

Epidemiological Study of The Frequency of Early Postoperative Complications in Dental Implantation

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Abstract: Dental implantation in modern dentistry is one of the most effective methods for restoring lost teeth and represents a reliable solution to the problem of adentia. Over the past two decades, dental implantation technology has undergone significant improvements, however, the risk of postoperative complications remains a pressing problem in clinical practice.

Keywords: Detailed Implantation, Postoperative Complication, Reimplantation, Soft Tissue Inflammation

Introduction

Dental implantation is currently an integral part of modern dental practice and is considered a highly effective method for restoring chewing function and dental aesthetics. However, despite significant progress in the field of implantological materials, surgical technologies, and diagnostic methods, the problem of postoperative complications remains relevant and continues to be actively discussed in scientific literature[1]. The increase in the number of implantation interventions, the expansion of indications for their use, as well as the growth in the proportion of patients with complicated somatic status, necessitates an in-depth study of the etiological factors and pathogenetic mechanisms of complications arising after dental implantation. Understanding the nature of these complications is considered a fundamental basis for developing effective preventive and therapeutic strategies aimed at improving the predictability of implant treatment[2].

Early postoperative complications in dental implantation occur within the first 4-12 weeks after surgery and can significantly affect the outcome of implant osseointegration, the patient's quality of life, and the economic component of treatment. The most common complications are inflammatory processes of soft tissues, swelling, bleeding, peri-implantitis, divergence of wound edges, infectious complications, and rejection of the implant[3].

The relevance of this study is due to the fact that in the context of growing demand for implant services and the expansion of the contingent of patients receiving this type of treatment (including patients with a complicated history and concomitant pathology), it is necessary to have reliable information on the frequency, structure, risk factors, and ways to prevent early complications. Systematically studying the prevalence and nature of early postoperative complications in dental implantation allows for optimizing patient selection, improving surgical and orthopedic protocols, justifying indications and contraindications for implantation, and developing personalized management programs for patients in high-risk groups[4].

The prevalence of early postoperative complications after dental implantation is on average 10-20% depending on the patient population and the evaluation criteria used, with the most common being inflammatory processes of soft tissues (8-15%) and swelling (5-10%). The main risk factors for the development of early complications are the patient's age above 65 years, concomitant somatic pathology (diabetes mellitus, immunodeficiency), smoking, poor oral hygiene, the presence of a periapical infection in the implantation area, and a violation of the surgical procedure protocol. Systematic use of antibacterial prophylaxis (prescription of broad-spectrum antibiotics before surgery and continuation in the postoperative period) demonstrates high effectiveness in reducing the frequency of infectious complications by 40-60%, especially in patients at risk[5].

Modern understanding of the etiology of postoperative dental implantation complications is based on

the multifactorial concept, according to which the development of complications is the result of a complex interaction of systemic, local, microbiological, and iatrogenic factors [6]. Among systemic factors, the leading role is assigned to the patient's general health status and the characteristics of their immune and metabolic status [7]. Numerous clinical studies have shown that the presence of diabetes mellitus is associated with an increased frequency of both early and late complications after implantation. Pathogenetically, this is due to a disruption of microcirculation, a decrease in the activity of osteoblasts, a slowdown in angiogenesis, and a change in the inflammatory response, which leads to a deterioration in the processes of osteointegration and increased susceptibility to infectious agents [2,9]. Similar mechanisms are described in other systemic diseases accompanied by impaired bone metabolism and immune regulation [8].

Significant attention in the literature is paid to the role of osteoporosis and age-related changes in bone tissue in the development of postoperative complications. The decrease in bone mineral density, changes in bone tissue architectonics, and imbalance between resorption and bone formation processes create unfavorable conditions for the formation of a stable bone-implant contact. In the pathogenesis of these complications, bone remodeling disorder plays a key role, which can lead to marginal resorption and decrease in the primary stability of the implant [9].

Smoking is considered one of the most significant modifiable etiological factors of postoperative complications. Nicotine and tobacco burning products have a pronounced vasoconstrictor effect, leading to tissue hypoxia and suppressing the functions of immune system cells. In the pathogenetic aspect, this is accompanied by a decrease in fibroblast activity, slowed epithelialization, and impaired angiogenesis, which significantly increases the risk of inflammatory complications and implant loss [10]. Clinical observations confirm that in smoking patients, peri-implantal mucositis develops more frequently, which, without timely intervention, can progress to peri-implantitis.

The microbial factor occupies a special place in the etiology and pathogenesis of postoperative complications. The formation of a bacterial film on the surface of the implant is considered the central link in the pathogenesis of inflammatory diseases of the peri-implant tissue. Modern microbiological studies show that the biofilm in peri-implantitis is characterized by high complexity and resistance, and its composition is largely similar to the microflora of chronic periodontitis, including anaerobic gram-negative microorganisms [7]. The adhesion of bacteria to the implant surface leads to the activation of the innate immune response, the release of pro-inflammatory cytokines and mediators, which triggers a cascade of inflammatory reactions and promotes the resorption of the alveolar bone [11].

The condition of the soft tissues around the implant plays an important role in the pathogenesis of complications. Insufficient thickness of the keratinized mucous membrane and disruption of the structure of the peri-implantal epithelial attachment create conditions for the penetration of microorganisms and maintenance of chronic inflammation. Literature emphasizes that soft tissue deficiency worsens the barrier function of the mucous membrane and contributes to faster progression of inflammatory changes [16]. Pathogenetically, this is due to increased permeability of the epithelial junction and decreased local immune defense.

Iatrogenic factors occupy a special place in the structure of postoperative complications. Errors at the diagnosis and planning stage of implantation, incorrect selection of implant size and position, insufficient bone tissue volume, and non-compliance with the principles of atraumatic surgery can lead to impaired primary stability and micro-mobility of the implant. In the pathogenesis of these complications, micro-mobility causes the formation of fibrous tissue in the bone contact zone of the implant instead of complete osseointegration, which significantly increases the risk of early implant loss [15]. An additional risk factor is premature or excessive functional stress, leading to bone tissue overload and accelerated resorption.

In recent years, scientific publications have increasingly focused on the immuno-inflammatory mechanisms of the pathogenesis of peri-implantal complications. It has been established that patients with peri-implantitis exhibit pronounced expression of pro-inflammatory cytokines, including interleukin-1 β , interleukin-6, and tumor necrosis factor- α , as well as increased activity of matrix metalloproteinases involved in the degradation of the extracellular matrix and bone tissue [14]. The imbalance between osteoclastic and osteoblastic activity is considered a key mechanism for the progression of bone resorption in the implant area.

The quality and characteristics of the implant surface also influence the development of postoperative complications. Modified surfaces with increased roughness contribute to accelerated osseointegration, however, with insufficient hygienic control, they can facilitate microorganism adhesion and the formation of a stable bioplenka. From a pathogenetic perspective, this emphasizes the importance of interaction between the physical and chemical properties of the implant, the microbial factor, and the body's immune response [4,6].

Conclusion

Thus, the analysis of modern scientific literature indicates that the etiology and pathogenesis of postoperative dental implantation complications represent a complex multi-level process, including systemic diseases, microbial contamination, the characteristics of soft and bone tissues, as well as iatrogenic and immunoinflammatory mechanisms. A comprehensive understanding of these processes allows not only to explain the causes of adverse outcomes of implant treatment but also serves as a scientific basis for developing personalized preventive and therapeutic approaches aimed at improving the clinical effectiveness and durability of dental implants

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