Reducing Radiation Exposure by Up to 67% by Addressing the Vertical Gap in Scatter Radiation Protection During PFA Procedures

Real-World Observations from an Electrophysiologist Returning to Fluoroscopy for PFA Ablation Procedures

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Background

For nearly a decade, my electrophysiology practice was conducted using a zero-fluoroscopy workflow for radiofrequency (RF) ablation procedures. By relying exclusively on intracardiac echocardiography (ICE) and advanced three-dimensional electroanatomic mapping systems, fluoroscopic imaging was eliminated from routine use. This approach effectively reduced occupational radiation exposure to near zero for all members of the electrophysiology team.

The recent adoption of pulsed field ablation (PFA) technology has been driven by evidence of enhanced procedural efficiency of pulmonary vein isolation. However, currently available commercial PFA platforms, such as the Boston Scientific FaraPulse™ system—reintroduce reliance on fluoroscopy for catheter visualization and manipulation. As a result, operators accustomed to "fluoro-less" workflows have experienced a measurable increase in occupational scatter radiation exposure, particularly to the head, neck, and upper torso. This shift has raised concerns regarding the cumulative long-term effects of repeated low-dose scatter radiation.

In response, I sought to evaluate whether incorporating a new-to-market, innovative scatter-radiation attenuation system could mitigate this renewed exposure. The Steradian Shield™ by Radux Devices Inc. is a lightweight, easy-to-deploy radiation protection pad and shield designed to reduce operator scatter dose without altering workflow or adding procedural complexity.

To assess Steradian Shield™ real-world impact, I conducted an observational evaluation during routine clinical practice. In December 2025, I performed two pulsed field ablation cases using the FaraPulse™ system while employing real-time dosimetry to quantify scatter exposure at the upper body, specifically the head and neck region. During the two cases we took a total of 47 radiation measurements to assess dose to the operator. The intent of this pilot assessment is to determine whether the Steradian Shield™ meaningfully reduced operator dose during PFA procedures compared to my recent baseline fluoroscopy-guided workflow.

The Vertical Gap Problem

During fluoroscopy-guided procedures, a significant source of operator radiation exposure to upper toros and head is from areas not covered by traditional shielding, but rather from a **vertical gap that exists between the patient and the ceiling-mounted shield**. Despite ideal positioning of the ceiling-mounted lead shield, maintaining this protective position throughout a procedure is nearly impossible. As the operator adjusts the table, exchanges catheters, and adjusts C-Arm angles between standard projections (AP, LAO 22°, RAO 30°), a vertical gap inevitably forms. Scatter radiation originating from the patient travels upward through this unshielded gap toward the operator's upper torso and head, where the operator has limited protection.

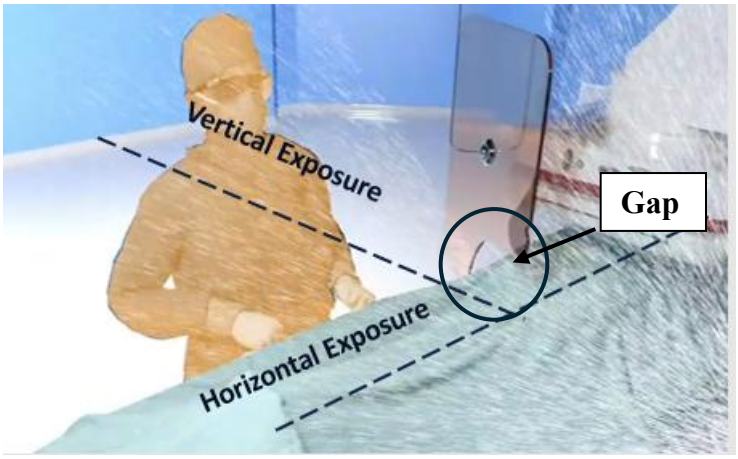

Figure 1: The vertical gap between the patient and ceiling-mounted shield is a primary source of scatter radiation to the operator's head and neck area.

> "The vertical gap between the patient and ceiling shield is a primary source of scatter radiation to the operator's head and neck."

