a few turns are obtained. The thread profile on implants can be pointed, rounded and asymmetrical.

The classic version of the implantation design with a thread provides for the same diameter of the implant body but its entire length "Vgapeshagk". Other modifications of screw implants are designed to taper conically to the tip (in particular, "Frialit-2" and "Replace"). Implant configurations are available in which the body itself is made in the form of a cone, and the thread has a variable, increasing depth, so that the outer contour of its turns forms a cylindrical profile. An example is the "Ankylos" and "Pitt-Easy Bio-Oss" implants. There are screw implants with a complex shape of the intraosseous part, for example, in the form of an ellipse of the brand "Steri-Oss".

Рис. 2. Винтовой имплантат

It is believed that conical implants are closer to the shape of the natural roots of the teeth and have better biomechanical characteristics. But screw implants with a cylindrical profile are more convenient and more accurately installed in the bone tissue, and also better use the real volume of the jaw bone, especially on the lower jaw.

The implant body usually contains an element of antirotational protection in the form of an anchor, a recess, a platform, a hole or a longitudinal groove. Protection from twisting is important not only during the period of bone regeneration, but also after achieving osseointegration - in single implants that are not connected to each other or with natural teeth. The apical part of the implant may end with a flat platform, have a rounded shape or be somewhat pointed.

In the neck part of the body of screw implants, a collar (cuff) 1-2 mm wide with a metal surface is usually created. It is assumed that such a structure reduces the load on the marginal part of the bone tissue, which is especially important for the outer compact plate. "ITI" implants have an expanding neck part. In the "Astra Tech" system, micro-threading is provided on this part of the body.

The body dimensions of screw implants can vary widely. For late dental implantation, structures with a diameter of up to 4 mm and a length of 10-14 mm are usually used. In direct, early and primary-delayed types of surgery, large diameter implants are usually used - more than 4 mm long. In some clinical situations, implants of large length - 20 mm or more are needed.

The different configuration of the implant body and the diverse geometry of the thread ensures the optimal choice of the implant for a particular type of structure of the jaw bones, and also contributes to adequate biomechanics in the system of interaction between the implant and the surrounding bone tissue. In case of complications, the screw implant can be removed from the jaw by unscrewing.

The connection of the body and the implant head is carried out by mechanical jamming of the cone parts - the Morse cone ("Impla", "Bicon"), but screw fastening is more often used. In its simplest form, the external element of the implant may contain a thread and then the head as such is screwed into the body of the implant.

A more advanced version of the implant provides for a head design with a central channel and a separate screw fixing the head to its intraosseous element. This design usually complements the neck part of the implant body with an internal or external hexagon, which ensures an accurate fit of the head and prevents it from twisting.

The axis of the head in most cases coincides with the axis of the implant body. But heads with an inclination are also produced - more often at an angle of 10 and 15 °, which is necessary if it is impossible to ensure the parallelism of the implant installation. When prosthetics are performed in the frontal part of the upper jaw, for cosmetic reasons, the relevance of an extra-bone element, partially or completely made of ceramics, is great.

In some implants (for example, "IMZ"), an intermediate element of elastic polymer material is inserted into the structure, located between the intraosseous part and the implant head. This device is designed to absorb chewing loads and is able to eliminate more than 50% of the mechanical stress of the implant.

Collapsible implants, as a rule, are equipped with a gum shaper for optimal healing of the mucous-periosteal cover and for temporary closure of the body of the implant opened into the oral cavity. Most collapsible implantation systems include a number of additional components for the orthopedic stage of treatment: an impression module, a laboratory analogue of the implant, a modeling cap made of ash-free plastic and others.

Among the most recent developments is the use of temporary mini-implants - non-removable screw of small diameter. They serve for temporary prosthetics for the period of achieving Osseo integration of implants intended to be the support of permanent dental structures.

The second principal variant of the body shape is flat or plate implants (Pic. 3). The vertical and vestibulo-oral dimensions of the intraosseous part of such structures are relatively small: the height is 7-8 mm, the thickness is about 1 mm. The lateral profile of the implant may have a profile tapering to the apical base (for example, from 1.35 to 0.9 mm). Such implants are very convenient for insertion into a significantly atrophied alveolar process of the jaw. Their body length (mesiodistal size) it can be from 6 to 28 mm. The outer edges of the flat implant on the sides of its head are called shoulders.

Pic. 3. Flat implant

The profile of the intraosseous element usually has a sinuous shape (in the form of a snake), and its surface is decorated with a corrugated macrorelief. As a rule, the implant body has through holes of round, oval or irregular configuration for the germination of bone tissue, which improves their fixation in the jaw. The recommended ratio of holes and the total area of the intraosseous part is approximately 1/3.

Flat implants are available with a different shape of the intraosseous part according to the topographic and anatomical features of the jaws in specific clinical situations. For example, the company "Oraltronics" produces 20 configuration options for plate implants for the lower jaw, 16 for the upper and 8 more universal for both jaws. The most characteristic configurations of the upper implants have a concave contour of the apical edge, and the lower ones have a convex contour. Many designs are asymmetrical.

