Dose Reduction during Fluoroscopic Procedures

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In an article published with RSNA in 2001, Dr. Mahadevappa Mahesh discussed the risks of radiation dose during fluoroscopic procedures, the factors that influence that dose, and various dose reduction techniques. It is these techniques that we are most interested in – how can the radiation exposure during interventional procedures be reduced?

Dr. Mahesh is currently the Chief Physicist at The John Hopkins Hospital and a Professor of Radiology and Radiological Science. Among Dr. Mahesh's research interests are image quality and radiation dose.

Fluoroscopy has long been integral to the practice of diagnostic radiology. When fluoroscopic procedures were primarily diagnostic, the risk of radiation exposure was relatively low. As procedures have evolved to be more therapeutic, they have become more complex and often require longer procedure times. With that reality, the risk of radiation exposure to the patient and staff has grown.

For our purposes here, we won't go into detail on the biologic effects of radiation, how that dose is monitored, or what doses are typical for fluoroscopic procedures. We'll leave that to the expert and refer you to the excellent work that Dr. Mahesh has provided in his article on RSNA.

What we do want to discuss are some dose reduction techniques – different ways that radiation exposure can be reduced to the patient and staff during interventional procedures. Some of these are methodological (improved processes) while others take advantage of the technology of modern equipment. The technology is what we are most interested in here.

Some of the technology that Dr. Mahesh wrote about in 2001 is commonplace now – but still not always universal. Pulsed fluoro emits X-ray energy as a series of short pulses rather than as a continuous beam. Modern systems use pulsed technology and advanced image processing to deliver high image quality with dramatically reduced radiation exposure. Dose level settings are another now common technology. Using the right level of dose for the procedure and image quality needed reduces the radiation risk during a case. Metal filter technology also reduces risk. Copper filters, for example, reduce dose by significant levels.

As effective as pulsed fluoro, dose level settings, and metal filters are, the technologies of dose spreading and collimation are what we are most interested in. Dose spreading refers to an anatomy of interest – a region of interest (ROI) – by focusing on a particular anatomic region during an interventional case. We've discussed ROI technology previously as it is proven to dramatically reduce the radiation levels inherent in interventional cases.

Collimation goes hand-in-hand with ROI. The ROI is the area in the anatomy an interventionalist is focused on, while collimation is the technology that effectively reduces the overall radiation level during a case. This is done by blocking – by collimating – the X-ray beam to everything outside of the ROI. The full field of view (the FOV) is exposed to radiation only at a level sufficient to provide a point of reference image for the interventionalist. By focusing on the ROI, the exceptional image quality required is achieved where it is essential while reducing the overall radiation exposure to the peripheral anatomy outside of the ROI.

In 2019, Omega embraced this technology with the introduction of FluoroShield™. Omega systems use AI image-guided technology that automatically tracks and collimates to the ROI – reducing radiation exposure by up to ~84% while delivering superior image quality. These results are above what is provided by pulsed technology, dose levels, and metal filtering.

Currently, Omega is the only interventional system manufacturer building this radiation reduction technology into their systems. Omega has created a new modality, a new standard of care that obsoletes non-AI/ROI systems that cannot match Omega's proven results in radiation reduction and safety.

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