

Software Framework to Quantify Pulmonary Vein Isolation Atrium Scar Tissue

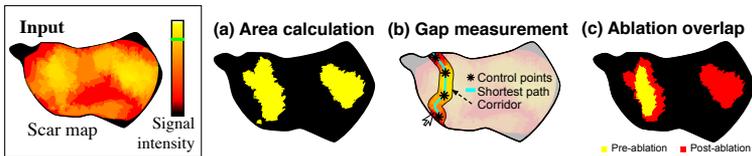
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Background: Computationally assessing atrial scar tissue from cardiac magnetic resonance (CMR) scans can be useful in evaluating pulmonary vein isolation (PVI). PVI is a common ablation procedure to isolate abnormal electrical signals occurring in the pulmonary veins. A successful ablation produces a lesion encircling the veins, preventing atrium activation.

Aims: This work presents a set of methods to robustly quantify features in the scar tissue within the left atrium, with emphasis on comparing the status of the scar tissue before (pre) and after (post) ablation procedures for PVI.

Methods: Input meshes were created from segmented late-gadolinium-enhanced CMR scans with scalar values at each node representing the signal intensity of the scar. A threshold is chosen by the user to distinguish scar from healthy tissue.



The technique has three functionalities: (a) *Calculating the area of the scar tissue* by adding the areas of triangular elements in the mesh with a value above the threshold; (b) *Assessing ablation lesions* by creating an encircling corridor around the veins via user-defined control points. *Gaps in the ablation* correspond to areas in the corridor where the scar's signal intensity are below the threshold; (c) *Comparing the pre- and post-ablation scar tissues*. A visualisation of both scar maps is available in the method through a superposition of the two meshes and corresponding segmented scar tissues.

Results: Six cases were assessed as a proof of concept, where patients had undergone pre- and post-ablation scans. In all tests, an increase in fibrotic tissue was found, from averages in pre- and post- ablations of $2 \pm 1.9\%$ and $36 \pm 18\%$ respectively. Post-ablation lesions cause $72 \pm 15\%$ encirclement of the pulmonary veins, with 2-4 *gaps* around each pair (left or right) of veins.

Conclusions: The techniques presented are a semi-automated, user-friendly framework where users are able to assess the success of an ablation procedure.