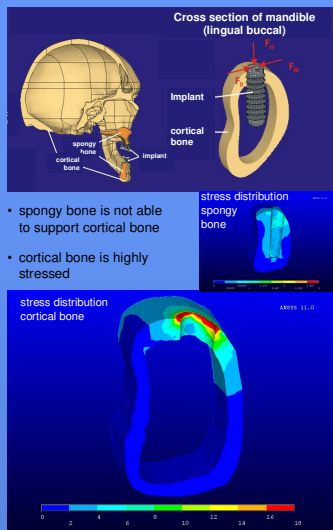


FLACH M¹, STRECKBEIN R², ELLERHORST M⁶, STRECKBEIN P³, MÜLLER K⁴, HASSENPLUG R⁵

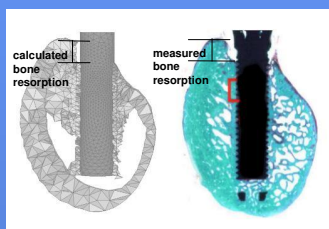
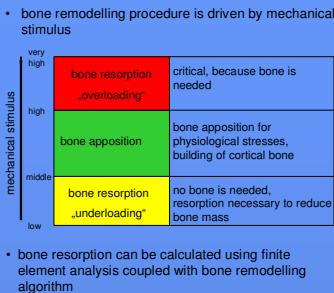
(1) University of applied sciences Koblenz, Virtual prototyping, Koblenz. (2) Department of Oral Medicine & Implantology; St. Vincenz Krankenhaus, Limburg. (3) University Hospital Giessen and Marburg, Department for Cranio-Maxillofacial Surgery, Giessen. (4) IGZ, cooperative for dentists, board, Diez. (5) IGZ, cooperative for dentists, board, Diez. (6) BEGO Implant Systems GmbH & Co. KG, Bremen.

Bone Implant Interaction (Bone Resorption)

Stress Distribution in the Bone

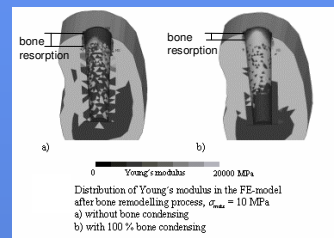
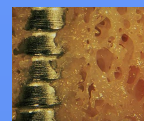


Calculation of Bone Resorption



Influence of Bone Condensing

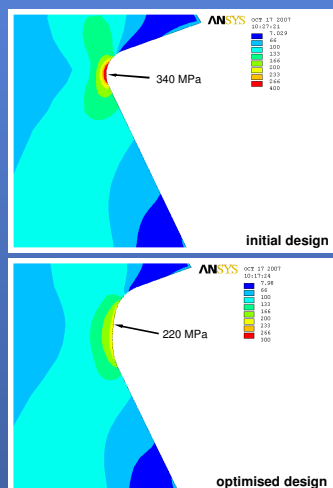
- different dental implant designs for bone condensing are available
- Bego RI implant uses a special thread to achieve bone condensing
- influence of bone condensing technique can be studied using finite element analysis coupled with bone remodelling algorithm
- bone density is equivalent to Young's modulus
- higher bone resorption without bone condensing compared to optimal (100%) condensed bone were found



Development using Design Optimisation and Testing

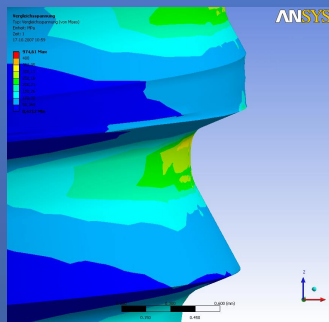
Design Optimisation

- minimisation of stresses to avoid early fractures



Verification of Optimised Design

- optimal design was found using finite element axial symmetric submodels (2D) with short calculation times
- implant was designed in a 3D CAD system
- CAD geometry was transferred to the finite element system
- stresses of optimised design was verified using CAD data

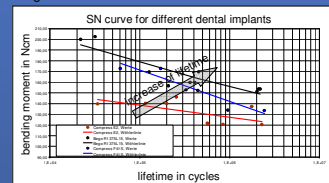


Verification by Testing

- lifetime of the implant has to be tested
- standard test according to ISO 14801 will lead to long testing times (usually more than two month)
- main influence on lifetime of the implant is the bending moment
- testing time can be reduced by rotating bending test devices to two weeks



- SN curves were taken to evaluate the resistance against fracture



Final Implant Design

Implant Design

- precise CAD geometry used for calculation
- forces for pre stressing of abutment screw and chewing considered

Stresses

- equivalent stress caused by chewing
- overview over whole implant system

Verification of Details

- equivalent stress for cross section of implant
- critical locations verified

