Effects of buccal bi-cortical anchorages on primary stability of dental implants: a numerical approach of natural frequency analysis.

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Abstract

The purpose of this study was to investigate influences of buccal bi-cortical anchorages on natural frequency (NF) values of dental implants in different diameters utilizing the three-dimensional finite element method. Three degrees of buccal bi-cortical engagements were generated in D2 and D3 bone quality models, which were 0-mm engagement (i.e. implants just had contact with the buccal cortex), 0.5-mm (i.e. implants were penetrated into the buccal cortex by 0.5 mm) and 1.0-mm engagement, while only 0- and 0.5-mm engagement were simulated in D4 bone models. The uni-cortical engagement was set as the control. By the modal analysis, NF values of bending and axial vibration mode were computed as a function of different bi-cortical engagements. The results showed that buccal bi-cortical anchorages significantly enhanced bending and axial NF values. The increasing rates resulting from 0.5-mm engagement ranged from 10.5 to 42.3%, with a mean of 24.3%. From 0- to 0.5-mm engagement, the NF values maintained an increasing trend, and from 0.5- to 1.0-mm engagement, the values levelled off or even decreased. In 0.5- and 1.0-mm engagement models, increasing implant diameter resulted in small increases of NF values. In conclusion, buccal bi-cortical anchorages could significantly increase both bending and axial NF values of dental implants, but extra-buccal cortical bone engagement could not produce considerable incremental increases of NF values as anticipated. Increasing implant diameter could result in limited increases of NF values in case of implants being bi-cortically anchored.