

**Radiation dose to interventional
radiology staff –
can it be assessed according to
the exposure of only one
radiation badge: trunk, head or
finger?**

Interventional procedures

- Vascular system
- Urinary system
- Biliary system
- Venous accesses

Procedure	Fluoroscopy time	Patient's skin dose
Treatment of G.I. bleeding	57 minutes	4.9 Gy

No. of procedures 2008 - 2011

Year	No. of procedures
2008	2260
2009	2352
2010	2424
2011	2604

15% increase

Protection devices

Protection devices	Lead equivalent (mm)
Wraparound apron	Front: 0.50 Back: 0.25
Thyroid shield	0.5
Protective eyeglasses	0.5/ 0.75
Sterile protective gloves	Appr. 0.02
Upper protective shielding	0.5
Lower protective shielding	0.5



Interventional radiologists monitoring

1. Trunk badge - behind the protective apron, measuring body exposure
2. Head badge - above the protective apron, measuring unprotected head regions.
3. Finger badge



Is it possible to estimate radiation exposure of trunk and finger badges based on head badge measurement ?

Factors which influence radiation badges exposures

Nature of procedures performed

Usage of ultrasound guidance

Usage of upper protective shielding

Badges locations



Type of protective apron

Radiographer's involvement

The study

- **A follow up during 52 months for three interventional radiologists was performed, observing their trunk, head and finger badges exposures**
- **We checked whether the radiation badges exposures and the relations between them are influenced by the badges location ,by the overlapping of the lead apron and by other factors.**

Location of head badges and apron's overlapping

Period	Location of head badges		Apron's overlapping
Aug. 2007 - Mar. 2008	Chest level		Partial overlapping
Apr. 2008 - Jan. 2009	Thyroid shield		Partial overlapping
Feb. 2009 - Nov. 2011	Thyroid shield		Full overlapping

Full overlapping - Full protection

At a wraparound apron consisting of 0.25 mm lead equivalent (l.e), full overlapping in the apron's front side creates a 0.5 mm l.e.



Partial overlapping – Partial protection

Partial overlapping forms two vertical strips of only 0.25 mm I.e.

Depending on its location, the trunk badge will measure the exposure behind 0.25 mm or 0.5 mm



Data analysis

No. of monthly reports	Excluded reports	Non reported trunk badges exposures
52 X 3 = 156	31/156 ~ 20%	55/125 = 44%

31 reports were excluded for 2 reasons:

-ratio between trunk and head badge exposures above 10% ,

probably caused by changing badges locations.

- lack of head badge report.

Data analysis

No. of monthly reports	Excluded reports	Non reported trunk badges exposures
52 X 3 = 156	31/156 ~ 20%	55/125 = 44%

At 55 from the remnant measurements, the trunk badge exposures were not reported, being lower than 10 mrem - the lowest measurable dose for trunk badges.

In order to enable data analysis, we arbitrary replaced these non reported exposures by values of 7 mrem.

Average monthly exposure of the head badges (mSv)

Period	Dr. K	Dr. O	Dr. L*
Aug. 2007 -Mar.2008	11	16	5
Apr. 2008 -Jan. 2009	-----	5	4
Feb. 2009 - Nov. 2011	6.7	6.2	3.4

*partially employed

Decreased ratios, mostly as a result of changing head badge location

Average monthly exposure of the trunk badges (mSv)

Period	Dr. K	Dr. O	*Dr. L
Aug. 2007 - Mar. 2008	0.7	0.6	0.2
Apr. 2008 - Jan. 2009	-----	0.3	0.12
Feb. 2009 - Nov. 2011	0.09	0.15	0.08

*Partially employed

Relatively low doses, decreased at the third period due to proper work methods, beside the use of full overlapping aprons

Average monthly exposure of the fingers badges (mSv)

Period	Dr. K	Dr. O	Dr. L
Aug. 2007 to Mar.2008	22	24	13
Apr. 2008 to Jan. 2009	26	20	23
Feb. 2009 to Nov. 2011	21	18	19

Fingers exposures are consistently high, inevitable considering the large number of procedures and their complexity.

Trunk to head badge exposures ratios

Period	Dr. K	Dr. O	Dr. L
Aug. 2007 - Mar.2008	6.0% ± 2.3%	4.0% ± 2.4%	2.9% ± 2.3%
Apr. 2008 - Jan. 2009	-----	3.2% ± 1.5%	3.1% ± 1.9%
Feb. 2009 -Nov. 2011	2.0% ± 0.8%	2.6% ± 1.5%	2.8% ± 1.6%

At the third period, due to similar measurement conditions (same location of the head badge and full apron's overlapping), the ratios for the three radiologists are close, comparing to the first period.

Head to finger badges exposures ratios

Period	Dr. K	Dr. O	Dr. L
*Aug. 2007 - Mar. 2008	51% ± 16%	51% ± 29%	45% ± 16%
**Apr. 2008 - Nov. 2011	30% ± 15%	31% ± 17%	22% ± 16%

* head badge at the chest level

**head badge attached to the thyroid shield

Decreased ratios, mostly as a result of changing head badge location

Conclusions

1. A rough estimate of the trunk exposure based on the head badge measurement is possible
2. An estimation of the head badge exposure based on the trunk badge measurement is difficult to be established
3. A reliable correlation between head and finger badges exposures can't be established for radiologists working in different units



Thank you •

