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AESTHETIC RESTORATION USING ZIRCONIUM CROWNS

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Abstract

Since beautiful teeth are important for self-esteem and a sense of comfort, there has been a trend in prosthetic dentistry towards the use of non-metallic restorative materials. Patients want their restorations to be aesthetically pleasing, biocompatible, natural-looking, and long-lasting.

Ключевые слова: CAD/CAM, t-ZrO2, циркониевые коронки

Materials and Methods

The most promising material used in dental restorations is tetragonally stabilized zirconium dioxide (t-ZrO2). This material has a combination of unique properties, including chemical stability, high crack resistance and hardness, low thermal conductivity and high light transmittance. Of great importance for aesthetic dentistry is also the fact that the color characteristics of such ceramics are similar to the color of the natural tissues of the tooth. According to scientific studies, ceramics based on t-ZrO2 do not cause allergies and signs of incompatibility in the oral cavity. Moreover, zirconium dioxide is biocompatible with the mucous membrane and tissues of the oral cavity. High functionality and corrosion resistance, as well as impeccable aesthetic and mechanical properties are the undeniable advantages of this material. Zirconium dioxide does not participate in galvanic processes and does not transmit X-rays. When using this material, the problem of thermal sensitivity is eliminated due to its insulating properties and low thermal conductivity. Three types of ceramics are used in dentistry: polycrystalline, infiltration and glass-ceramic. Glass-ceramics and infiltration ceramics are multiphase materials containing crystalline components in addition to the amorphous glass phase. Zirconium oxide is the only polycrystalline ceramic that contains very little glass and therefore has excellent durability. Zirconium oxide intended for high-load applications is typically tetragonal polycrystalline zirconium oxide partially stabilized with yttrium oxide. Such materials are called transformation-hardened and are crack-resistant. Under the action of tensile stresses arising at the vertices of the cracks, zirconium oxide passes from the metastable tetragonal phase to the more thermodynamically favorable monoclinic phase. This process is accompanied by a local increase in volume, which leads to the occurrence of local compressive stresses at the vertices of cracks that counteract external loads. This property of the material makes it possible to make favorable long-term forecasts for the clinical use of zirconium dioxide scaffolds, combining high initial strength and resistance to fatigue failure [7]. The high strength properties of ceramics make it difficult to manufacture all-ceramic prostheses, as they are difficult to process even with diamond cutters. Only with the advent of digital computer technology, this problem was solved: in the field of dental prosthetics, the CAD / CAM process (Computer Aided Design - Computer Aided Manufacture) is used, beautiful teeth are important for self-esteem and a sense of comfort, so there is a tendency to use non-metallic restoration materials [10]. Patients want their restorations to be aesthetically pleasing, biocompatible, natural-looking, and long-lasting. The most promising material used in dental restorations is tetragonal modified stabilized zirconium dioxide (t-ZrO2). This material has a unique combination of properties, including chemical stability, high crack resistance and hardness, low thermal conductivity and high light transmittance. For aesthetic dentistry, it is also important that the color characteristics of these ceramics are similar to the color characteristics of natural tooth tissues. According to scientific studies, ceramics based on t-ZrO2 do not cause allergies and signs of incompatibility in the oral cavity. Moreover, zirconium dioxide is biocompatible with the mucous membrane and tissues of the oral cavity. High functionality and corrosion resistance, as well as impeccable aesthetic and mechanical properties are the undeniable advantages of this material. Zirconium dioxide is not involved in galvanic processes and is immune to X-rays. The use of this material eliminates the problem of temperature sensitivity due to its insulating properties and low thermal conductivity. Three types of ceramics are used in dentistry: polycrystalline, infiltration and glass-ceramic. Glass ceramics and infiltration ceramics are multiphase materials containing crystalline components in addition to amorphous glass phase. Zirconium oxide is the only polycrystalline ceramic that contains very little glass and therefore has excellent durability. Zirconium oxide intended for high-load applications is typically tetragonal polycrystalline zirconium oxide partially stabilized with yttrium oxide. Such materials are known as transformation-hardened materials and are crack-resistant. Under the influence of tensile stresses arising at the vertices of cracks, zirconium oxide passes from a metastable tetragonal phase to a more thermodynamically favorable monoclinic phase [1, 3, 8]. This process is accompanied by a local increase in volume and the occurrence of local compressive stresses at the vertices of cracks that counteract the external load. This property of the material makes it possible to make a favorable long-term prognosis for the clinical use of zirconium dioxide frameworks, combining high initial strength and resistance to fatigue failure. The high strength properties of ceramics make it difficult to manufacture all-ceramic prostheses even with the use of diamond cutters. The advent of digital computer technology has made it possible to solve this problem. In the process of CAD/CAM (Computer Aided Design - Computer Aided Manufacture) in the field of dental prosthetics, non-metallic restoration materials are used, since beautiful teeth are important for self-esteem and a sense of comfort are usually used [10]. Patients want restorations to be aesthetically pleasing, biocompatible, look natural, and last a long time. The most promising material for use in dental restorations is tetragonal stabilized zirconium dioxide. This material has a combination of unique properties, including chemical stability, high crack resistance and hardness, low thermal conductivity and high light transmittance. Of great importance for aesthetic dentistry is the fact that the color properties of such ceramics are similar to the color of natural tooth tissues. According to scientific studies, ceramics based on t-ZrO2 do not cause allergies and signs of incompatibility in the oral cavity [3]. Moreover, zirconium dioxide is biocompatible with the mucous membrane and tissues of the oral cavity. High functional stability and corrosion resistance, impeccable aesthetics and mechanical properties are the undeniable advantages of this material. Zirconium dioxide does not participate in galvanic processes and is X-ray permeable. The use of this material eliminates thermal sensitivity problems due to insulation and low thermal conductivity. Three types of ceramics are used in dentistry: polycrystalline, infiltration and glass-ceramic. Glass-ceramics and infiltration ceramics are multiphase materials containing crystalline components in addition

