



Optimizing the Surgical Phase of Dental Implants

Optimization of the Surgical Phase of Dental Implantation Based on Computer Modelling

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ABSTRACT

Reducing the number of complications after dental implantation remains an urgent problem in dentistry. All risk factors can be divided into general - smoking, systemic pathology, condition after radiation therapy, etc., and local - poor oral hygiene, periodontal disease, iatrogenic conditions, design and quality of processing of the transgingival part of the implant. Understanding the course of inflammatory and destructive processes around a dental implant after its placement directs scientists and implant manufacturers to improve already used conservative and surgical methods of treatment of these diseases, as well as to pay more attention to the prevention of this pathology and, consequently, to the risk factors of its development. The development of new surgical and prosthetic techniques and the creation of new implant systems will increase the life span of implant-supported dentures and improve the quality of life of patients.

Keywords:

Dental implant, peri-implantitis, mucositis

Introduction. In recent years, there has been an increasing trend in the number of patients with partial or total loss of teeth. Among adults, the partial absence of teeth is one of the most common diseases, according to the WHO, this pathology affects up to 75% of the population in different regions of the world. In the population, the complete absence of teeth, according to the WHO, is detected in 15% of adults on the planet. One of the main objectives of orthopaedic dentistry is to restore the lost anatomical formations of the oral cavity and their function, with maximum preservation of their own tissues. Dental implantation is the restoration of the integrity of the tooth row by introducing artificial materials. The search for ways to improve the effectiveness of dental prosthetic rehabilitation of patients with dental defects is mainly focused on the adequate choice of

structures, technologies and materials of dental prostheses.

In non-pathological development of osseointegration processes there is a close relationship between the dental implant surface and the adjacent bone tissue, characterized by the absence of intermediate connective tissue layer. In the case of pathology, a fibrous layer is formed between the dental implant surface and the bone tissue and fibrointegration is the result. The intermediate type of connection is called fibrointegration. There is a problem with correct positioning of the implant due to a mismatch between the shape and size of the alveolar socket and the size of the implant, as well as the possibility of compensating for the bone defect. This can lead to a lack of osseointegration and, as a consequence, loss of the implant, with possible premature cervical

bone resorption, which significantly worsens the aesthetic result of treatment.

Biomechanical relationships in the supra-structure-implant-bone system and quality osseointegration are also important, which allows to achieve optimal interaction of bone tissue with the surface of the dental implant, being an important condition for long-term, successful use of the structure.

After intraosseous dental implantation the area between the dental implant and the bone is filled with blood, over time there is a fixation of platelets on the surface, fibrinogen, as well as other proteins of the complement system. These proteins have more than just a protective function. For example, fibrin acts as an optimal adhesive medium for fixation of bone and mesenchymal stem cells with their subsequent migration to the dental implant surface and bone tissue proliferation. In this context the relief features of the detailed implant play one of the key roles in the "accretion" of young bone tissue to it. It should be noted that immediately after dental implantation there is necrosis and degradation of the 'old', damaged bone adjacent to the implant and release of pro-inflammatory factors. The subsequent infiltration of this area by macrophages leads to the accumulation of growth factors they express. Later, as the surrounding tissues recover, macrophages clear the damaged zone from the necrotic remains; fibronectin and bone cells aggregate on the surface of the dental implant and extracellular matrix is formed. The completion of this cascade of events is the restoration of the bone defect]. In a study of the general inflammatory response after dental implantation, patients with advanced peri-implantitis were found to be immunodeficient in the T-cell pool, with the degree of T-lymphocyte suppression directly correlating with the severity of the peri-implant area lesion. Humoral immunity indicators such as IgA, IgG, IgM, on the contrary, exceed the values of the physiological norm, with the same correlation dependence on the severity of peri-implantitis.

Post-implantation inflammatory complications in the peri-implant tissues are subdivided depending on the timing of their

occurrence. Early and late postimplantation complications are distinguished.

Early post-implantation inflammatory complications occur within one month after dental implantation - during the period of dental implant engraftment. These complications include: - swelling and hyperemia in the peri-implant area; - suppuration in the peri-implant area; - pain syndrome; - suture separation.

These complications develop in the first days after dental implantation and persist for several days to 2 - 3 weeks, if inflammation is not controlled, it can develop into peri-implant mucositis and then dental peri-implantitis. Early post-implantation inflammatory complications can be caused by: positioning the implant close to a periapical lesion, from where micro-organisms can spread to the implant. This raises doubts about the appropriateness of even temporarily preserving teeth with periapical inflammation near the area of surgery; bacterial penetration from nearby teeth treated earlier in the endodontic procedure. In this case, the distance from the tooth to the implant and the age of endodontic treatment is important in predicting the risk of inflammatory process; improper preparation of the bone bed and other errors during the surgical stage of implantation; granulation residues in the dental implant site after the previous tooth extraction for periodontitis.

