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The effect of dental LED light-curing unit photoactivation mode on 3D surface morphology of dental nanocomposites evaluated by two-dimensional multifractal detrended fluctuation analysis

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Abstract

The objective of this study was to evaluate the effect of two photoactivation modes of dental LED light-curing unit (LCUs) (conventional and "Soft Start" mode) on surface texture parameters of two dental resin-based nanocomposites. LED LCUs were considered as standard light-curing devices in contemporary dental practice. Atomic force microscopy (AFM) was applied to investigate surface morphology on 90 × 90 μm^2 scanning area through 2D multifractal detrended fluctuation analysis with computational algorithms basis. In order to compare 3D surface roughness at nanometer scale, singularity spectrum f[α] was used which characterize local scale properties of multifractal nature of samples. The results confirmed that larger spectrum width Δα ($\Delta\alpha = \alpha_{max} - \alpha_{min}$) of f(α) is associated with non-uniform surface morphology. Moreover, materials whose polymerization was photoactivated by the "soft start" polymerization mode, showed better quality of the surface microstructure with lower values of AFM surface texture parameters.

Keywords: Atomic force microscopy, Composite dental resin, Nanocomposite, Photoactivation modes, Surface roughness, 2D multifractal detrended fluctuation analysis.