



# Finite element analysis to evaluate fracture of implant

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## Statement of problem

Overload can cause bone resorption or fatigue failure of the implant. Implant fracture is an uncommon but significant problem.

## Purpose

The purpose of this study was to investigate fracture of fixture by finite element analysis and to compare 3.75mm, 4.0mm, 5.0mm diameter fixture according to the level of alveolar bone resorption.

## Materials and Methods

The single implant and prosthesis was modeled in accordance with the geometric designs for the Osstem and 3i implant systems. Modeling were processed by the software programs Hyper-mesh version 7.0(Altair engineering Inc., Troy, MI, USA) and ANSA(beta CAE Systems version 11.2.4). 3-dimensional finite element models were acquired : (1) a regular 3.75 13mm titanium implant(2) a regular 4.0 13mm titanium implant(3) a wide 3i 5.0 13mm titanium implant with a cemented abutment and titanium alloy screw. The amount of preload was hypothesized as 650N and 12mm diameter, 9mm height round and flat type prosthesis was loaded to 600N. 4 loading offset point(0, 2, 4, 6mm from center of implant) was evaluated. To evaluate fixture fracture by alveolar bone resorption, we

investigate stress distribution of the fixtures according to different alveolar bone level(0, 1.5, 3.5, 5.0 mm alveolar bone loss). Using these 12 models, the effect of the offset of loading, the effect of alveolar bone resorption and the size of fixture was evaluated. The PAM-CRASH 2G(ESI, version 2004, France) was used for analysis of stress. The PAM-VIEW(ESI, version 2004, France)and HYPER-VIEW(Altair engineering Inc., Troy, MI, USA) were used for post processing.

## Results

1. With application of preload, von Mises stress is maintained until loading offset 2mm.
2. In 3.75 implant, fracture of abutment screw is possible from 4mm offset and when bone loss 3,5 and 5.0mm, fracture of implant is also possible.
3. In 4.0 implant, fracture of abutment screw is possible from 4mm offset and when bone loss 3,5 and 5.0mm, fracture of implant is also possible.
4. In 5.0 implant bone loss 0mm, fracture of abutment screw is possible from 4mm offset, but when bone loss 1.5, 3,5 and 5.0mm, fracture of abutment screw is possible from 6mm offset. Fracture of 5.0 implant is impossible.