Application of Raman spectroscopy for evaluation of bone condition in periodontitis

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Periodontitis is an inflammatory disease accompanied by destructive destruction of all periodontal tissues [1]. Inflammatory periodontal disease (ILD) is still an urgent and not completely solved problem of modern dentistry due to the continuing high prevalence of gingivitis and periodontitis in various populations. The incidence of inflammatory periodontal disease reaches 62-94% among the residents of the Russian Federation, and among individuals aged 18-24 years living in different regions of Russia, the prevalence of periodontal disease is from 83.6% to 96.6%. [2]. Periodontitis is one of the factors of tooth bone tissue resorption [3-5]. Osteoclasts are the main resorption factor and can resorb bone[4]. Odontoclasts and osteoclasts have similar modes of action, but act in different places.[5] Likewise, periodontitis leads to impaired bone mineralization of the teeth[6]. There are many methods to assess the state of the teeth in periodontitis, such as orthopantomography, X-ray, CT scan and others [3].

The aim of this work was to determine changes in the spectral characteristics of bone tissue in periodontitis.

The Raman spectroscopy was carried out using an experimental setup (Figure 1) consisting of a Raman probe RPB-785 combined with a LuxxMasterLML-785.0RB-04 laser module (up to 500 mW power, 784.7 ± 0.05 nm wavelength) and a high-resolution digital spectrometer Shamrocksr-303i providing spectral resolution of 0.15 nm with an integrated cooled chamber DV420A-OE [7]. The detailed analysis of Raman spectra was performed in the software environment MagicPlotPro and by means of discriminant analysis method (LDA) in the software IBMSPSSStatistics [8].

Chemometric analysis of bone tissue combinatorial scattering spectra in norm and in periodontitis was carried out as a result of the studies. Spectral changes in the bone tissue in periodontitis were revealed. It was found that spectral changes associated with changes in the relative intensity of lines 956 cm-1 (v1P-Osymmetricstretch (PO43-) and1070cm-1 (C-Oinplanestretch (CO23v1)) were observed in periodontitis. These lines are associated with changes in mineral co-state. There are also observed line intensity changes at 1570 cm-1 (AmidII (Phosphoproteins, collagen)), 1665 cm-1 (Amid I, C-C-H valent) associated with bone resorption.

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