Observational Methods

To quantify this observation, real-time scatter radiation measurements were obtained during two routine PFA procedures using a RaySafe 452 real-time dosimeter. The dosimeter was positioned at two consistent locations near my head and left shoulder: (1) head height, approximately 65 cm above the patient, and (2) shoulder height, approximately 50 cm above the patient. These positions represent the areas of highest exposure risk that are inadequately protected by standard lead aprons and ceiling-mounted shields.

The RaySafe 452 dosimeter remained in position throughout each procedure, recording dose rate measurements during active fluoroscopy. Fluoroscopy times for the two cases were 9.3 and 6.0 minutes respectively. Measurements were collected across three standard fluoroscopic angles commonly used during left atrial ablation: AP (anteroposterior), LAO 22° (left anterior oblique), and RAO 30° (right anterior oblique). For each angle, data was collected under different shielding conditions with and without the Steradian Shield™. A limited number of measurements were

obtained in the RAO projection, which were insufficient to support meaningful analysis; therefore, RAO results are not reported.

Observations

With the Steradian Shield™, positioned vertically to block the gap below the ceiling-mounted hanging shield, substantially reduced scatter radiation at both left head and shoulder levels. This effect was most pronounced in the AP and LAO 22° projections, which consistently produced the highest scatter and created a larger unshielded vertical gap. These findings demonstrate that effective operator protection during fluoroscopy-guided PFA procedures requires shielding that specifically addresses the vertical scatter gap.

Table 1: Distribution of scatter radiation measurements across C-arm projections

C-Arm Angle & Position	Baseline Dose (mSieverts/hr)	Shielded Dose (mSieverts/hr)	Total Reduction (mSieverts/hr)	Percent Reduction	n
AP – Head	4.19	1.40	2.79	67%	15
AP – Shoulder	5.40	1.80	3.60	67%	9
LAO 22° – Head	3.08	1.05	2.03	66%	15
LAO 22° – Shoulder	2.73	1.01	1.72	63%	8
OVERALL MEAN	**3.85**	**1.31**	**2.54**	**66%**	**47**

** Overall mean values are simple averages across the four measurement conditions. Individual row calculations: Total Reduction = Baseline − Shielded; Percent Reduction = Total Reduction ÷ Baseline.*

Image 2: RaySafe 452 Survey Meter (Fluke Biomedical) used to capture radiation scatter dose

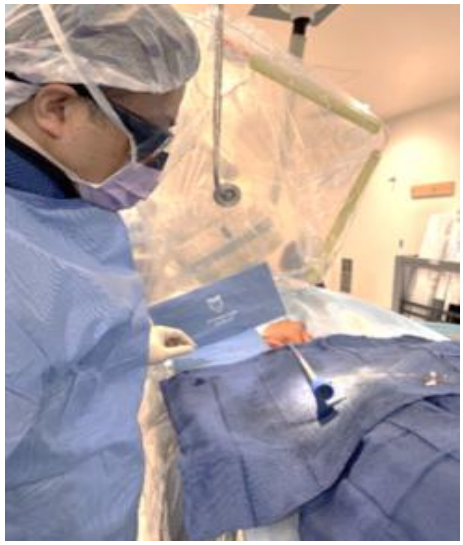

Image 3: Steradian Shield™ positioned on patient to block vertical scatter radiation to operator's head and neck.

> The Steradian Shield™ blocked the vertical scatter pathway and produced clinically meaningful dose reduction of **up to 67%**.

