METHODS FOR DETERMINING IMPLANT STABILITY AT DIFFERENT TIMES OF THE OSSEOINTEGRATION PROCESS

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Abstract
In the last decade, dental implantation has taken a strong place among the main dental activities. The main directions of research in dental implantology, according to many scientists, are: the study of osseointegration processes; development of methods for assessing osseointegration; expansion of indications for implantological treatment; development of dental implants from new biocompatible materials; improvement of implantation techniques using means that improve the process of osseointegration [1,2,5,6,8,9,10].

Keywords: implants, osseointegration, methods for determining stability.

One of the most important criteria for the successful and long-term functioning of dental implants and the effectiveness of implantation is the rigidity of their fastening, which changes during the process of osseointegration in the postoperative period and at subsequent stages of operation [3,11]. Osseointegration is a biological phenomenon that means the fusion of a non-living (metal) element with living tissue. R.I. Bagantag [4] defined osseointegration as "the apparent direct attachment or attachment of living bone tissue to the surface of the implant without the introduction of a layer of connective tissue." The possibility of osseointegration has been proven beyond any doubt, but success depends on careful treatment planning, impeccable surgical intervention, the correct selection and manufacture of a prosthetic structure, and the characteristics of the body [2,3,4,5]. Undoubtedly, the most important condition for implant integration is primary stability, and the stability of the implant at different times during the osseointegration process and after its completion is a reflection of the reliability of osseointegration. The first two weeks after surgery are quite important for the development of inflammatory complications and further prognosis for the success of dental implantation [2]. Today, three main options for organizing tissue at the implant-bone interface are known: the first and most optimal is direct contact of bone tissue with the surface of the implant, i.e. osseous integration or (osseointegration); the second option is indirect contact, when a layer of connective tissue is formed between the bone tissue itself and the surface of the implant, consisting mainly of collagen fibers and coarse-fibered bone tissue, i.e. fibroosseous integration or (fibroosteointegration); and third, the most unfavorable is the formation of fibrous connective tissue on the surface of the implant, i.e. connective tissue integration.[2]. Currently, the following research methods are used to assess the degree of osseointegration and stability of dental implants [7,8,10,12]: 1. Clinical assessment of stability: identifying the presence or absence of mobility of the implant and the prostheses resting on it, as well as assessing the condition of the gingival tissue≪ cuffs≫. 2. X-ray examination: the main characteristic is loss of bone tissue. This parameter reflects the degree of vertical and horizontal resorption of the bone tissue surrounding the implant, as well as determining the density of the bone tissue around the implant. 3. Gnathodynamometry and echoosteometry. 4. Torque test using a torque wrench 5. Periotestometry: use of the "Periotest" device to assess the resistance of the implant to horizontal load. 6. Method of frequency resonance analysis. To determine the condition of the bone tissue around dental implants, a number of x-ray examination methods are used [9,10]. Targeted visiography allows a more detailed analysis of the condition of the periapical tissues of the selected segment, and also allows one to determine the so-called optical density of bone tissue, but does not make it possible to assess the functional condition of dental implants load[10]. Today, at the stages of planning dental intraosseous implantation, its implementation and dynamic assessment of results, the method of computed tomography (CT) and magnetic resonance imaging (MRI) is used. X-ray computed tomography - allows you to obtain a layer-by-layer image in a three-dimensional plane of the studied area of bone tissue, in a volumetric ratio of 1:1. The method is based on recording the energy of a beam of X-ray radiation passing through an object at different angles while rotating the tube, using highly sensitive sensors that convert the received information into electrical signals. RCT makes it possible to determine with high accuracy the metric characteristics of the area under study, which is important at the stage of planning and installation of dental implants [12]. Using computed tomography data, it is possible to create an anatomical model of the jaw,

