
Current Problems and Modern Technologies in Orthopedic Dentistry

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Abstract: Orthopedic dentistry offers us modern technologies that improve the quality of work performed, it is important to know them and successfully apply them in your practice.

Key words: dental prosthetics, metal-free structures, bridges, zirconium oxide, orthopedic dentistry.

The purpose of the study: to compare the characteristics of metal-free non-removable structures.

Results and discussion. Metal—free structures are one of the modern types of dental prosthetics. A special feature of all-ceramic structures is the fact that they are made of very durable ceramic material. Advantages of porcelain products: aesthetics; porcelain crowns retain their original color and do not darken over time. The product fits tightly on the tooth, which provides reliable protection against the development of secondary caries and other inflammatory processes; hypoallergenic; the products are very light, it is easy to get used to them. Disadvantages: the fragility of porcelain does not allow it to be used for making bridges; poor adhesion to the gum; high cost. The next type of metal-free structures for prosthetics are all-zirconium crowns based on zirconium dioxide. Dignities: the highest aesthetics; perfect fit to the tooth; zirconium is an inert material, reactions to which are excluded; the possibility of creating bridges; preservation of initial parameters throughout the service life; ideal for prosthetics on implants. Minimal preparation of tooth tissues is required for their installation. The disadvantage of zirconium crowns is only one – the high cost.

Another type of metal-free structures are crowns on a zirconium frame, lined with ceramic mass. In such crowns, the connection between zirconium and ceramics is achieved mechanically due to compressive stress and surface synthesis. The advantages of such crowns are: aesthetics; high strength, which allows you to create bridges, install crowns on implants, and the absence of deformation. The disadvantage of such crowns is the high cost.

Recently, the technology of manufacturing structures of metal-free ceramics has undergone revolutionary changes. Specialists use both new materials and new methods of manufacturing structures. CAD/CAM (Computer Assisted Design/Computer Aided Manufacturing is a modern technology for the production of denture frames using computer modeling and milling on a numerically controlled installation. Using CAD/CAM systems, it is possible to produce single crowns and bridges of any length, telescopic crowns, individual abutments for implants. With the use of such technologies, it has become possible to manufacture structures from high-tech ceramics - zirconium oxide, which has high mechanical strength, biological compatibility and aesthetics. By adding a small fraction of yttrium oxide, a microstructural change is achieved that increases the strength of zirconium oxide. In terms of optical refraction, gloss and stability, zirconium oxide is close to the hard tissues of natural teeth. The light rays hitting the surface of the artificial tooth are scattered in the direction of the adjacent gum as a result of optical refraction inside the facing ceramics. The main properties of zirconium oxide are: no toxicity in the composition; low solubility, high stability to an acidic environment; smooth surface that prevents plaque accumulation; absolute bioinertness with respect to other materials in the oral cavity; high

thermal insulation properties. Such restorations allow for a more gentle treatment of the supporting teeth. As a result, the thickness of the frame and facing ceramics may be less than the thickness of all-ceramic restorations. This ensures the preservation of a larger volume of healthy tooth tissues. Bruxism is an absolute clinical contraindication to the use of zirconium oxide-based structures. Deep bite is a relative contraindication. In this case, orthodontic correction is required first.

In recent years, the technology of manufacturing metal-free ceramic structures has undergone revolutionary changes. Specialists use both new materials and new methods of manufacturing structures. CAD/CAM (Computer Assisted Design/Computer Aided Manufacturing – computer-controlled design/production) is a modern technology for the production of denture frames using computer modeling and milling on numerically controlled machines. CAD/CAM technology makes it possible to obtain denture frames of the highest precision, excellent biocompatibility and impeccable aesthetics with high automation of labor. With the help of CAD/CAM systems, it is possible to produce single crowns and bridges of small and large extent, telescopic crowns, individual abutments for implants, recreate the full anatomical shape for models of press ceramics applied to the frame, create temporary crowns in full profile. With the use of this technology, it is possible to manufacture structures from high-tech ceramics – zirconium oxide, which has high mechanical strength, biological compatibility and aesthetics. By adding a small fraction of yttrium oxide, a microstructural change is achieved that increases the strength of zirconium oxide.

