Mandibular fracture after dental implantation

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FEA Evaluation

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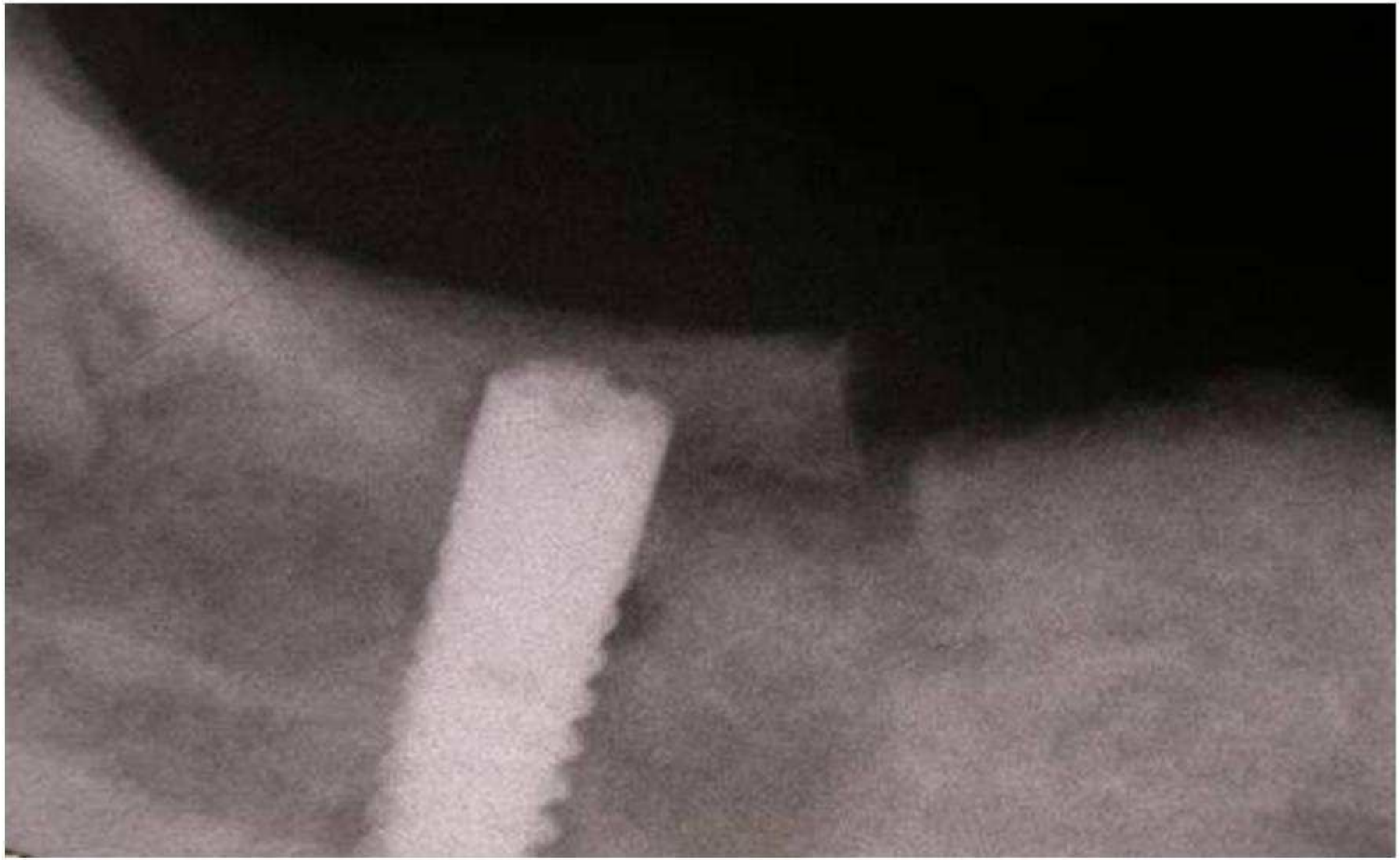
Case



