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Improvement of the Geometric of Dental Bridge Framework through Automatic Program

Authors : Rong-Yang Lai, Jia-Yu Wu, Chih-Han Chang, Yung-Chung Chen

Abstract : The dental bridge is one of the clinical methods of the treatment for missing teeth. The dental bridge is generally designed for two layers, containing the inner layer of the framework(zirconia) and the outer layer of the porcelain-fused to framework restorations. The design of a conventional bridge is generally based on the antagonist tooth profile so that the framework evenly indented by an equal thickness from outer contour. All-ceramic dental bridge made of zirconia have well demonstrated remarkable potential to withstand a higher physiological occlusal load in posterior region, but it was found that there is still the risk of all-ceramic bridge failure in five years. Thus, how to reduce the incidence of failure is still a problem to be solved. Therefore, the objective of this study is to develop mechanical designs for all-ceramic dental bridges framework by reducing the stress and enhancing fracture resistance under given loading conditions by finite element method. In this study, dental design software is used to design dental bridge based on tooth CT images. After building model, Bi-directional Evolutionary Structural Optimization (BESO) Method algorithm implemented in finite element software was employed to analyze results of finite element software and determine the distribution of the materials in dental bridge; BESO searches the optimum distribution of two different materials, namely porcelain and zirconia. According to the previous calculation of the stress value of each element, when the element stress value is higher than the threshold value, the element would be replaced by the framework material; besides, the difference of maximum stress peak value is less than 0.1%, calculation is complete. After completing the design of dental bridge, the stress distribution of the whole structure is changed. BESO reduces the peak values of principle stress of 10% in outer-layer porcelain and avoids producing tensile stress failure.

Keywords : dental bridge, finite element analysis, framework, automatic program
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