UNIVERSITÄT LEIPZIG iccas innovation center computer assisted surgery Fraunhofer IWU

A planning software for stent implantation

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Background

The vessel surgeons software for planning a stent implantation is presently limited to simple measurement methods [Fig.1]. A more functional software, that assists throughout the whole planning process, can improve the planning result by optimizing implant selection and their position in the vessel. In the research project of ICCAS and Fraunhofer IWU the integrability of a physically based simulation model of stent graft and aorta into the clinical environment was examined.

Fig.1 Diameter and length measurement during the planning phase

Methods

Simulation-sensitive parameters for stentgraft-vessel interaction and material attributes were specified. The next step is to pass the parameters to a finite elements method (FEM) simulation which gives information about the implantation result. The DICOM standard was analyzed with reference to the data support of stent graft models and the extension of the patient´s record with simulation results.

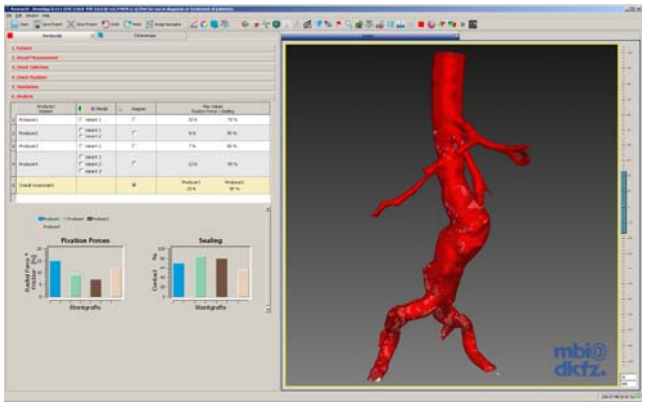

Fig.2 Prototype of Stenting Planning software with a first approach for analysing simulation results (left). Right: segmented vessel with plaque

MITK, an open source framework specialized in medical software applications, is used to integrate and visualize the simulation result [Fig. 2].

Results

With blood pressure, plaque occurrence and approaches for vessel, plaque and stentgraft properties the essential parameter were determined. Helpful output quantities are the radial force of the stent graft and the gap size between implant and vessel wall which can help the surgeon to evaluate implant fixation and sealing [Fig. 3]. The DICOM “Generic Implant Template” IOD in conjunction with its intrinsic “Surface Segmentation” IOD can be used to save the models geometry as well as parameters describing the flexible behaviour of a stent graft [Fig. 4]. Simulation results can be stored in the “Implantation Plan” structured report document.

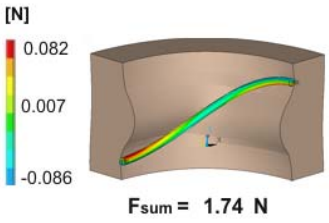

Fig.3 1/4 Finite-Element Model: Radial forces of a Nitinol-Stentring considering blood pressure (160mm/Hg) and vessel /plaque properties

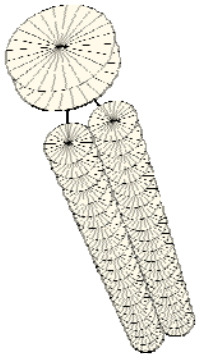

Fig.4 Functional stent model representing flexibility properties

Conclusion

Simulation relevant values were determined. At present, there are limitations due to specification of individual vessel material parameters. Existing DICOM supplements are suitable for clinical integration of simulation model parameters and can furthermore be used for supporting a data base for stent graft surface models.

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