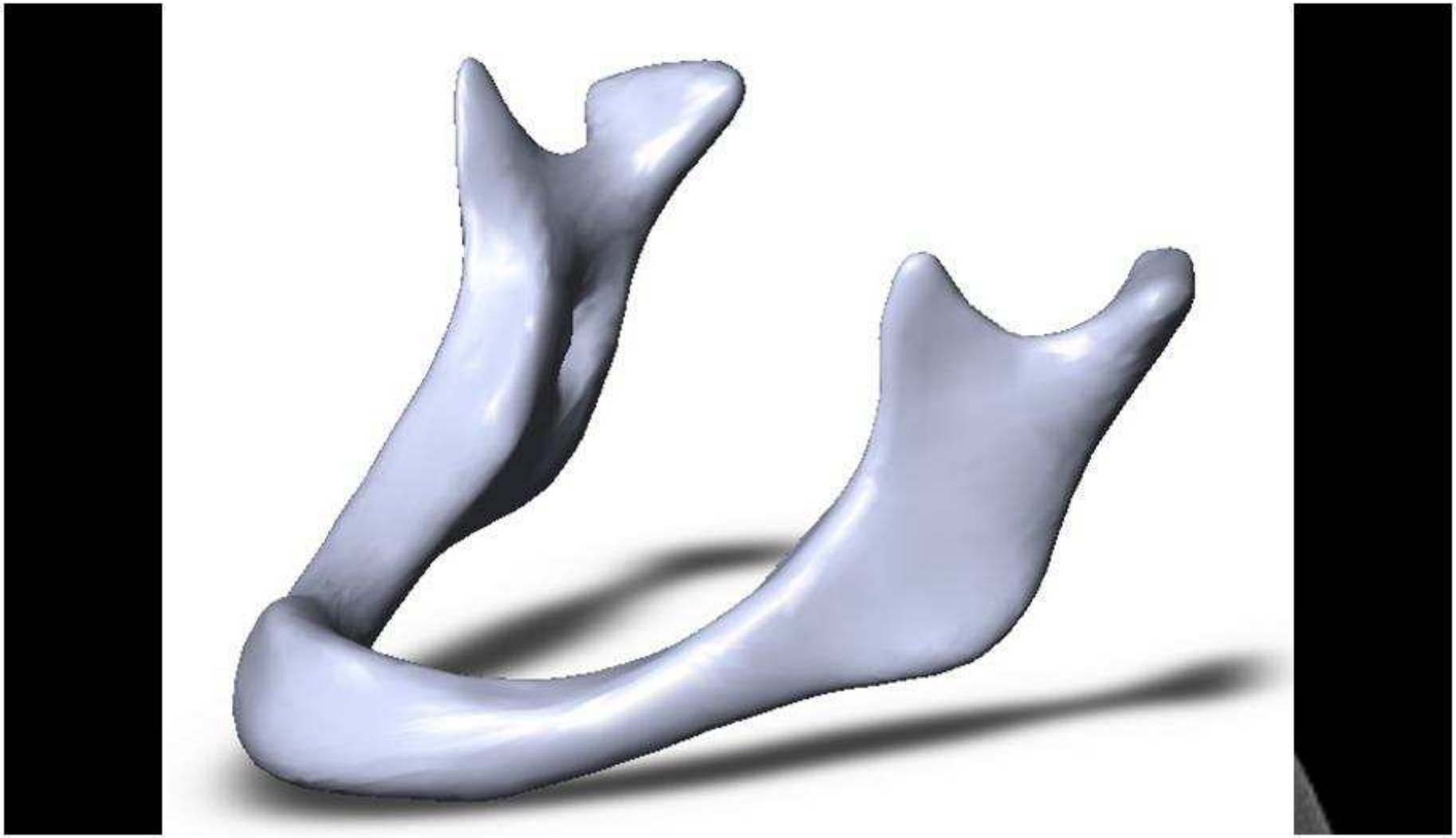
- Evaluation of fracture mechanism in adult edentulous lower jaw

  – Interforaminal implantation on a biomechanical simulation model
  – Biomechanical forces in mandibula
  – Role of masticatory system
  – Influence of implant's diameter
  – Influence of implant's position

