Spectral evaluation of biomaterials from juvenile dentin of various degrees of demineralization using Raman spectroscopy

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Abstract: Osteoplastic materials are the basis for the formation of the patient's own tissue. These materials serve as a biocompatible matrix for building bone tissue during its regeneration and should be completely replaced by the patient's own tissue. Dentin is biocompatible and bone tissue is formed after its transplantation. Experiments on optical evaluation using Raman spectroscopy of biomaterials from juvenile dentin demineralized with hydrochloric acid solutions with varying degrees of normality have been carried out. The objects of research were dentin obtained from healthy juvenile teeth pre-mechanically treated. Each sample was cut into 2 equal parts and further divided into two groups, according to the stages of their processing: group 1 – biomaterials from juvenile dentin demineralized in hydrochloric acid of 1.2N degree of normality; group 2 – biomaterials from juvenile dentin demineralized in hydrochloric acid of 1.8N degree of normality. Demineralization was carried out in a hydrochloric acid solution using the "LIOPLAST" technology. It is shown that in the process of demineralization of juvenile teeth, the degree of normality of the hydrochloric acid solution causes minor structural changes. With demineralization of 1.2N with hydrochloric acid solution, a greater number of organic components are preserved compared to demineralization with a hydrochloric acid solution of a normality degree of 1.8 N.

Keywords: juvenile dentin, Raman spectroscopy, spectral analysis, demineralized biomaterials, changes in dentin, demineralized bone matrix, demineralized dentin

Introduction. Osteoplastic materials serve as a biocompatible matrix for building bone tissue during its regeneration and must be completely replaced by the patient's own tissue. Allogeneic analogues of bone tissue are considered to be the most accessible source of biomaterials-substitutes that contain biologically active cellular structures. Dentin can be used as a graft, as it contains structural proteins of bone tissue, has low antigenicity and high osteoinductivity [1, 2].

Assessment of the degree of demineralization of biomaterials from juvenile dentin is an urgent task, because the biocompatibility of the graft directly affects its engraftability and the subsequent formation of its own bone tissue.

Objective. The aim of the study is to evaluate and compare the composition of biomaterials obtained from juvenile dentin demineralized with hydrochloric acid with varying degrees of normality using the Raman spectroscopy method.

Materials and methods. The objects of research were dentin obtained from healthy juvenile teeth pre-mechanically treated. Each sample was cut into 2 equal parts and further divided into two groups, according to the stages of their processing: group 1 – biomaterials from juvenile dentin demineralized in hydrochloric acid of 1.2N degree of normality; group 2 – biomaterials from juvenile dentin demineralized in hydrochloric acid of 1.8N degree of normality. Demineralization was carried out in a hydrochloric acid solution using the "LIOPLAST" technology [TU-9398-001-01963143-2004].

As the main method of analyzing biomaterials from juvenile dentin, the Raman spectroscopy method was used, implemented using an experimental stand, including the RPB-785 Raman probe combined with the LuxxMaster LML-785.0RB-04 laser module and the high-resolution Shamrock sr-303i digital spectrometer with a built-in DV420A-OE cooled camera [3].

The analysis of the spectra was carried out in the MagicPlotPro software environment, as well as using the discriminant analysis (LDA) method in the IBM SPSS Statistics software environment. The averaging of the spectra was carried out in the Mathematica 8 mathematical software package.

Results. As a result of the conducted studies, spectral differences of biomaterials from juvenile dentin demineralized in hydrochloric acid of varying degrees of normality were established. It is shown that demineralization of 1.2N with hydrochloric acid solution allows to preserve a larger number of organic components compared to demineralization of 1.8N with hydrochloric acid solution, as evidenced by an increase in the intensity of the lines 918 cm-1 (Proline, hydroxyproline), 1171 cm-1 (Tyrosine (collagen type I)), 1271 cm-1 (Collagen (amide III)), 1663 cm-1 (Proteins, including collagen I).

List of literature:

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