Mandibular fracture after dental implantation

- 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 on 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) interforal
- 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

<table>
<thead>
<tr>
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<th>Bone (Brinkmann et al. 2002)</th>
<th>Implants (Astra-Tech) Ti Al6V4</th>
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<tbody>
<tr>
<td>Density</td>
<td>1.5 g/cm³</td>
<td>4.43 g/cm³</td>
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<tr>
<td>E-modulus</td>
<td>6.25e³ N/m²</td>
<td>110000 N/mm²</td>
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<tr>
<td>Poisson</td>
<td>0.08-0.45</td>
<td>0.32</td>
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<tr>
<td>Shear-modulus</td>
<td>0.31e³ N/m²</td>
<td>42058.28 N/m²</td>
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<tr>
<td>Max. tensile strength</td>
<td>87-151e⁶ N/m²</td>
<td>900 N/mm²</td>
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<tr>
<td>Max. shear strength</td>
<td>53-82e⁶ N/m²</td>
<td>870 N/mm²</td>
</tr>
</tbody>
</table>

**Load on implant 100N**

Stress distr. in mandibular bone

Superficial high stress areas vs. Deep stress areas
Stress distr. with masticatory system
Stress distr. with large implant diameter

Astra-Tech® Ø5.0 x 12mm
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:

- Carls FR, Pajarola G, Sailer HF.: Mandibular fractures due to implant management--incidence, mechanism of injury and therapeutic characteristics, Fortschr Kiefer Gesichtschir. 1996;41:106-8