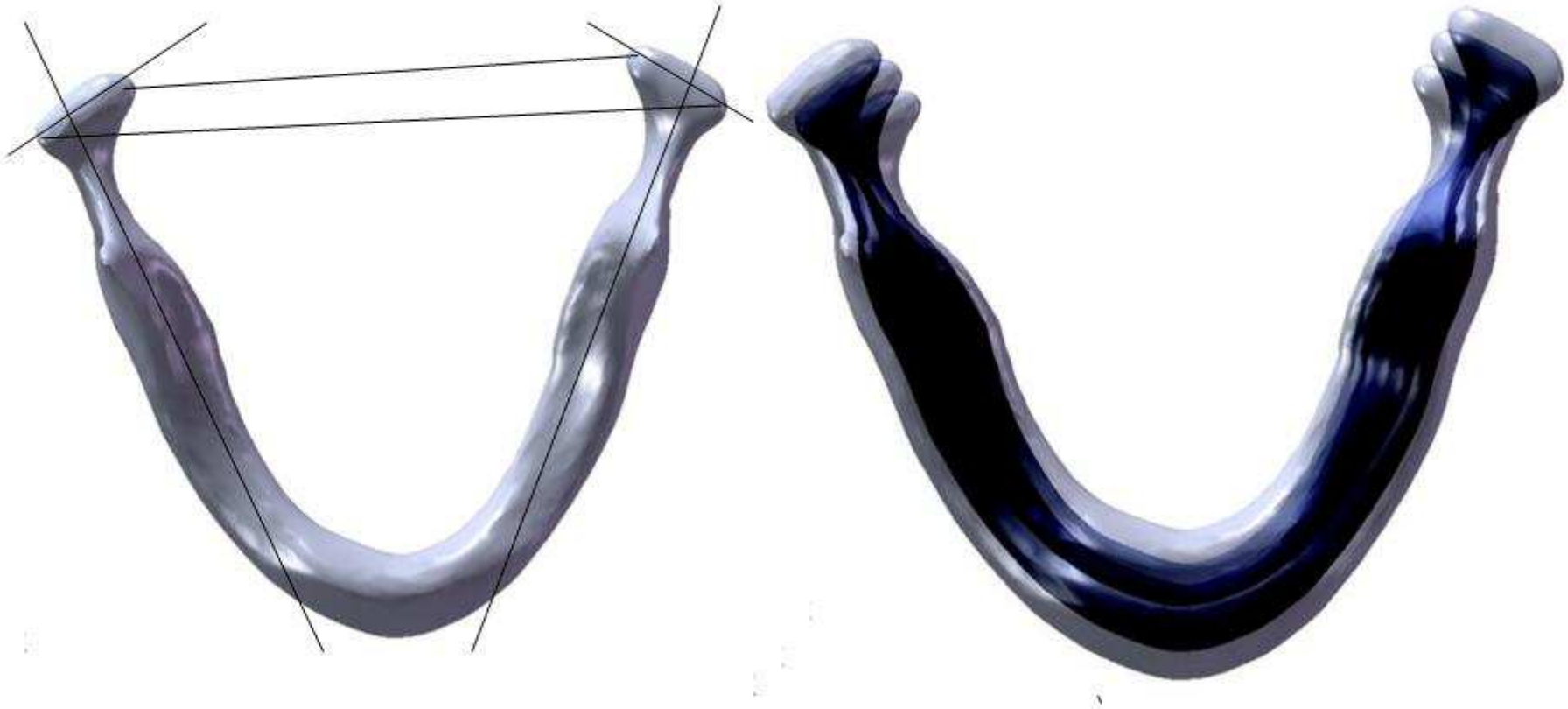
Workflow

- Transformation of Dicom- data into 3D-Solids with Pro/E® -software an a CAD-workstation
- Matching of 3D- CT edentulous mandibular studies (35)
- Construction of a hybrid-model with insertion of 4 Astra-Tech® implants (Ø4,0mm x 6mm) interforaminal
- FEA analysis with SolidWorks/ Cosmos® and an additionally masticatory system