which allows for a detailed study of the area of proposed implantation [10]. To assess the osseointegration of dental implants using this method, the density of the peri-implant bone tissue is determined. However, the use of this method is associated with significant radiation exposure to the patient. Magnetic resonance imaging is a method of radiation diagnostics based on recording the energy emitted by protons of hydrogen nuclei in the internal environments of the human body when they return from an excited state to their original state (so-called relaxation). MRI allows you to obtain images in any plane - frontal, sagittal, axial, etc., which can then be reconstructed into three-dimensional images. This method has advantages in visualizing soft tissues, such as muscle, fat, cartilage, etc., which makes its use especially necessary when studying the TMJ, mucous membranes of the paranasal sinuses and oral cavity, salivary glands and other soft tissue structures of the head and neck . The method is not burdensome for the patient and does not have any harmful effects on his body. In turn, to a certain extent, there are limitations in the use of this method for the dynamic assessment of the results of dental implantation, which is associated with distortion of the research results due to the magnetic resonance effect on metal inclusions [10]. Despite the possibility of obtaining comprehensive information about the state of bone tissue when conducting data research methods and their application in everyday practice are inaccessible to most clinicians, which is primarily due to financial and economic issues. According to the literature, at present, panoramic radiography is most often used when conducting x-ray examinations in clinical practice of dental implantation; cephalometric radiography and intraoral radiography[10,11,12]. Among modern clinical methods for assessing the osseointegration of dental intraosseous implants, attention should be paid to the periotestometry method. This technique involves the use of the "Periotest" device, developed by Siemens and the University of Tuebingen (Germany), which carries out electronically controlled and reproducible percussion of a tooth or implant. The method is based on the registration of mechanical vibrations converted into an electrical impulse [1,7]. The periotestmetry method was developed to assess the attachment strength and damping characteristics of a natural tooth surrounded by the periodontal ligament and only then began to be used to assess the attachment strength of dental implants. This method is now quite widely used to assess the readiness of implants for functional loads during reconstructive operations. Currently, the attention of clinicians and researchers has been attracted by a new method for assessing the stability of implants using the method of frequency resonance analysis [5,6,7]. The method of frequency resonance analysis of implants was proposed by N. Meredith in 1997. The method is based on recording resonant electromagnetic oscillations of the implant and surrounding bone when exposed to an electromagnetic field through a magnetized pin. The resonance frequency, being a measure of the stability of implant fixation (corresponding to the degree of its osseointegration), is calculated based on the response signal. Implant Stability Coefficient ranges from 1 to 100 units. The higher the value, the greater the stability of the implant fixation. A number of scientists have tested the validity of the opinion on the advisability of using tapered implants and drills of smaller diameter than the implant to achieve strong primary stability. 127 implants with both immediate and delayed loading were studied [5,7,8]. The authors experienced a large number of complications after one year (17.3%); more in the upper jaw (19.7%) compared to the lower jaw (5.9%). Failures were more observed in bone types III-IV (27%), less in types I-II (8%). The authors concluded that high primary stability from compression of bone tissue by conical implants and narrow drills is temporary; it decreased due to mechanical relaxation of the bone trabeculae. A number of authors recommend, depending on the primary indicators of frequency resonance analysis, choosing a single or two-phase technique for using implants [1,5,6]. They believe that resonance frequency analysis can reveal the decreasing stability of implants due to overload, which will allow measures to be taken to treat them. An analysis of the few published studies on the use of frequency resonance analysis in implantology shows the promise of the method in determining indications for immediate and early loads and in dynamics for a comprehensive assessment of the effectiveness of implantation. Thus, the frequency resonance analysis method provides the opportunity to clinically measure the stability of the implant and evaluate the effectiveness of dental implantation in conditions of bone tissue deficiency.

Conclusion. Thus, osseointegration is not a frozen process, but a process that changes over time. Therefore, it is very important to know, understand and follow its basic principles when choosing both surgical and orthopedic tactics in order to achieve satisfactory clinical results, as well as to use modern and informative methods for assessing the degree of osseointegration and stability of dental implants.

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