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PREDICTING THE BEHAVIOR OF IMPLANTS AND CROWNS USING THE FINITE ELEMENT METHOD IN VARIOUS OCCLUSION SCHEMES

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Relevance. Implementation of functional occlusion management principles has important preventive significance in the manufacture of non-removable structures. Non-removable structures supported by implants play a special role, where an important condition is ensuring the maximum axial direction of chewing forces applied to the supporting elements [1, 2]. Occlusion, from the point of view of dentists, is of significant importance, especially in the restoration of defects in dental rows and changes in the position of teeth with a change in the angle of application of the load. In this case, it is important to understand how contact occurs in the frontal, sagittal planes during the parafunctional and functional activity of the chewing apparatus. In this regard, there are currently several main concepts of occlusion: the concept of group function on the laterotrucial side; the concept of balanced occlusion; the concept of the clitoral guide. The formation of functional occlusion during prosthetics with non-removable structures is the main task of optimal creation of the chewing surface of the replaced dental defect. Ensuring the safe use of orthopedic structures is necessary to protect the supporting elements from excessive loads, as well as to minimize their movement during the adaptation process [3, 4]. Digital methods for manufacturing non-removable structures also allow for recording the volume of movement of support elements and structures. This will allow for the creation of software for predicting the displacement of support teeth and taking into account the obtained results when modeling non-removable structures. An important aspect requiring special attention is both the location of the supporting element and the nature of the support, i.e., the implant or natural tooth. Since the degree of mobility of these elements is different, the reaction to overload is also different [5, 6]. The chewing system adapts relatively easily to changes in occlusal relationships during short periods of no-load. When dynamic equilibrium is disrupted (tooth preparation), the vertical displacement is 40 μm per day, while the horizontal displacement is 30 μm per day. This process is reversible when manufacturing an orthopedic structure in the shortest possible time or when using temporary crowns. At the same time, the formation of a secure occlusion occurs functionally.

The purpose of the study is to study the volume of movement of dentoalveolar system elements during the formation of functional occlusion after replacing dental row defects with permanent structures.

Materials and methods. During the examination of patients who applied to the orthopedic stomatology clinic for prosthetics, standard examination schemes based on WHO recommendations were used. Radiological studies were conducted: RVG imaging, orthopantomography, and conical-radiation computed tomography (CRLT) on a KaVo OP300 Maxio apparatus. The digital examination and treatment control unit included scanning with a Medit i500 intraoral scanner, and the obtained optical prints were analyzed in the ExoCad program. The CLCT study was further processed using the Diagnocat artificial intelligence

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software. Optical axiography was also performed on a Proaxis device, and the obtained data were analyzed in the P-art program [7, 8].
Such a volume of examination was carried out in blocks after dissection, after fixation of the non-removable structure, and after 3 weeks of final adaptation. The study used 35 models of patients with various non-removable structures (including metal ceramics - 12, zirconium dioxide - 16, pressed ceramics (E-max) - 7). Model comparison occurred in three time periods: after preparation, after fixation of the non-removable structure (up to 5 units), and after 3-4 weeks of adaptation (according to Kurlyandsky). Natural sanitized teeth were antagonists to prostheses. As a control group, 17 students of the 3rd-4th years of the Faculty of Stomatology participated with similar scanning intervals. The study of the movement of dentoalveolar system elements was carried out at 5 junction points using mathematical models.
Results Conducted studies of the degree of displacement of dentoalveolar system elements depending on the type of material from which the permanent structures were made showed the following results: 3 units of metal-ceramic dental prostheses were displaced by 206 - 235 µm, 4 units - by 248 - 282 µm, 5 units - by 298 - 332 µm. At the same time, dental prostheses made of zirconium dioxide showed the following results: 3 units - 55-86 µm, 4 units - 60-92 µm, 5 units - 70-110 µm. The lowest displacement indicators were shown by implants: from 25 to 60 µm depending on the length and regardless of the material type. During the formation of functional occlusion, structures made of zirconium dioxide have the lowest displacement volume, which reflects the features of modeling and the physical and mechanical characteristics of this material. Wear and movement of antagonist teeth is observed in a significantly smaller volume during prosthetics on implants. This is due to the rigid fixation of the implant in the bone and the vertical application of force, which provides the least displacement of the structure and the main impact is perceived by the antagonist teeth. Accurate digital extraction of the occlusal surface prevents changes in the muscles that lift the lower jaw and, accordingly, prevents temporomandibular joint diseases
Conclusion. The key factor in the formation of functional occlusion is the manufacturing method and material, as well as the degree of error established during digital modeling. Using implants as a support requires reducing the density of occlusal contacts, taking into account that the dentoalveolar system forms a final occlusion due to the movement of antagonist teeth. Based on the results of studying the movement of support elements, software has been created that helps in the modeling process of non-removable structures..

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