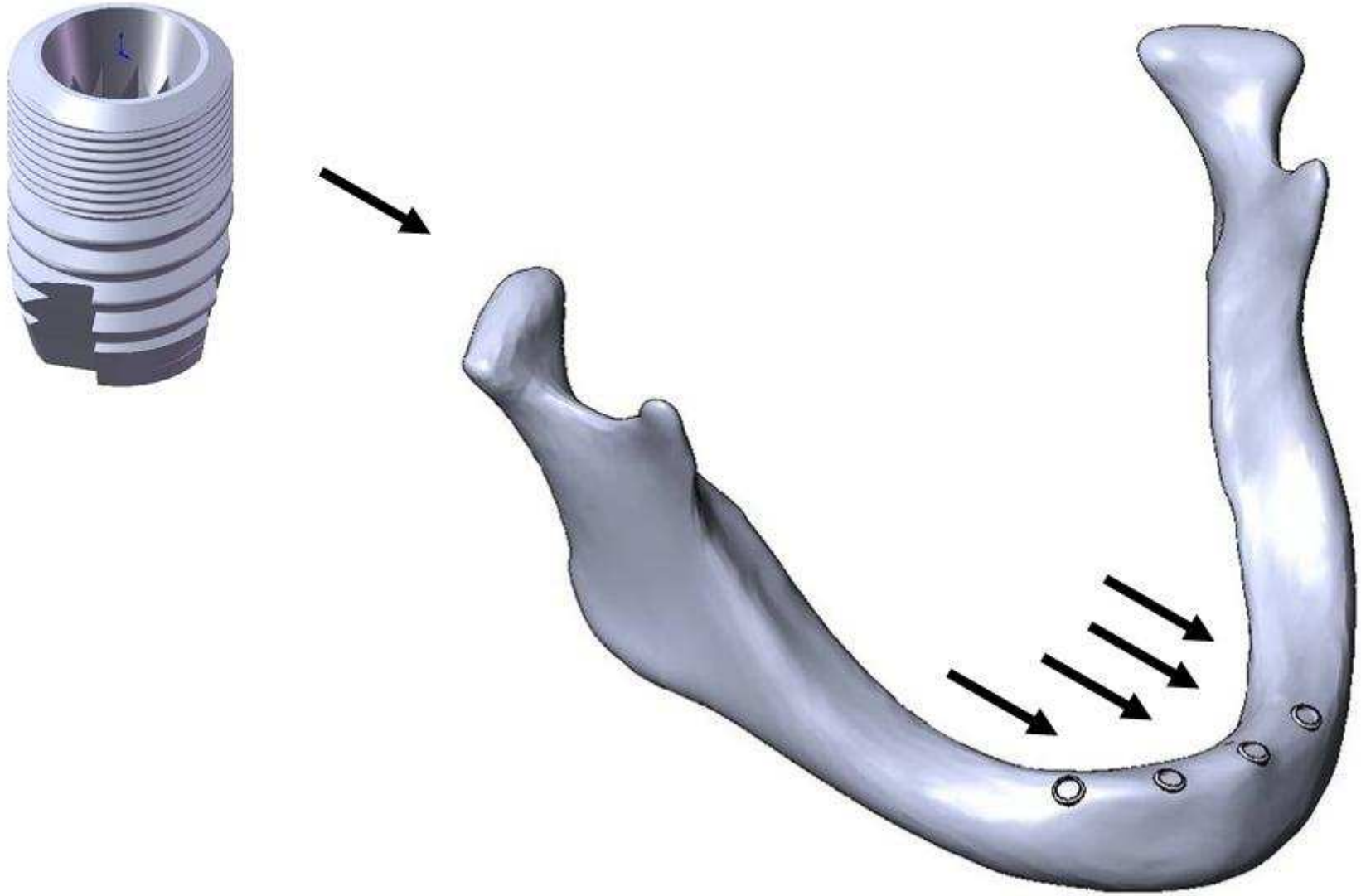
Transformation of DICOM-data



Matching of 3D- CT studies



Construct a Hybrid-model



Materials and implant load

	Bone *(Brinkmann et al. 2002)*	Implants *(Astra-Tech) Ti Al6V4*
Density	1.5 g/cm^3	4.43 g/cm^3
E-modulus	6-25e^9 N/m^2	110000 N/mm^2
Poisson	0.08-0,45	0.32
Shear-modulus	0.31e^9 N/m^2	42058.28 N/m^2
Max. tensile strength	87-151e^6 N/m^2	900 N/mm^2
Max. shear strength	53-82e^6 N/m^2	870 N/mm^2

