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The Value of Composite Protective Shields in Exposure Reduction during Interventional Procedures.

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PURPOSE: To evaluate the effectiveness of composite lead equivalent materials for the reduction of scatter radiation during interventional procedures.

MATERIALS AND METHODS: An anthropomorphic torso phantom was placed on an angiographic table (Siemens, Axium Artis TA) 110 cm above the floor, with the C-arm configured so that the X-ray tube was under the table. A RadCal 9015 Dosimeter with a 180 cc chamber was fixed on a tripod 1 meter from the point where the beam intersected the phantom. It was then adjusted to eye (170 cm), chest (145 cm), waist (105 cm) and knee (75 cm) levels and exposure measurements were recorded with and without the composite shields in place at each height during fluoroscopy. Measurements were made with the C-arm at 0, 15, 30, and 45 degrees oblique.

RESULTS: The table shows the exposure with and without the shields at the levels and angles indicated.

CONCLUSION: The composite shields when applied in the appropriate combinations reduced the exposure to the operator as simulated by the dosimeter chamber by greater than 80% under all conditions tested.

Exposure with and without Shields:

Height/Obliquity	without shield	with shield
Eye @ 0	12.6	2.2
Chest @ 0	19.0	3.0
Waist @ 0	21.3	3.1
Knee @ 0	22.2	6.9
Eye @ 30	15.6	2.1
Chest @ 30	20.0	2.9
Waist @ 30	26.4	3.1
Knee @ 30	30.2	2.9

Values in mrem/sec. (end of abstract)

[Note: “Composite shields” used were RADPAD® Shields]

The Value of Composite Protective Shields in Exposure Reduction During Interventional Procedure

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ABSTRACT

THE VALUE OF COMPOSITE PROTECTIVE SHIELDS IN EXPOSURE REDUCTION DURING INTERVENTIONAL PROCEDURE

Gary D. Hartwell, Allen R. Goode, David J. Spinosa, John F. Angle, Alan H. Matsumoto

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METHODS: An anthropomorphic torso phantom was placed on an angiographic table (Siemens, Axium Artis TA) 110 cm above the floor, with the C-arm configured so that the X-ray tube was under the table. A RadCal 9015 Dosimeter with a 180 cc chamber was fixed on a tripod 1meter from the point where the beam intersected the phantom. It was then adjusted to eye (170 cm), chest (145 cm), waist (105 cm) and knee (75 cm) levels and exposure measurements were recorded with and without the composite shields in place at each height. Measurements were made with the C-arm at 0, 15, 30 and 45 degrees oblique.

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METHODS

BACKGROUND & OBJECTIVE

Many of today's popular fluoroscopically guided interventional procedures require high exposure which can result in potentially serious long term consequences for the physicians who perform them. Due to the fact that patients are often large and long fluoroscopic times are required, the radiation exposure can be very high. The benefits of these procedures to patients far outweigh the risks; however, over a career the risks to the physician are not mitigated by a corresponding benefit. The shields that have been available are very awkward to position where they will be most effective and make it tricky to maintain a sterile field.

Composite protective shields have recently been introduced to provide shielding from scatter radiation while maintaining the integrity of the sterile field (Fig. 1). The objective of this study is to evaluate how effective these shields are as a means to reduce exposure to the physician.

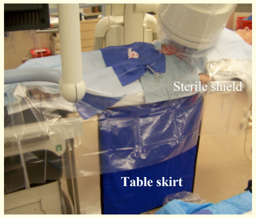


Fig. 1 RadPad composite sterile and movable shield

The anthropomorphic torso phantom located on the angiographic table (Fig.2) (Siemens, Axium Artis TA) 110 cm above the floor, with the X-ray tube under the table. A RadCal 9015 Dosimeter with a 180 cc chamber (Fig. 2)was fixed on a tripod 1meter from isocenter, the point where the beam intersected the phantom. It was then adjusted to eye (170 cm), chest (145 cm), waist (105 cm) and knee (75 cm) levels and exposure measurements were recorded with(Fig. 3&4) and without (Fig. 2) the composite shields in place at each height. Measurements were made with the C-arm at 0, 15, 30, 45 degrees oblique. A measurement was also made at 0 degrees operating at the maximum exposure rate to simulate the amount of scatter radiation that would be expected from large patients.

