学位論文内容の要約

学位論文題目

The minimization of diameter and length of dental implants according to bone quality using finite element analysis and optimized calculation.

（有限要素解析と最適化計算による
骨質に応じたインプラントの直径と長さの最小化）

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ABSTRACT: The purpose of this study was to investigate the influence of bone quality and implant size on the maximum equivalent elastic strain in the peri-implant bone (MES) using finite element (FE) analysis, and to minimize implant size with optimized calculation.

Three-dimensional FE models consisted of a mandible and a titanium implant with a superstructure were constructed. A vertical load or a lateral load of 60N was applied to the node corresponding to the central fossa. We investigated the effect of four variables: the thickness of the cortical bone (C), Young's modulus of the trabecular bone (T), and diameter (D) and length (L) of the implant. According to the variables determined using Latin hypercube samplings, 500 FE models were constructed and analyzed under each of the loads automatically. Based on the response surfaces constructed with MES as a response value, D and L were minimized by optimized calculation under the limited MES to 3000 microstrain which was the physiological limit with reference to the Mechanostat Theory.

MES under the lateral load was greater than that under the vertical load, and increased as C and T become smaller. D strongly had an influence on MES compared to L with significance. MES could be restricted to 3000

microstrain, when L or D was larger than 4.0mm and 10.0mm, respectively, unless both C and T were small. Considering MES quantitatively from the viewpoint of Mechanostat theory, we suggested minimum diameter and length of implants according to the Young's modulus of trabecular bone and the thickness of the cortical bone, which may be clinically applicable. The reduction of the stress in bone around the bottom of implants may be a key to extend the adaptability of implants to the bone of poor quality.