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ASSESSMENT OF FRACTURE RESISTANCE OF CAD-CAM CERAMIC CROWNS

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ABOUT ARTICLE

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Abstract: Angular abutments have been developed in the anterior part of the upper and lower jaw to achieve optimal mechanical, aesthetic and biological results in treatment based on implants. The optimal placement of the implant and the design of the suprastructure make it possible to achieve a high aesthetic result. It is known that with an increase in the angle of inclination of the abutment, the microstrain increases significantly, which makes it important to choose the preferred material of the suprastructure. An option for restoring the dentition in case of partial adentia is prosthetics based on implants, which allows preserving the integrity of adjacent teeth.

INTRODUCTION

Angular abutments have been developed in the anterior part of the upper and lower jaw to achieve optimal mechanical, aesthetic and biological results in treatment based on implants. The optimal placement of the implant and the design of the suprastructure make it possible to achieve a high aesthetic result. It is known that with an increase in the angle of inclination of the abutment, the microstrain increases significantly, which makes it important to choose the preferred material of the suprastructure. An option for restoring the dentition in case of partial adentia is prosthetics based on implants, which allows preserving the integrity of adjacent teeth [1].

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CEREC CAD/CAM dentistry is a process in which dental restorations are made using an HD intraoral video scanner, computer—aided design software and precision milling equipment. It uses advanced motorized equipment to create 3D objects, including customized dental crowns that are perfect for your mouth.

Ceramic Crown CAD/CAM

Let's take a closer look at what the materials used are, what their advantages are and how the procedure itself goes.

A CAD/CAM crown is essentially a denture for a tooth that is made without the use of metal. Instead, lithium disilicate is used, which is characterized by greater strength and durability. In addition, these types of prostheses are almost impossible to differentiate from one's own teeth.

The metal-free construction of this type was developed in Germany, because of the substance used, it is also called glass ceramics. It is characterized by wear resistance even at high chewing loads and the ability to maintain its properties for more than two decades.

Advantages of crowns using CAD/CAM technology

CAD/CAM ceramic crowns have a number of advantages that place them in the top of products used for similar purposes:

• Aesthetics and convenience. Due to the color features, they are practically indistinguishable from their own teeth, and a tight fit to the gum gives a feeling of comfort.

• Security. The materials do not cause irritation of the oral mucosa and rejection reactions, so the option is especially preferable for people with allergies.

• The ability to keep your own tooth tissues alive. This is due to the small thickness of the structure, and, consequently, there is no need for intensive preparation.

• Light weight of the product. Due to this, minimal pressure is exerted on the underlying bone.

• The ability to use glass ceramics for both front and chewing teeth.

• Special strength, which makes it possible to operate such products for a very long period of time.

Indications for the procedure

The replacement of zirconium oxide with lithium disilicate made it possible to multiply the service life of the product and solved the issues of its premature failure.

The cost of this type of prosthetics is slightly higher than using alternatives in the form of cermets, but this is the only drawback of the method.

However, only a dentist can determine whether the system is suitable for a particular person, so make an appointment with a competent specialist before making a decision. First of all, the doctor conducts a general examination of the oral cavity and identifies anatomical and physiological indications for the procedure. The next step is to determine the condition of a particular damaged tooth, clean it, process it, and in rare cases even remove it. Sometimes, however, even these activities are not required. The next step is to determine the bite and begin the process of making a CAD/CAM crown (check the price in the price list). The process takes about 2-3 weeks and during this period, temporary prosthetic options are installed for the patient. At the end of the period, the restoration is completed directly by installation.

Tooth loss is accompanied by changes in anatomical structures and resorption of the alveolar bone. According to the study, using the example of an incisor bone, 25% of the bone volume is lost in the first year after tooth extraction, and 40-60% in the first 3 years. In addition, a change in anatomy in the compact bone of the vestibule after tooth extraction may cause difficulties in implant placement [2]. Angular abutments have been developed in order to achieve optimal mechanical, aesthetic and biological results in the anterior part of the upper and lower jaw during implant-based treatment [3,4]. Clinical results with the use of angular abutments are considered satisfactory [4].

Visually, single restorations based on implants are compared with adjacent natural teeth, especially in patients with gingival type of smile. In metal-ceramic restorations, the unnatural appearance of the

metal infrastructure negatively affects aesthetics [5]. Since the optimal placement of the implant and the design of the suprastructure are necessary to simulate the natural appearance of the tooth and achieve a high aesthetic result, ceramics can be used to restore the crown part.

Recently, computer-aided design (CAD) and automated manufacturing (CAM) technologies have been used in the standardized production of monolithic crowns [6]. Due to its excellent aesthetic as well as mechanical characteristics, such as high fracture resistance and bending strength, zirconium is a reliable alternative to metal restorations [7]. An in vitro study conducted by Beuer et al. showed that zirconium crowns in full anatomy have a higher resistance to fracture than zirconium crowns with traditional cladding.

A new glass-ceramic material has appeared in dental practice, lithium-silicate ceramics reinforced with zirconium (Vita Suprinity ,VS), combining the beneficial physical properties of zirconium dioxide (ZrO2) and the aesthetic characteristics of traditional glass ceramics [9].

Vita Enamic (VE), a hybrid ceramic obtained by combining ceramics and composite, has advantages such as low brittleness, lateral stability, in addition, the material is perfectly amenable to processing [10]. Due to the finer crystalline silicate particles and the homogeneous structure, the material has a high abrasion resistance. The dense glass matrix in the composition gives an aesthetic appearance [11].

Due to the high bending strength, these materials, used in a monolithic manner, demonstrate reliability in the manufacture of restorations in the area of the chewing group of teeth, in patients with high occlusal loads, as well as with insufficient interclusal distance [12].

The angle of the abutment is a mechanical variable that can affect the internal and external structure of bone tissues [13]. It is known that with an increase in the angle of inclination of the abutment, the micro-voltage increases significantly. In this case, it becomes important to choose the preferred suprastructure material [1].

Goal

The purpose of this study was to study fracture resistance, as well as the types of fractures of monolithic all-ceramic blocks mounted on abutments with different angles of inclination.

METHODS

CAM-CAD restorations were mounted on titanium abutments, the angle of inclination of which was: 0 (group 0), 15 (group 15) and 25 (group 25).

Artificial CAM-CAD crowns were made of:

• monolithic zirconium dioxide [Zir],

• lithium silicate ceramics reinforced with zirconium dioxide [VS],

• hybrid ceramics [VE].

The samples were subjected to dynamic loading and thermocyclic aging in vitro. The values of resistance to destruction were measured, as well as the types of destruction were determined.

RESULTS

The highest fracture resistance was found in the 0-Zir group, and the lowest in the 15-VE group. Fracture resistance showed significant differences between group 0 and group 15 for Zir and VE materials, as well as between group 0 and group 25 for VS; no statistical significance was revealed between the other groups. When analyzing the types of fractures, complete or partial fractures of artificial crowns were detected in the samples, and abutment deformation was found in some samples.

CONCLUSION

The fracture resistance of monolithic crowns, which include zirconium, is higher than that of hybrid materials. As the angle of inclination of the abutment increases, the resistance of the restoration to destruction decreases. When using an angular abutment, the material of the suprastructure plays an important role.

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