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The relation between structural, rugometric and fractal characteristics of hard dental tissues at micro and nano levels

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Abstract

Human tooth exhibits a structure of a mixture of inorganic hydroxyapatite nanocrystals and organic phases. The aim of this study is to investigate different tissues of human canine teeth surface along with the micro structure parameters of each tissue. X-ray diffraction (XRD) is used to study the amorphous or crystalline nature of each tissue with different mineral compositions and crystalline structures where the highest crystalline quality is related to enamel. The surfaces are also examined by energy-dispersive X-ray spectrometry. Moreover, crystalline quality factor is carried out to estimate the crystallinity of the tissues. Also, based on the basic Scherrer equation, the Williamson–Hall equation is applied to extend the formula for the XRD. Enamel and cementum tissues of a typical human tooth, which look similar, are composed of a large variety of wide lines with different widths through Raman spectra analysis. In addition, the applied scanning electron microscopy extracts similar morphology for all tissues with round granular structures which are denser in the cementum. Atomic force microscopy is finally used for investigation of micro-morphologies of the different tissues and the results are compared with the fractal analysis which ends to the bifractal and anisotropic nature of enamel and cementum along with monofractal and isotropic nature of dentin.

Keywords: AFM, Dental micro-morphology, Fractal analysis, Hydroxyapatite, SEM, X-ray crystallography.