

**Radiation Protection of staff
in In^{111} radionuclide therapy.
Is the lead apron shielding effective?**

**M. Lyra, V. Charalambatou*,
M. Sotiropoulos, N. Lagopati**

*Radiation Physics Unit, A' Radiology Department,
Kapodistrian University of Athens, Athens, Greece*

* *Presenting author (e-mail: pcharalad@gmail.com)*

INTRODUCTION:

- In^{111} ($E_{\gamma} = 171\text{-}245\text{keV}$, $t_{1/2}=2.83\text{days}$) is used for targeted therapies of endocrine tumors. An average activity of 6.3GBq is injected into the liver by catheterization of the hepatic artery.
- time-consuming (4-5min) procedure \rightarrow doctors and technical staff involved, are subjected to radiation exposure.

PURPOSE:

- The affectivity of the use of lead apron as far as the radiation protection of the working staff is concerned.

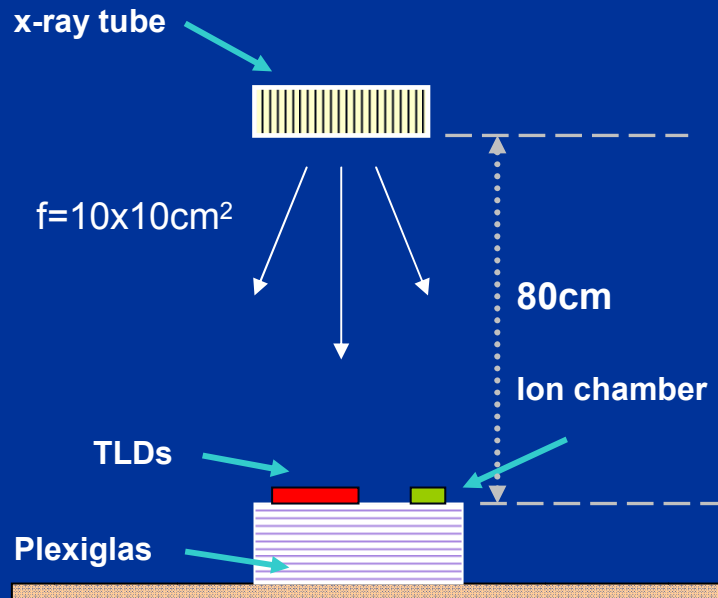
THERMOLUMINESCENT DOSEMETER PROCEDURES

Type: **Li F: (Mg, Cu, P) (GR-200A)**

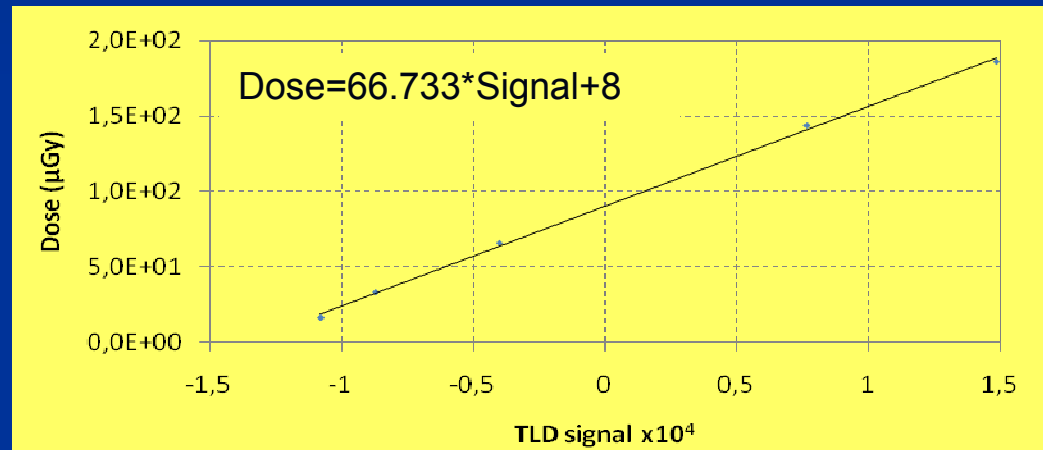
Characteristics:

- *High sensitivity*
- *Linear energy response over energy range used*
- *Near tissue equivalence*
- *Lack of significant fading (0.01% per day)*

1) TLD CALIBRATION SETUP



V=50 kVp, for various mAs



2) TLD READING PROCEDURE

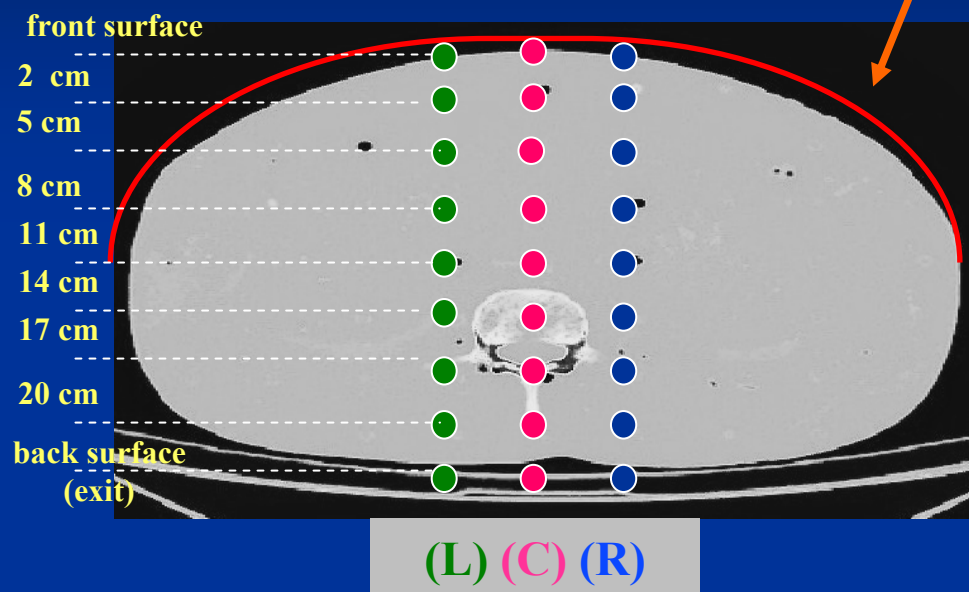
- Reading out in a Fimel's LTM reader at 135° C
- Signal distribution (Cb) at LTM's reader software
- Annihilation at 250° C for 15 min, in a microprocessor controlled annealing oven (ETT, Fimel)
- Cooling down for about 1 hour.