Zirconium oxide is called "white steel". This material is five times more durable than all-ceramic restorations and has the following physical and mechanical characteristics: hardness (according to Vickers) 1200 N/cm, wear strength 1000 MPa, modulus of elasticity 210 GPa.

In terms of optical refraction, gloss and stability, zirconium oxide is close to the hard tissues of natural teeth. The rays of light hitting the surface of the artificial tooth are scattered in the direction of the adjacent gum as a result of optical refraction inside the facing ceramics.

The main properties of zirconium oxide:

- a) the absence of toxicity in the composition;
- b) low solubility, high stability to acidic environment;
- c) smooth surface that prevents plaque accumulation;
- d) absolute bio-inertia in relation to other materials in the oral cavity;
- e) high thermal insulation properties, allowing you to fully feel cold or hot food.

Restorations on zirconium oxide allow for a more gentle treatment of the supporting teeth. As a result, the thickness of the frame and facing ceramics may be less than the thickness of all-ceramic restorations. This ensures the preservation of a larger volume of healthy tissues of the dental organ. To obtain a high-quality impression, the double retraction method should be used, the impressions are removed with impression materials used in orthopedic dentistry. The technology of manufacturing the frame of crowns or bridges made of zirconium oxide is carried out in several stages. After taking casts and making models, these models are scanned with a laser beam, the data obtained are processed by computer. A computer program is used to simulate the frame of the future structure, taking into account the shrinkage occurring during the firing process. The processed data is loaded into a computer connected to a digital micro milling machine, and the frame is turned out of a single block of zirconium oxide. After the end of milling, the mass is sintered in a special high-temperature furnace, which ensures high-strength characteristics of the frame material. Next, the dental technician covers the frame with a special ceramic mass having a coefficient of thermal expansion similar to ZrO₂. A center for aesthetic prosthetics and implantology has been established in the regional clinical dental clinic, which is one of the clinical bases of the university, where a set of Cercon® art equipment and software manufactured by DeguDent GmbH is used. The technology has been tested and is successfully used in the manufacture of metal-free ceramic structures: crowns, bridges, pin-stump inserts, caps of various

shades, individual abutments for implants. When evaluating the already existing positive results of the use of this technology, some difficulties were also identified at the stages of application in the clinic and laboratory. Bruxism is an absolute clinical contraindication to the use of zirconium oxide-based structures. Pronounced deep bite is a relative contraindication. In this case, treatment is possible after a preliminary orthodontic change in the relationship of the dentition. A difficult aspect of the application is the removal of these structures if it is necessary to treat the supporting teeth. When the root canal is opened through the crown, microcracks are initiated in it, which can subsequently lead to the destruction of structures. The area of the articulation zones of individual elements in the frame of the bridge prosthesis should not be less than 9 mm², therefore, with a significant extent of the defect, the use of these structures is impossible. The technical aspect of working with this material is the problem of rapid wear of expensive diamond tools during processing, which entails an increase in the final cost of metal-free ceramic structures.

Thus, modern technologies for the manufacture of metal-free ceramic structures ensure the creation of durable and highly aesthetic dental structures with various pathologies of hard tissues of teeth and dentition.

Conclusion. Metal-free non-removable structures are an effective, hypoallergenic, highly aesthetic material for prosthetics, while having a high cost. However, each type of structure has its own positive and negative properties: porcelain crowns are quite fragile and can be used as single crowns. In turn, all-zirconium crowns have practically no disadvantages, their installation requires minimal grinding of the hard tissues of the teeth. Crowns on a zirconium frame lined with ceramic mass can be used on depulped teeth, changed in color.

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