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

F. Bourier1, A. Brost1, J. Hornegger2, Kiraly3, J. Barbot3, N. Strobel4, N. Zorger5, H-J. Schneider1, F. Heissenhuber1, K. Kurzidim1

1 Klinik für Herzrhythmusstörungen, Krankenhaus Barmherzige Brüder, Regensburg, Germany
2 Pattern Recognition Lab, Friedrich-Alexander-University, Erlangen, Germany
3 Siemens Corporate Research, Princeton, United States of America
4 Siemens AG, Angiography & Fluoroscopy Division, Forchheim, Germany
5 Institut für Radiologie, Krankenhaus Barmherzige Brüder, Regensburg, Germany

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:

- 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. 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

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

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

• 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)

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

• 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. 6: Cryo Balloon reconstructed in biplane fluoroscopy (-30° /60° RAO/LOA) 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

This work has been supported by the German Federal Ministry of Education and Research in the context of the initiative Stuttgart Medical Valley