Previously, flat implants were produced mostly unassembled. Modern manufacturers are increasingly offering implants with removable heads, which can either be screwed onto a pin protruding from the intraosseous part, or screwed into the implant body. Such structures are equipped with a temporary healing cap for the period of achieving osseointegration, a cast module, a laboratory analogue of the implant, etc. The number of heads can be 1 or 2. Sometimes the head is located eccentrically.

In most plate-type systems, an appropriate analogue is provided for each model. This element exactly repeats the shape of the main implant, but has a slightly smaller thickness. At the stage of surgical intervention, the analogue of the implant allows you to control the correctness of the formation of the perceiving bone bed.

It is relatively rare for a patient to be offered a combined type of dental implants. Their body consists of a cylindrical part and one or two flat plates. Disk implants are adjacent to this group, in which the intraosseous element is completed with a screw pin and a rounded plate (disk), which is located horizontally in the bone, joining the pin at right angles.

Disk implants incorporate the principle of modularity. A characteristic feature of such structures lies in the device of the intraosseous part, which consists of separate elements of various purposes and sizes, assembled into a single whole taking into

account the individual characteristics of a particular patient. Moreover, the procedure for the final assembly of the implant structure takes place directly during surgery. At the same time, all the information obtained during the operation is taken into account. Another example of modular implants is the Patent of the Russian Federation 2187283 A 61 C 8/00 (authors: I.M. Fedyaev and V.Y. Nikolsky).

There is a trend towards the creation and factory production of implants closely reproducing the configuration of the root part of the molars of the upper and lower jaws. The use of such structures should be clearly justified taking into account the topographic and anatomical conditions of the molar segments of the jaw bones and the features of their functional loading. Two-pronged (U-shaped) implants for the replacement of lower molars, proposed at the Department of Maxillofacial Surgery and Dentistry of Samara State Medical University (RF Patent 2187282 A 61 C 8/00), belong to the pioneering developments in this direction.

A special place in dental implantology is occupied by the so-called "Biodesign implants". They are made using the technology of computer X-ray scanning of the tooth, which is shown removal. Then, taking into account all the parameters of the virtual model of the root intended for removal, a product is created that accurately reproduces the original, and installed in the dental well by direct implantation.

Situational tasks.

1. In patient A., 21 years old, the primary absence of 12 and 22 teeth is determined. Parameters of bone tissue in the area of missing teeth: type A1 according to Lekholm and Zarb, type D1 according to Misha, the width of the bone is 5 mm, the distance to the bottom of the nasal cavity is 21 mm.

Make and justify a treatment plan.

2. Patient B., 42 years old, is missing 44 teeth. Parameters of bone tissue in the area of the missing tooth: type A2 according to Lekholm and Zarb, type D2 according to Misha, the width of the bone is 6 mm, the distance to the mental hole is 17 mm.

Make and justify a treatment plan.

3. Patient V., 35 years old, is missing 36 teeth. Parameters of bone tissue in the area of the missing tooth: type A2 according to Lekholm and Zarb, type D2 according to

Misha, the width of the bone is 7 mm, the distance to the mandibular canal is 14 mm, the mesiodistal distance between 35 and 37 teeth is 12 mm.

Make and justify a treatment plan.

4. Patient G., 49 years old, has a partial absence of teeth of the lower jaw, class II according to Kennedy, 46,47 and 48 teeth are missing. The parameters of bone tissue in the area of missing teeth are as follows: type B2 according to Lekholm and Zarb, type D2 according to Misha, the ratio of the width of the bone and the distance to the canal of the lower jaw: at the level of 46 teeth - 5.5 and 15 mm, respectively, between 46 and 47 teeth - 6 and 13 mm, at the level of 47 teeth - 6 and 11 mm.

Make and justify a treatment plan.

5. Patient D., 58 years old, has a partial absence of upper jaw teeth, class II according to Kennedy, 25,26, 27 and 28 teeth are missing. Bone tissue parameters in the area of missing teeth: type SZ according to Lekholm and Zarb, type D3 according to Misha, bone width 3.5—4 mm, distance to the bottom of the maxillary sinus: at the level of 25 teeth - 10 mm, at the level of 26 teeth - 8 mm, at the level of 27 teeth - mm.

Make and justify a treatment plan.

6. Patient E., 53 years old, has a partial absence of lower jaw teeth, class II according to Kennedy, 46, 47 and 48 teeth are missing. Bone tissue parameters in the area of missing teeth: type SZ according to Lekholm and Zarb, type D3 according to Mish, bone width 3.5-4 mm, distance to the mandible canal: at the level of 46 teeth - 10 mm, at the level of 47 teeth - 9 mm, at the level of 48 teeth - 8 mm.

Make and justify a treatment plan.

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