Variation of Fluoroscopy Technique & Exposure Rate for Different Phantoms for Dose Estimation Program

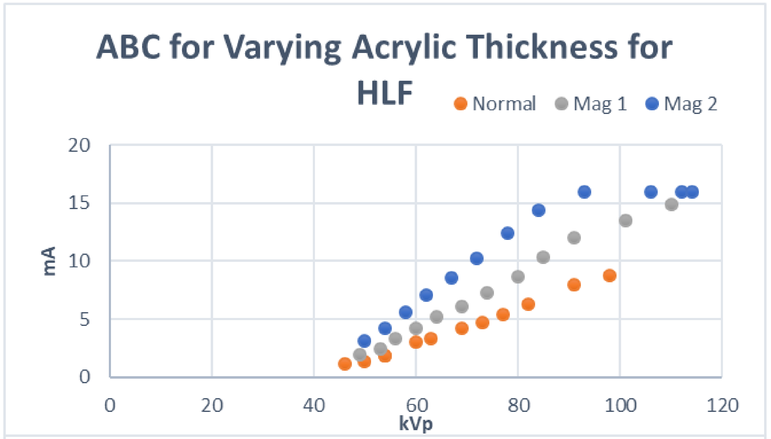
Authors: V. Garcia[1], W. Wang[1]

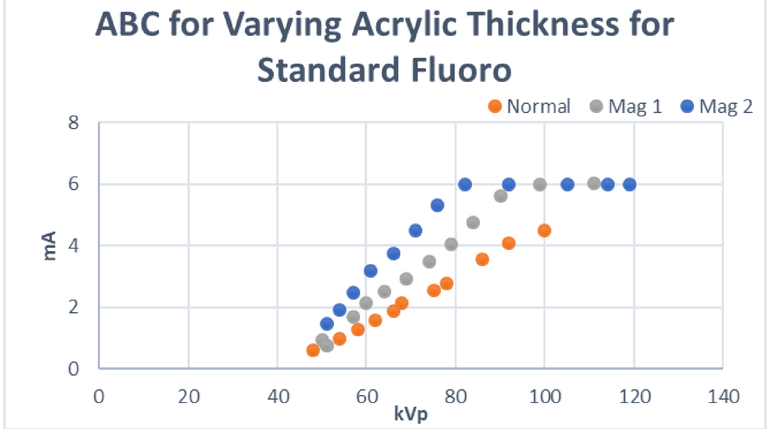
1The University of Oklahoma Health Sciences Center, Oklahoma City, OK

Purpose: Fluoroscopy can be very beneficial, but not without the possibility of high dose to the patient from prolonged fluoroscopy. The dose is determined indirectly by the Automatic Brightness Control (ABC), which chooses the kVp and mA to maintain image quality. These parameters will change based on the patient thickness. It is important to check these and the exposure rate to determine how much dose the patient will receive from an examination.

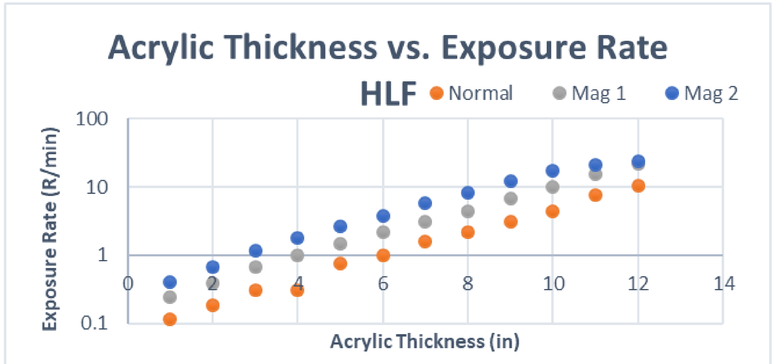
Methods: Using GE 9900 and Philips BV Pulsera C-Arms, a RadCal 10X5-6 ion-chamber was placed at 70 cm source-to-chamber distance. An Acrylic phantom was placed on the image intensifier, ranging from thicknesses of 1 inch to 12 inches. For each thickness of Acrylic, the kVp and mA chosen by the ABC and the exposure rate measured by the ion-chamber. The kVp, mA, and exposure rate were recorded for various types of fluoroscopy examinations (e.g. Thorax, Abdominal, etc.), Standard and High-Level fluoroscopy, and for the various magnification modes. The techniques were compared with those using Copper and various Nuclear-Associates phantoms.

