FIXATION OF REMOVABLE DENTURES ON TELESCOPIC CROWNS

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Abstract

Modern dentistry offers a large number of different types of prostheses for restoring damaged teeth - the doctor selects the necessary design for each patient. Many patients have heard about telescopic dentures, but do not quite understand what they are - in this article we will try to explain how telescopic dentures differ from conventional ones. There are removable and fixed (bridges, implants) dentures. Telescopic crowns are removable. Despite the fact that permanent structures, due to their name, may seem more durable, telescopic fastening of a denture in the oral cavity can last a very long time and provide a complete replacement of a lost tooth.

Keywords: removable dentures, telescopic crowns, diagnostic models, digital radiography.

Currently, information technologies are increasingly penetrating various areas of medicine, including dentistry. And we are not talking about the banal use of a computer as a typewriter. Computer power is actively used at the stages of diagnostics (scanned diagnostic models, digital radiography and photography) and prosthetics. To justify the use of various types of orthopedic structures, mathematical modeling methods are widely used. Their essence lies in predicting the results of medical intervention when calculating the stress-strain states of the organs of the dental system, dentures or crowns. In this work we will talk about telescopic crowns. The finite element method [1, 4] is a numerical method also intended for solving partial differential equations that arise when solving problems of mathematical physics. The method is widely used to solve problems in the mechanics of a deformable solid, as well as for problems of heat transfer, hydrodynamics and electrodynamics. As the name of the method suggests, its essence lies in finding a solution on a discretized area - dividing the original area into many subdomains (elements). For each element, the type of approximating function is selected (in the simplest case, a polynomial of the 1st degree). These functions are null outside the scope of their element. The matching conditions are also met - equality of the values of the approximating functions at the boundaries of the elements (at nodes). These matching conditions also make it possible to determine the coefficients of the approximating functions on their elements. A system of algebraic equations is compiled and solved. Since each function is limited to the domain of its element, the system is usually sparse, which makes it easier to solve.

The purpose of the study is to evaluate the cone retention force for the considered physical model of the crown. The holding force occurs when the crowns are pressed against each other; the inner cone fits like a wedge into the outer one. In this case, a significant pressure force appears on the surface of the cone, which is directed perpendicular to the surface - a normal force, which also determines the magnitude of the friction force. The stronger the components of the crown are pressed against each other, the greater the holding force will be generated and the more securely the crown will be fixed.

Material and methods.

In the numerical experiment we will perform several variants of calculations: for different angles and for different loads. We will vary the angles from 40 to 120 in increments of 2. On average, the human jaw creates a load of about 108 Pa when chewing. All options for parameters of a numerical experiment are specified in the problem.xml parameter file. We will generate the area and perform calculations for each pair (angle-load) of a specific parameter value. To generate the area and mesh we will use the free-software package Gmsh. To carry out the calculations, we will use the open-source tool FEniCS [3], which is designed to solve problems described by partial differential equations using the finite element method. Results. For all loads and angles, the maximum values of the resulting holding force are presented. The magnitude of the inclination angle of the cone generatrix is inversely proportional to the magnitude of the resulting holding force. In practice, it is not recommended to use angles greater than 6° for telescopic conical crowns.

Conclusion. The main results of this work are as follows. To solve the boundary problem of elasticity theory in a domain of complex shape, a numerical method based on the finite element method was constructed. The design of telescopic cone-shaped crowns was modeled. A Python program was developed for the simulation. Based on modeling, the influence of the geometric parameters of the crown on the holding force was assessed. In general, it has been established that for cone-shaped crowns it is not worth choosing an angle greater than 6°, since for large angles the holding force decreases sharply.

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