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to the amorphous glass phase. Zirconium oxide is the only type of polycrystalline ceramics, and in its properties it is superior to other types of ceramics, as it contains very little glass and, therefore, has high long-term strength. Zirconium oxide designed for high-load applications is usually tetragonal polycrystalline zirconium oxide partially stabilized with yttrium oxide. Such materials are called transformational-strengthened, they have the property of resistance to cracking. The tensile stresses present at the apex of the crack cause the transition of zirconium oxide from the metastable tetragonal phase to the more thermodynamically advantageous monoclinic phase. This process is accompanied by a local increase in volume, which leads to the emergence of a localized compression stress at the top of the crack, counteracting the external load. This property of the material makes it possible to make favorable long-term predictions about the clinical use of zirconium dioxide frameworks, which have high initial strength in combination with resistance to fatigue failure [7]. The high strength characteristics of ceramics make it difficult to manufacture all-ceramic dentures, since the material is difficult to process even with diamond cutters. Only with the advent of digital computer technologies, the issue was resolved [8, 9]. The CAD/CAM process includes obtaining initial data using digital volumetric scanning, transferring it to a computer and processing it, followed by manufacturing a model of the future prosthesis on an automatic machine using CEREC devices. Then the manufactured frames of dentures are fired according to a certain mode to a tightly sintered state. Ceramic material based on zirconium dioxide, stabilized with yttrium oxide, is promising for use in orthopedic dentistry. Clinical example. Drug treatment of the canals was carried out with the combined use of EDTA in the form of a 15–17% gel and a 3% solution of sodium hypochloride. Temporary filling of root canals with calcium hydroxide preparations was used for the purpose of antiseptic treatment. Root canal filling was performed by lateral condensation of gutta-percha pins under the control of an X-ray. Next, stump pin inlays made of wax were modeled. After taking optical silicone impressions, working models were cast in the dental laboratory. Stump inlays made of zirconium dioxide were made using the Zirkonzahn system (Prettau Zirconia blocks) using models of inlays made of CCS stored in the oral cavity. In the clinic, they were fitted, fixed on double-cured composite cement (Fig. 4).

Next, the final processing of the abutment teeth was performed with the formation of a circular ledge. Teeth 1.1 and 2.1, previously under metal-ceramic crowns, are destroyed up to and below the gum level. After the final odontopreparation, the gingival margin became inflamed, spontaneous bleeding was observed. The patient underwent treatment with a drug containing soluble furagin. As a result, the gum became pale pink, slight swelling remained, and there was no bleeding (Fig. 5). In the dental laboratory, a collapsible model and bite rollers were made and cast according to the impressions obtained. After determining the central occlusion, fixation in the occluder and duplication of the model with composite material were carried out. After fitting the composite structure in the oral cavity, the patients in the laboratory performed the casting of the workpiece, gluing the structure and installing the ICE Zirkon Translucent zirconium block, milling, separating the work from the block, adjusting the neck area, painting and firing. In the clinic, a frame was stored in order to check the occlusal relationship with antagonist teeth. Further, the porcelain mass was applied in the laboratory and after fitting in the clinic (the final processing of the finished structure was carried out. Artificial crowns were fixed on double-cured composite cement. The finished artificial crowns corresponded to aesthetic restoration structures. The patient noted the absence of an adaptation period and was very pleased with the result.

Conclusion:

Thus, artificial crowns based on zirconium dioxide meet the high aesthetic requirements imposed by our patients today on orthopedic structures.

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