Nonlinear Finite Element Analysis of proximal femur nail (PFN) combination.

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ABSTRACT

Geometrical nonlinear analysis of proximal femur nail combination under static loads including fractured parts using computer tomographic data for femur stiffness and geometry with realistic contact conditions. The mechanical behaviour of the implant is compared to clinical observations.

keywords: PFN, femur, fracture, CT-density,CT- bone-geometry, mapping , morphing

1. **Introduction:**
Nowadays modern CAE Methods are also applied in the large area of medical care. In particular nonlinear FE-analyses are used to predict the mechanical behaviour of implants and can attribute in the future to a higher reliability on the selection and functionality of the specific femur nail combinations for the surgical practice.

2**. Method**
The considered part of the skeleton is reproduced via computer-tomography. The data are imported to CAD-programs in the present work to ANSA and contain information concerning the shape of the bones as well as the distribution of densities which are used to define the repartition of the bone-stiffness.The CAD-data of the implants are blended into the bone surface and bone stiffnesses are mapped to the 3-dim mesh. One specific loadcase is analysed by geometrical nonlinear calculation, allowing the incremental analysis of the motion guaranting equibilbrium at every time step. Thus the behaviour of every part in interaction may be analysed and evaluated and the complete motion may be animated.

3. **Results**
The application of commercial software (ANSA, ABAQUS) in the area of medical area is shown. The behaviour of the proximal region of a fractured femur under a load of 2000 N [1] was analysed, showing a slip back of the femural neck screw relative to the antirotational screw. This may lead to a tilting of the proximal main fragment around a sagittal axis.

4.**Discussion**
The employed FEM-Anlyses reproduce various phenomena that are also observed in pratice. The presented approach shall be extended to a preoperative tool allowing the selection of an optimal implant for the indivudual case. For this aim a catalogue of

different sizes of standarized bones modelled with a large number of implants will be established allowing a prompt response using an automatized morphing procedure (ANSA), that accounts for the density information via the individual CT data of the patient.

REFERENCES

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