Augmented fluoroscopy-based Navigation on a biplane Angiography System for Pulmonary Vein Isolation

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Purpose

- **Pulmonary Vein Isolation** (PVI) is the current default interventional treatment of **Atrial Fibrillation**
- PVI is an **anatomical-based** procedure and guided by mono- or biplane fluoroscopy and mapping-systems
- Biplane fluoroscopic navigation during PVI is improved by **3D-Overlay** of volumetric datasets, created ablation lesions are assessed and integrated into the 3D-Model

Material & Methods

A new software-prototype facilitates **planning of PVI ablation lines**, based on a preprocedurally acquired MRI-, CT- or rotational angiography-dataset:

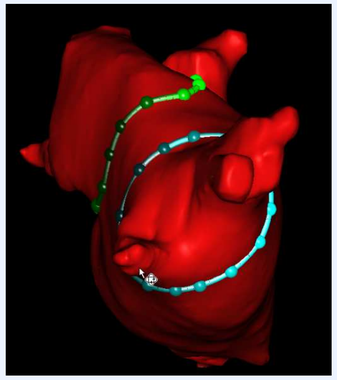

Fig. 1: Preprocedural 3D-Dataset (MR-Angiography), segmented Left Atrium, pre-planned antral ablation lines, encircling the ipsilateral Pulmonary Veins (PVs). A color gradient displays anterior parts of ablation lines lighter, posterior parts darker

Biplane 3D-Overlay

The volumetric data and the corresponding pre-planned ablation-lines are superimposed onto biplane fluoroscopy. The **3D-Overlay** is **automatically adapted** to C-arm angulations, patient table positions and distance between X-Ray tube and detector

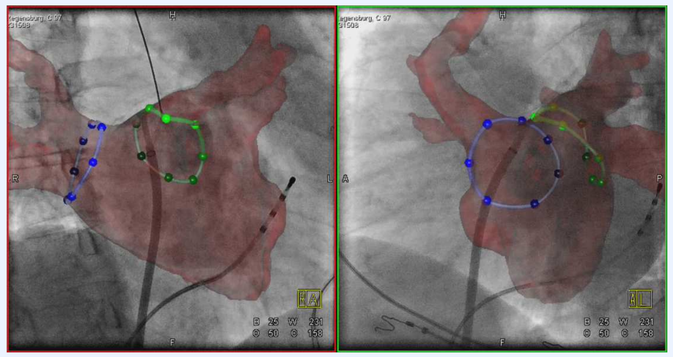

Fig. 2: Biplane fluoroscopy (RAO/LAO -30°/60°) displaying 3D-Overlay of left atrium, pre-planned ablation lines. Mapping-Catheter placed in coronary sinus, contrast agent injection through transseptal sheath. Ablation line encircling right PVs displayed blue, ablations line encircling left common ostium displayed green

Documentation

Progress of procedure is documented by **tagging of 3D-points**, point localization based on triangulation

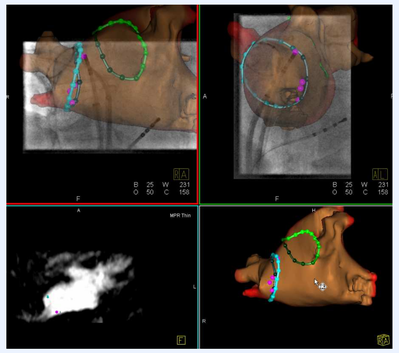

Fig. 3: Prototype screen view - Biplane fluoroscopy (RAO/LAO -30°/60°) with 3D-Overlay; MRA-dataset, 3D-visualization of segmented left atrium, pre-planned ablation lines, documented ablation lesions

Results

- The prototype was evaluated in 156 PVI procedures. 3D-Overlay registration process, based on an angiography of PVs / LA or catheter positions, was performed within a mean time of 11 sec. An angiography of a single PV is sufficient for complete 3D-registration of the superimposed 3D-dataset, as the 3D-volume is automatically adapted to all relevant C-arm-parameters in both planes
- Progress of PVI procedure was documented by displaying created ablation lesions:

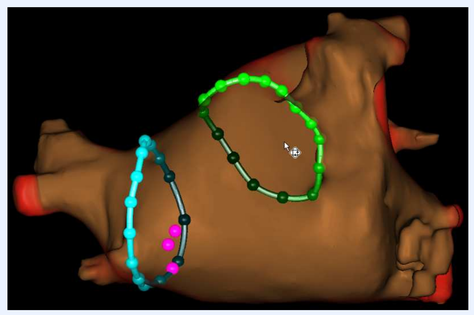

Fig. 4: Documented ablation lesion (violet points) at right inferior posterior ablation line (blue)

- Based on the principle of triangulation, complex ablation catheters like the Cryo Balloon were reconstructed in biplane fluoroscopy and visualized inside the 3D-dataset

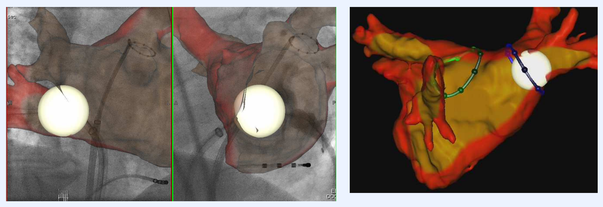

Fig. 5: 28 mm Cryo Balloon reconstructed in biplane fluoroscopy (-30°/60° RAO/LAO). Sphere, representing the balloon catheter, is visualized inside the 3D-dataset, including the segmented left atrium and pre-planned ablation lines

Conclusions

- Pre-procedurally, the prototype **assists planning** of ideal ablation lines encircling the ipsilateral pulmonary veins
- Graphical highlighting of **safety relevant anatomic structures**, e.g. the left atrial appendix, the aortic root and accessory pulmonary veins aids to the safety of the procedure
- As PVI is an anatomical-based approach, superimposed 3D anatomy on biplane fluoroscopy offers helpful **visual guidance for catheter navigation and ablation**

Acknowledgment
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