Load on implant: 100N

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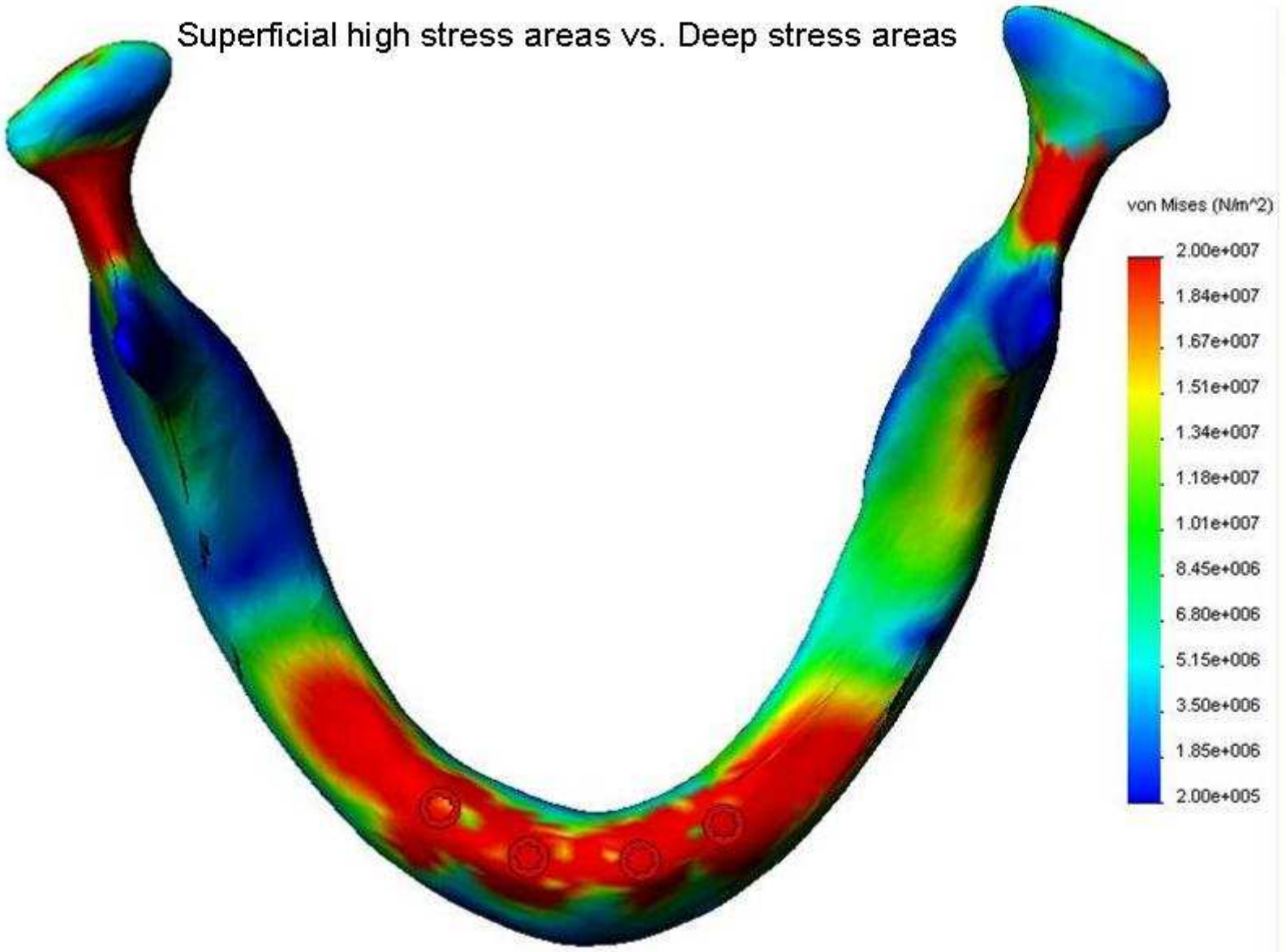
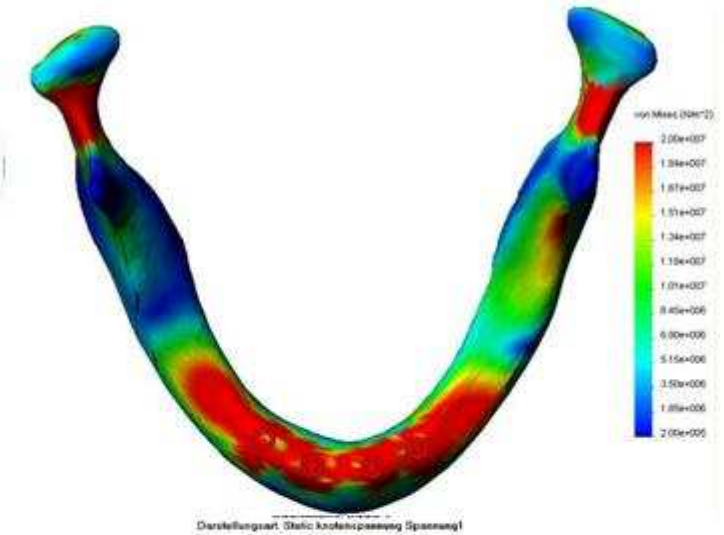
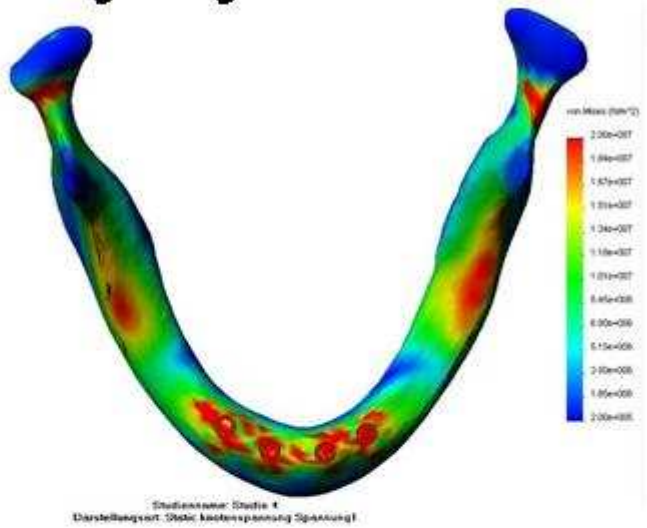
Stress distr. in mandibular bone

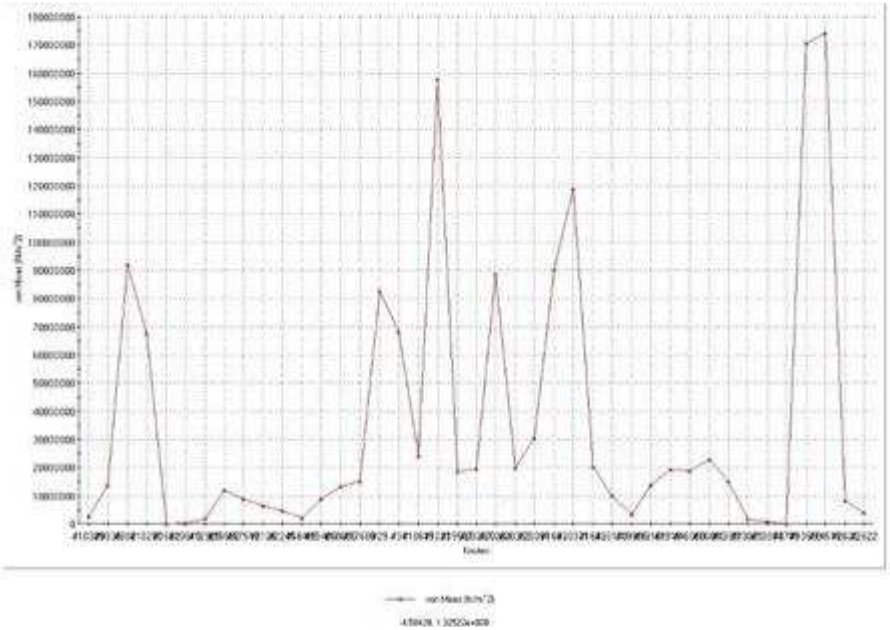
Superficial high stress areas vs. Deep stress areas