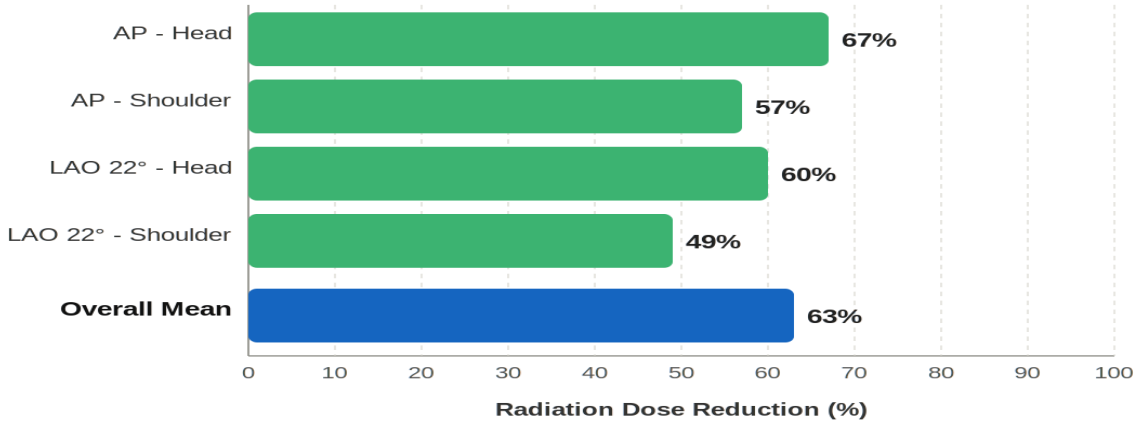

Figure 2: Observed radiation dose reductions with Steradian Shield™ across C-arm projections. Overall mean reduction of 63% was observed across 47 total measurements.

Comparison to Horizontal Radiation Pad — LAO 22° Projection

To provide additional clinical context, scatter radiation measurements were also obtained comparing the Steradian Shield™ directly against a commercially available flat radiation pad (RadPad, .125mm lead equivalent) during two cases. Three paired readings were recorded for RadPad and six for the Steradian Shield™ under otherwise identical procedural conditions.

The Steradian Shield™ produced a 63% reduction (1,255 mRem/hr) in operator head dose compare to RadPad of (3,387 mRem/hr). These findings are consistent with the well-documented limitation of horizontal pads: because they lie flat across the patient and do not block vertical gap.

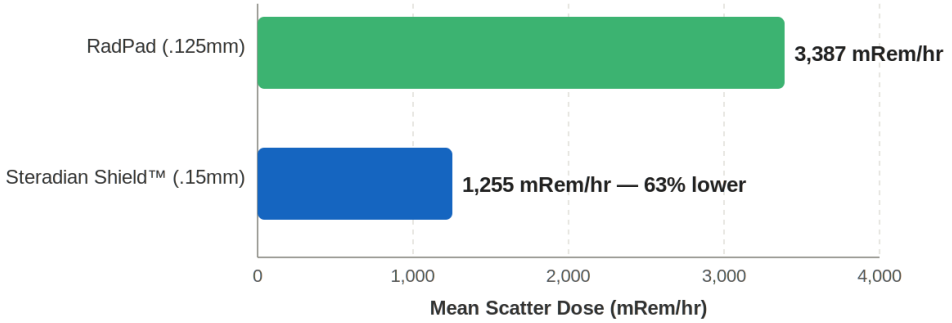

Figure 3: Mean scatter dose comparison between RadPad (.125mm) and Steradian Shield™ (.15mm) at LAO 22°. Steradian Shield™ produced a 63% reduction in operator head dose.

Clinical Implications and Conclusion

As the use of pulsed field ablation (PFA) grows and procedural volumes increase, occupational radiation exposure is emerging as a renewed concern, particularly for electrophysiologists who adopted zero or low-fluoroscopy workflows.

Given these trends, radiation-mitigation strategies for PFA should specifically address the vertical gap, which continues to be a significant source of operator exposure. The Steradian Shield™ provides a practical, workflow-compatible solution designed to close this gap and enhance operator protection without compromising procedural efficiency.

This clinical observation series from real-world clinical practice, demonstrates measurable reductions in radiation exposure when the vertical gap is blocked during PFA procedures. While not a controlled comparative study, the prospective measurements across multiple fluoroscopic projections and two procedures show consistent and clinically relevant dose-reduction patterns.

For electrophysiologists and institutions adopting or expanding PFA programs, integrating vertical barrier protection with Steradian Shield™ should be considered an essential component of a comprehensive radiation-safety strategy.

Observational data collected during routine clinical practice at Providence St. Joseph Medical Center, Burbank, California. Not intended as a formal peer-reviewed publication.