Cureus

# Feasibility Study of Atrial Fibrillation Ablation Using Image Guided Stereotactic Ablative Radiosurgery Delivered in a Cox-Maze IV Distribution

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**Abstract**
**Published 03/06/2024**



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**Categories:** Medical Physics, Radiation Oncology
**Keywords:** stereotactic ablative radiosurgery

**How to cite this abstract**
Kesbeh Y, Rahimian J, Joseph W, et al. (March 06, 2024) Feasibility Study of Atrial Fibrillation Ablation Using Image Guided Stereotactic Ablative Radiosurgery Delivered in a Cox-Maze IV Distribution. Cureus 16(3): a1119

## Abstract

Objectives:

Atrial fibrillation (AF) affects more than 8 million Americans. Refractory AF puts patients at an increased risk of cardiac death and stroke. To reduce this risk, an invasive ablative procedure is offered, but it is dangerous, time consuming, and costly. If radiation (RT) can be used to treat refractory AF, then such risks can be mitigated. Small studies have shown that RT is safe and promising in the treatment of ventricular tachycardia. We propose a novel approach to treating AF by targeting the “Cox-Maze IV” lesion set, which can offer more durable AF control, but is technically challenging. A Maze procedure involves pulmonary vein (PV) isolation and ablation in both atria to block macro-reentrant circuits. We hypothesize that it is possible to create single-fraction SBRT plans, which would offer ablative doses of RT in a Maze distribution while respecting tolerances of the organs at risk (OAR).

Methods:

We identified 5 patients who previously underwent cardiac ablation for refractory AF. These patients had previously received a computed tomography pulmonary venogram (CT PV) with 0.6 mm slice thickness. Their CTPV were uploaded to our treatment planning software. In collaboration with a trained electrophysiologist with experience in cardiac ablation procedures, the following four “lesion sets” were contoured using a 3.5mm brush- right atrium (RA), right pulmonary vein (RPV), left PV (LPV), and PV connection (PVC). The lesion sets were merged into a clinical target volume (CTV). CTV was expanded by 2mm to create the planning target volume (PTV). The adjacent OARs were contoured. A 6MV FFF beam and Volumetric Modulated Arc Therapy (VMAT) using 4 arcs targeting a single isocenter were used to deliver 25Gy to the PTV. Dose volume histograms were generated, and the plans were analyzed. Mean and median doses were analyzed for the heart, esophagus, left anterior descending artery (LAD), tricuspid valve, mitral valve, lung, and spinal cord.

Results:

Single fraction SBRT constraints were met for esophagus, lung, and spinal cord. D0.035cc heart constraints were exceeded by an average of 0.74Gy. Average dose to the LAD was 6.76Gy. The mean dose to the tricuspid and mitral valve were about 7Gy and 12Gy respectively. Over 95% of the target was covered by more than 95% of the prescription dose.

Conclusion(s):

This study shows the feasibility of delivering ablative SBRT in a Cox-Maze IV distribution while respecting nearly all OARs. PTV coverage was prioritized to ensure no area was under ablated, which would theoretically allow for re-entrant circuits. Coverage was most compromised by the esophageal constraint due to its proximity to the PV connection (PVC) lesion set. Established heart constraints may not be practical for this treatment, which is aimed at ablating native heart tissue. Alternatively, a fractionated approach can be pursued. LAD artery dose was relatively low, which is important since higher doses are associated with adverse cardiac events and all-cause mortality.