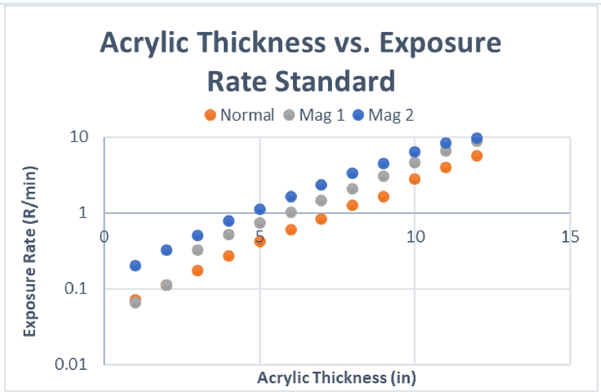
Results: The ABC adjusts the kVp and mA in a linear fashion until the mA saturates and only the kVp increases, as the thickness of the Acrylic increases. As the magnification increased, the kVp and mA increased at a much faster rate than the lower magnifications. The exposure rate increased exponentially with the increased thickness of Acrylic. The thickness of Copper was compared to the thickness of acrylic resulting in the same exposure rate (i.e. 2 mm Cu is equivalent to 6.2 in. of acrylic).





Figures 1 and 2 show the ABC curves for High Level and Standard Fluoro modes.





Figures 3 and 4 show the exposure rates for High Level and Standard Fluoro modes.

Exam Type	Mode	kVp	mA	Exposure Rate (R/min)
Abdominal	Standard	62	5.77	1.1880
Orthopaedics	Standard	70	2.74	0.8196
HQ Orthopaedics	Standard	69	4.30	1.2200
Head/Spine	Standard	67	3.73	0.9609

Table 1 shows the differences between various exam types.

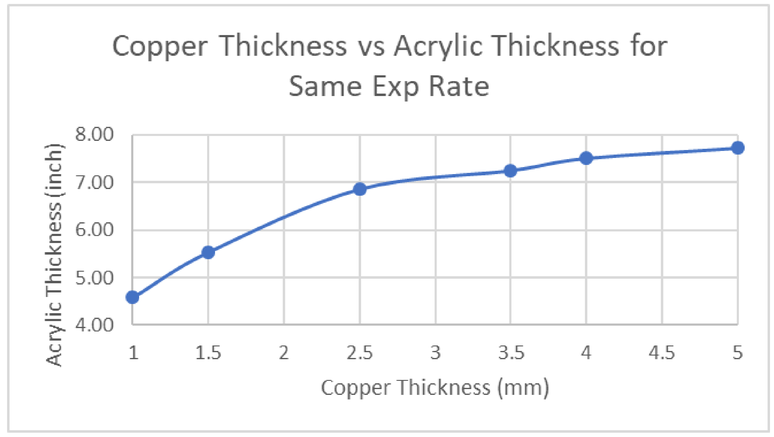


Figure 5 shows the equivalent acrylic thickness for different Copper phantoms for the same exposure rates measured.

Phantom	Phantom Materials	Eq. Acyrlic Thickness (")	R/min
Extremity	1"A+2 mm Al+1"A	2.47	0.1016
Chest	1"A+2mm Al+1"A+2" Air+1"A+1mm Al+1"A	4.71	0.287
Lateral Skull	1"A+2mm Al+4"A+1 mm Al+1"A	6.48	0.6546
Abdominal	8"A (Acrylic)	7.84	1.233
Lumbar Spine	8"A+5mm Narrow Al Plate	8.02	1.335

Table 2 shows the equivalent acrylic thickness for various phantoms as defined by Nuclear Associates.

Conclusion: From the exposure rate and fluoroscopy time, patient dose can be estimated for different thicknesses of patient, exam types, and magnification modes. The dose estimation program can use the techniques to assess the skin and organ dose. The dose estimation program will assist in the determination of the Joint Commission Sentinel Event of 15 Gy.

References:

1. The Joint Commission. Radiation Overdose as a Reviewable Sentinel Event. Oakbrook Terrance: The Joint Commission; 2006. 1-2

Contact Information:

Victor Garcia
Victor-Garcia@ouhsc.edu