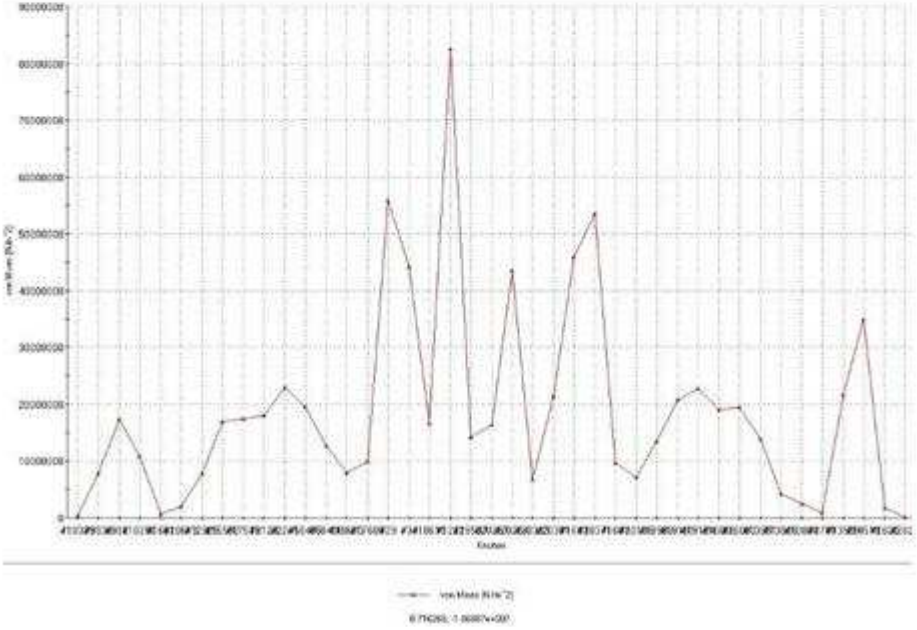


Stress distr. with masticatory system

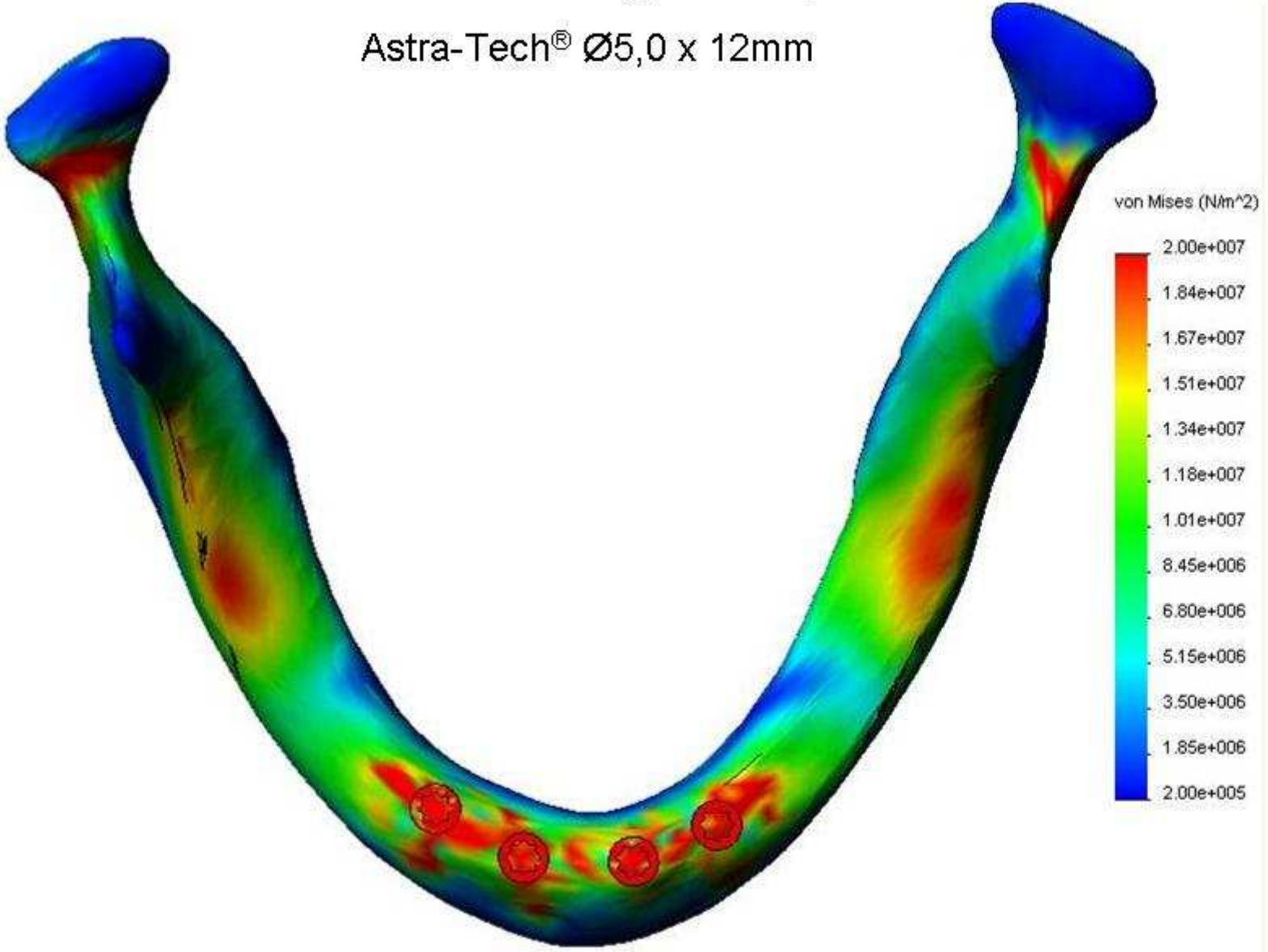




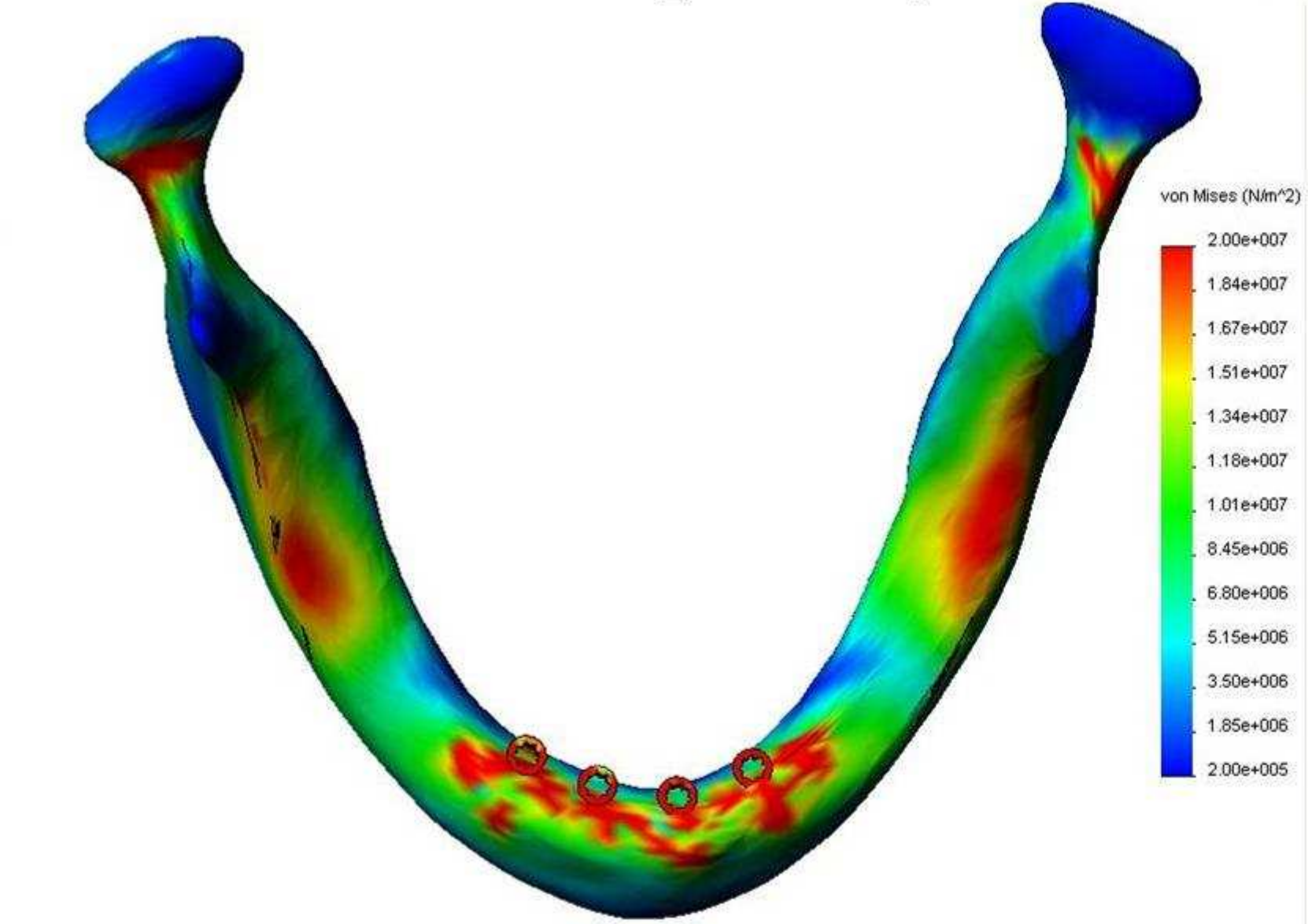




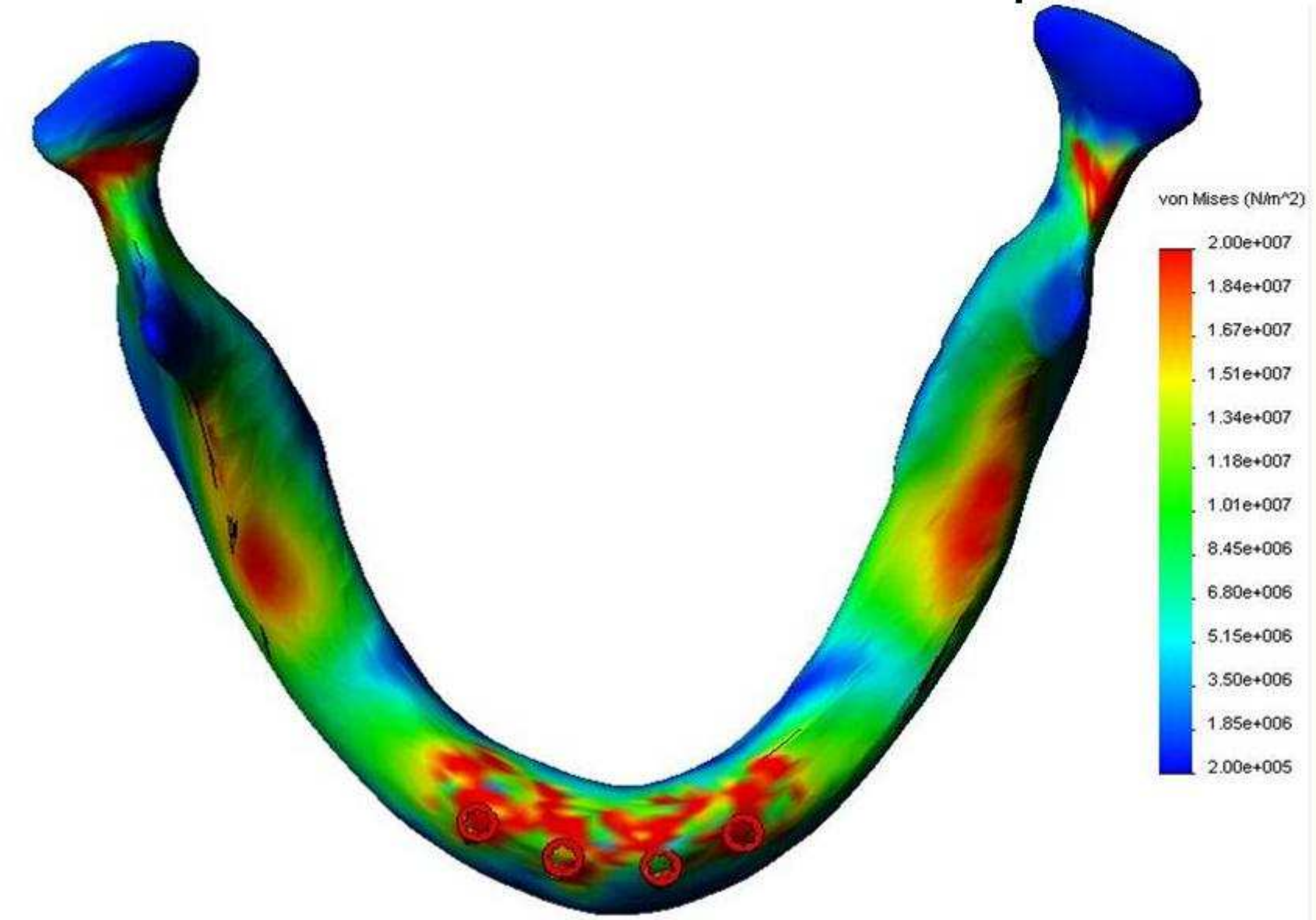
Stress distr. with large implant diameter



Stress distr. with lingual displacement



Stress distr. with vestibular displacement



Static and dynamic aspects

- Mainly superficial distribution of stress in mandibular bone
- Muscular shifting of stress peaks to distal bone structures
- Moderate influence of implant's diameter on non traumatic fracture
- Moderate influence of implant's vestibular/ lingual displacement on non traumatic fracture (but cave: trauma)

Literature:

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