General symptoms (hyperthermia, weakness, poor appetite) are clinically mild. In the oral cavity there is mobility of the placed implant, possible presence of pain, the mucous membrane is hyperemic, edematous, purulent discharge is observed from the peri-implant pocket.

Late post-implantation inflammatory complications are those that occur after the completion of the orthopaedic stage of dental implantation, developed in the first weeks after the superstructure placement and several years after that as the implants are functioning. Late post-implantation inflammatory complications include: - Peri-implantation mucositis - inflammation of the peri-implant tissues without bone damage. The clinical picture is characterised by the development of local signs of mucosal inflammation in the absence of

radiological changes and implant mobility. - Peri-implantitis is an inflammation of the peri-implant tissues accompanied by resorption of the peri-implant bone. There is a lesion of all tissues of the peri-implant zone, the formation of peri-implant-gingival pocket with pathological content, mobility, exposure of the implant; on X-ray images there are signs of bone resorption.

Both nosologies, in addition to the above manifestations, are characterized by the feeling of discomfort in the area of the dental implant, burning, pain, mucous membrane bleeding. In case of peri-implantitis a fistulous passage, abscess and periostitis development are also possible. Late post-implantation inflammatory complications can lead to: failure of implant stability; rejection of the implant; relocation (migration) of intraosseous dental implant into the maxillary sinus; osteoporosis of the jaw; formation of a jaw defect. In the context of the pathogenesis of post-implantation inflammatory complications, the following should be pointed out. The body responds to the placement of dental implants with a complex of connective tissue reactions as to the invasion of a foreign agent. These reactions are reduced to the changes similar to the periodontal inflammatory process.

It should also be noted that the inflammation in the peri-implant tissues is comparable with that around natural teeth - gingivitis and periodontitis. This is primarily due to the identical pathogenic agent, microbial invasion, and the development of an infectious-inflammatory response in response to it. However, in the case of peri-implantitis, bone destruction around the implant is faster and more severe than in chronic periodontitis, and the bone defect around the implant is usually formed circularly, which can lead to rapid failure of implant stability. In addition to the etiotropic component of therapy, a comprehensive treatment plan usually includes pathogenetic means of influence, the purpose of which is the correction of systemic and local metabolic disorders, optimization of protective resources and increasing the overall adaptability of the body in conditions of pathology.

Prevention of inflammatory tissue changes in the area of implants consists of a complex of surgical and orthopaedic techniques, design features of prostheses and implants, the use of physiotherapeutic methods of exposure, medications and various hygienic measures.

An important point in reducing the traumatic nature of surgery in direct dental implantation are minimally invasive manipulations using a special set of tools and devices in clinical practice, which lead to a decrease in the number of complications as well as improved treatment results.

The dental implant superstructure is prone to greater plaque accumulation than natural teeth. But the implementation of professional hygienic measures in the area of prosthetic constructions does not allow the use of traditional means and methods. Metal tools and attachments, for instance, can damage the materials of artificial crowns and prostheses, polishing with highly abrasive pastes is not desirable and standard bicarbonate powder cannot be used for machine hygiene. All this often leads to an increase in plaque adhesion to the implant surfaces.

The treatment of inflammatory and destructive processes of peri-implant tissues involves conservative and surgical measures. Heitz-Mayfield Lis, J.A. et al. (2014) apply the generally accepted standards of treatment of patients with inflammatory complications after dental implantation. Armas et al. (2013) in turn believe that conservative treatment of inflammatory complications is not sufficient to achieve a stable positive result. J. Lindhä et al. (2008) believe that local and general medication is not sufficient only in the case of peri-implantitis. Elimination of inflammatory phenomena in the implant area, elimination of peri-implant pockets with foci of microbial accumulation, stimulation of reparative properties of bone tissue are the main tasks in the treatment of peri-implant mucositis and dental peri-implantitis. An important role in the complex treatment of peri-implantitis is given to the mechanical treatment of gingival and bone pockets, deepithelialization of pockets with laser, antibiotic therapy and regenerative treatment [Bergmann, F., 2013].

Thus, it is necessary to study and create an evidence base in the treatment and prevention of inflammatory complications in patients with orthopaedic constructions in dental implants.

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