

Analysis of the influence of a four-implant retained bridge on the stress state in mandibular bone

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Abstract. The study deals with full dental prosthetic reconstruction on four implants (“All-on-four”). The aim is to compare the stress state in the mandibular bone between a non-restored mandible and a restored mandible. A finite element model (Abaqus®) of an edentulous mandible with a fully customized denture screwed onto four implants is established. Two anterior axial implants are placed in the right and left canine areas with another two posterior tilted implants. Three distinct phases of mastication are modelled: maximum intercuspation (ICP), incisal clench (INC) and unilateral molar clench (only the right molar clench RMOL is considered). In the bare mandible, the maximum stresses are found near the right tilted implant location during RMOL. Otherwise, the stresses are the highest during ICP, in comparison to the INC and RMOL stages: this seems to be logical, as ICP stage corresponds to the phase of the mastication where both jaws are completely tightened. In the restored mandible, during ICP, the decrease of the stresses is explained by the fact that the greatest stresses are supported by the framework. The slight rise of stresses during INC is the result of two separate mechanisms inducing opposite effects on the stresses: the stiffening of the mandible caused by the framework and the deformation process of the framework, significantly different between INC and ICP. The major differences between the non-restored and the restored mandibles arise during RMOL. They concern the working side's implants: the stresses decrease (about 65 %) near the tilted implant and increase (about 200 %) near the axial implant, which behaves as an essential component to transfer the twisting movement as a bending and translation movement for the rest of the lower jaw. This stress deviation could explain some of the therapeutic failures concerning implants loosening in the “All-on-four” technique.

Keywords: dental prostheses; bone/implant interface; finite element modeling

References

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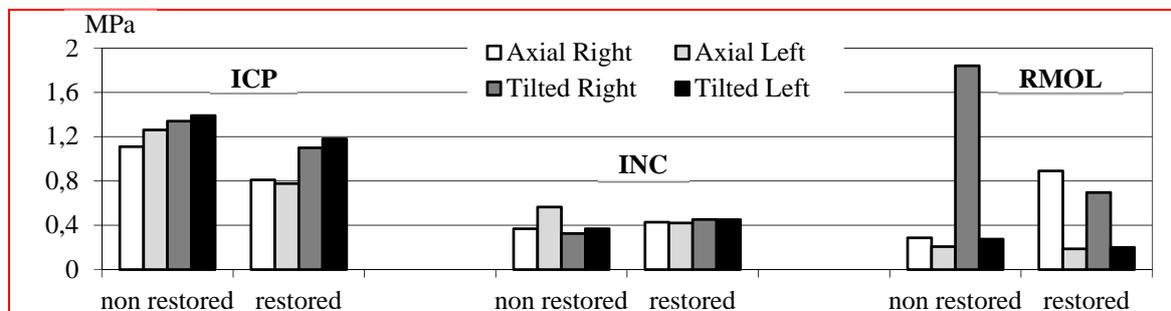


Fig. 1 Von Mises stresses at the 4 bone/implant interfaces in the bare mandible and in the restored mandible.

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