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Pin Structures from Zirconium Dioxide Used In Various Areas of the Dental Arch

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Abstract: One of the ways to preserve the morphological and functional unity of the dentition is the restoration of defects in the hard tissues of the teeth with a total or subtotal loss of the crown part, since the loss of the crown part of the tooth leads to an uneven distribution of masticatory pressure, which, in turn, causes further destruction of the dentoalveolar system. With the complete absence of the crown part of the tooth, root removal is not always justified. The preservation of roots that can be used for prosthetics prevents the formation of defects, deformations of the dentition and atrophy of the jaw bone tissue (E.A. Bragin, 2001, 2003; N.I. Lesnykh, 2004). Treatment of defects in hard tissues of teeth as a result of complicated caries is an important problem in dentistry, which is due not only to the high prevalence of this pathology, but also to the complexity and laboriousness of medical manipulations, a large number of complications with poor-quality treatment.

Despite new materials, technologies and instruments appearing in practice, the requirements for reliable and effective orthopedic treatment are constantly increasing. At the same time, the final stage of the treatment of complicated caries is of great importance - the restoration of the crown part of the tooth, which largely affects the outcome of the disease.

Keywords: Pin structures, zirconium dioxide, defect, deformation, atrophy, pathology, manipulation, pulpless tooth, endodontic treatment, biocoMPatibility, anticorrosion, radiopacity, resistance, electrogalvanic.

Introduction. Restoration of the crown part of the tooth after endodontic treatment and the use of tooth roots for prosthetics is one of the urgent problems of modern dentistry. Nevertheless, many practical questions remain open at the moment. The main task in the restoration of teeth with a destroyed crown part is to ensure adequate retention of the final restoration and maximum protection of the tooth root from fracture. The generally accepted solution to this problem is the use of various types of pins and pin structures.

A variety of clinical situations in the restoration of teeth with a destroyed crown part influenced a wide choice of sizes, shapes, manufacturing methods, physical and mechanical properties of dental pins and pin prostheses, as well as the nature of their interaction with the hard tissues of the tooth. It is well known that teeth after endodontic treatment are more fragile, and the probability of their preservation in the dentition is lower. According to statistics, fractures of pulpless teeth are observed significantly more often. Numerous studies have shown that most failures in restoring teeth after endodontic treatment are due to biomechanical or technological, rather than biological problems.

The choice of material for the manufacture of pins is of great importance, since it must have a number of characteristics, such as mechanical resistance to functional loads, biocoMPatibility, anti-corrosion, the ability to subsequently not change the aesthetics of the remaining tooth tissue, gums and subsequent reconstruction. Previously, pins made of metals were most widely used due to their mechanical properties. In addition to high strength, metal posts also have excellent radiopacity and

are a less expensive material. However, the oral cavity is an aggressive environment for metals. The possible pathological effects of metal alloys on the human body - chemical-toxic, electrogalvanic and allergic - are well known. Recently, there has been a development and increasing use of non-metallic materials. Standard pins made of zirconia partially stabilized with yttria (4-5%) have appeared on the dental market. This material not only offers good biocoMPatibility and excellent esthetics, which is also characteristic of glass ceramics, but, in contrast, is radiopaque and has a high degree of mechanical resistance. Currently, it is possible to manufacture a wide range of orthopedic structures based on zirconium dioxide: inlays, crowns, bridges of any length, it is widely used in prosthetics on implants, as well as for the manufacture of pin structures.

The use of standard post designs is not always indicated, especially in cases of high tooth decay index, when custom post designs are recommended. In addition, the use of standard post designs has other disadvantages: insufficient adaptation of the intra-root part of the post to the shape of the root canal, minimal guarantee of reconstruction stability, insufficient radiopacity, multi-layered and multi-component. An alternative proposal was the manufacture of individual pin stump structures from zirconium dioxide.

The purpose of the study was to determine the strength properties of individual pins made of zirconium dioxide in different parts of the dentition at different values of the occlusal load angle.

Material and methods. The test was carried out using an INSTRON 5900 universal testing machine (USA). Extracted natural teeth (incisors, premolars, molars) were used in the study; A cylindrical fastener has been specially developed for the INSTRON Universal Testing Machine. The extracted teeth were prepared, the root canals were prepared for the manufacture of pin structures while maintaining the required thickness of the hard tissues of the teeth of about 2 mm with the formation of a supragingival rim, scanned in the dental laboratory using a ZhirkonZahn S600 ARTI scanner (Germany), modeled in the ZhirkonZahn program and milled the pin stump tabs on the milling machine ZhirkonZahn M5 (Germany). The fabricated inlays were fixed into the teeth with Fuji I glass ionomer cement (Japan). Next, the samples were scanned for the manufacture of crowns. In the same program, crowns were modeled and milled from Ice Zircon Translucent zirconia. The crowns were fixed with Fuji I glass ionomer cement (Japan). After that, the teeth are placed in cylindrical molds filled with Heraeus bone cement (Palacos MV, Germany). This cement was chosen by us, since its physical and mechanical properties are as close as possible to the properties of bone tissue. The fixed samples were subjected to a destructive single excessive load at angles of 0, 15, 30°. The results were tabulated and statistically processed (SPSS 12.0.2 for Windows).

Results. Analysis of the results shows that the strength values of the cutters at an angle of 0° were 256.2±15.11 mPa, at an angle of 15° - 214.84±14.71 mPa, at an angle of 30° - 86.27±8.93 mPa. Strength values of premolars at an angle of 0° - 327.43±22.65 mPa, with an increase in the angle to 15° - 298.26±16.68 mPa. The strength of the molars under load at an angle of 0° - 487.95±44.16 MPa, at an angle of 15° - 463.48±48.94 mPa.

Based on the results of the study, it can be concluded that an increase in the load angle significantly affected the strength properties of the studied samples. The greatest strength was demonstrated by the molars at a load angle of 0°, and the lowest strength was demonstrated by the incisors at a load angle of 30°.

Conclusion. The results of bench tests of the strength of teeth of different functional groups with pin structures made of zirconium dioxide showed a more pronounced strength in the posterior teeth in coMParison with the anterior ones, which necessitates further optimization of the size of the inlays and the limits of preparation of the roots of the teeth of different functional groups.

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