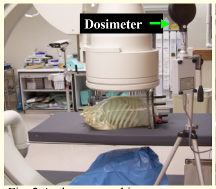


Fig. 2 Anthropomorphic torso phantom dosimeter at eyelevel without shield and the tube angled 0 °

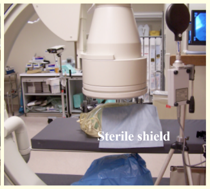


Fig. 3 Measurement at eyelevel with sterile shield tube angled 0 °

Fig. 4 Measurement at knee level with sterile and movable shield - tube angled 30 °

RESULTS

Table 1. Exposure Rate (uR/min) with/without shields @ 0° obliquity

Level	without shield	Sterile shield	% reduction	Sterile and Table skirt	% reduction
Eye Level	756	180	76.2%	132	83%
Chest level	1140	492	56.8%	180	84%
Waist level	1278	900	29.6%	186	85%
Knee level	1332	1266	5.0%	174	87%

Table 2. Exposure Rate (uR/min) with/without shields @ 15° obliquity

Level	without shield	Sterile shield	% reduction	Sterile and Table skirt	% reduction
Eye Level	936	354	62.2%	126	87%
Chest level	1200	414	65.5%	174	86%
Waist level	1584	714	54.9%	186	88%
Knee level	1812	1596	11.9%	174	90%

Table 3. Exposure Rate (uR/min) with/without shields @ 30° obliquity

Level	without shield	Sterile shield	% reduction	Sterile and Table skirt	% reduction
Eye Level	786	234	70.2%	210	73%
Chest level	1164	654	43.8%	162	86%
Waist level	1008	420	58.3%	156	85%
Knee level	798	642	19.5%	138	83%

Table 4. Exposure Rate (uR/min) with/without shields @ 45° obliquity

Level	without shield	Sterile shield	% reduction	Sterile and Table skirt	% reduction
Eye Level	1014	384	62.1%	156	85%
Chest level	1602	486	69.7%	204	87%
Waist level	1878	882	53.0%	216	88%
Knee level	2004	1584	21.0%	246	88%

As can be seen from the tables above the sterile pad becomes less effective as the angle increases and has little effect on the exposure at the knee level for all degrees of obliquity. The table skirt maintains its effectiveness for all angles evaluated.

Fig. 5: Plot of Table 1 Data (0°)

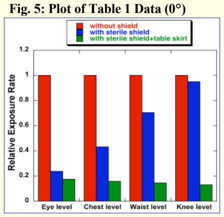


Fig. 6: Plot of Table 2 Data (15°)

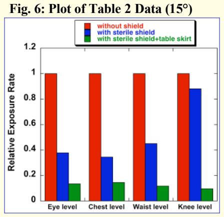


Fig. 7: Plot of Table 3 Data (30°)

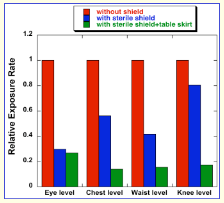
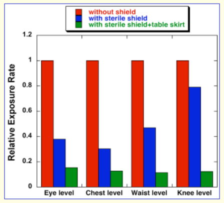


Fig. 8: Plot of Table 4 Data (45°)



CONCLUSIONS

These shields can be very effective if they are used in combination and are placed in the optimum location. This data suggests that a physician could do about five times the number of the same mix of cases with comparable dose levels using the shields. However it may not be practical to optimize the shields during clinical procedures. Some additional work will be, to do about 30 patients with composite shielding and compare the data acquired during these cases to previously acquired data without shielding. This will determine the effectiveness of these shields in a clinical setting.