EXPERIMENTAL SET UP

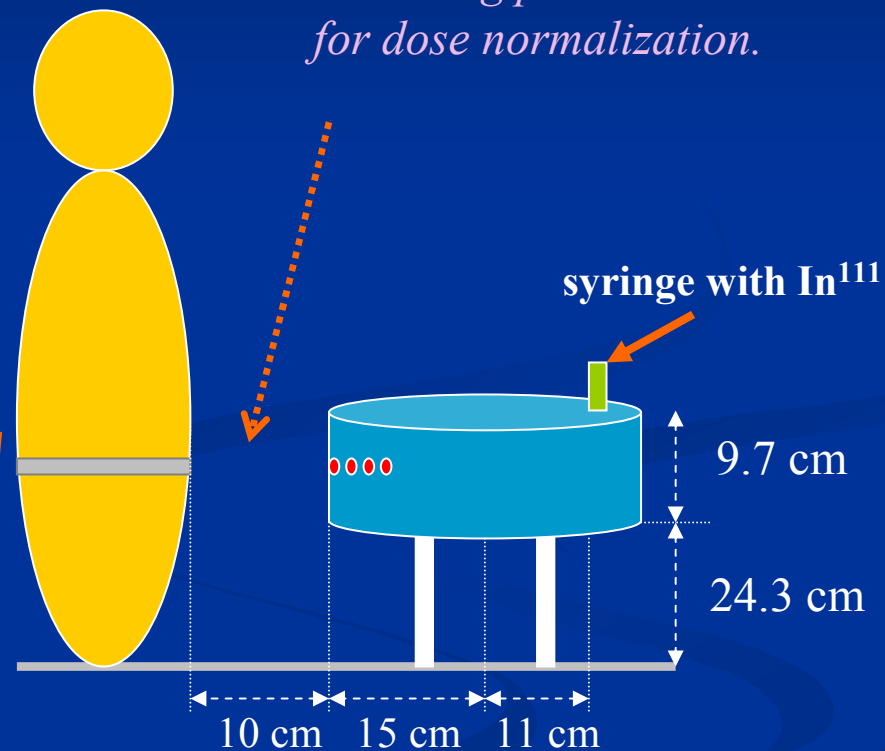
SLICE 26

POSITIONS OF TLD s

lead apron
(0.25 mm thick)



4 TLD s were placed on scattering phantom and used for dose normalization.



**RANDO
PHANTOM**

(representing doctor)

**SCATTERING
PHANTOM**

(representing patient)

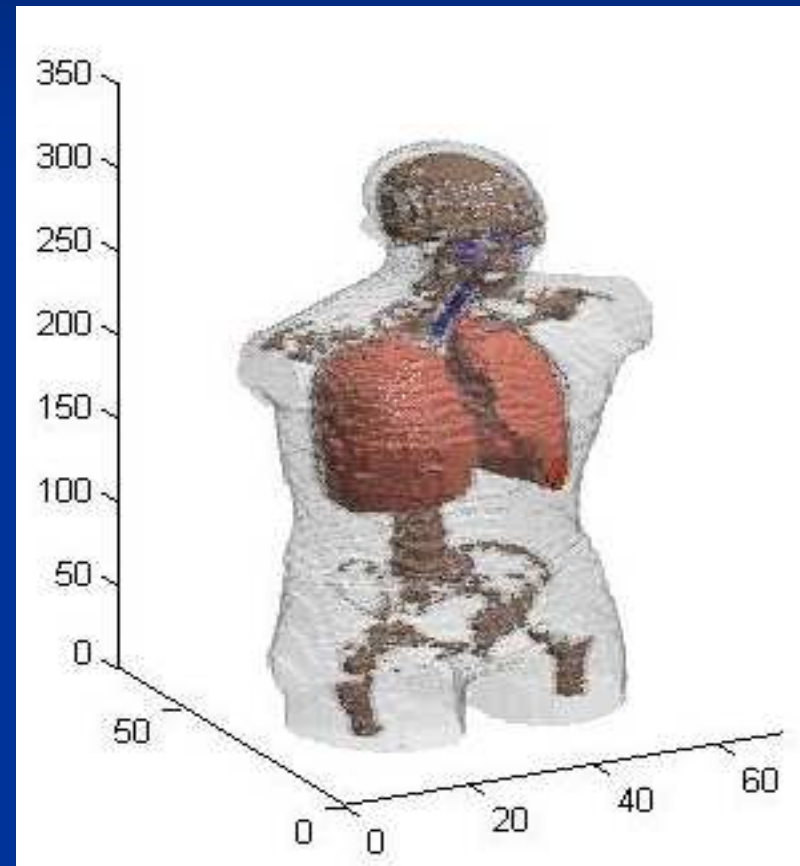
- Phase 1: measurements without lead apron
- Phase 2: measurements with lead apron

→ Rando Phantom was irradiated for about 24 hr.

→ 10 TLD s were used for background measurement.

MONTE CARLO simulations

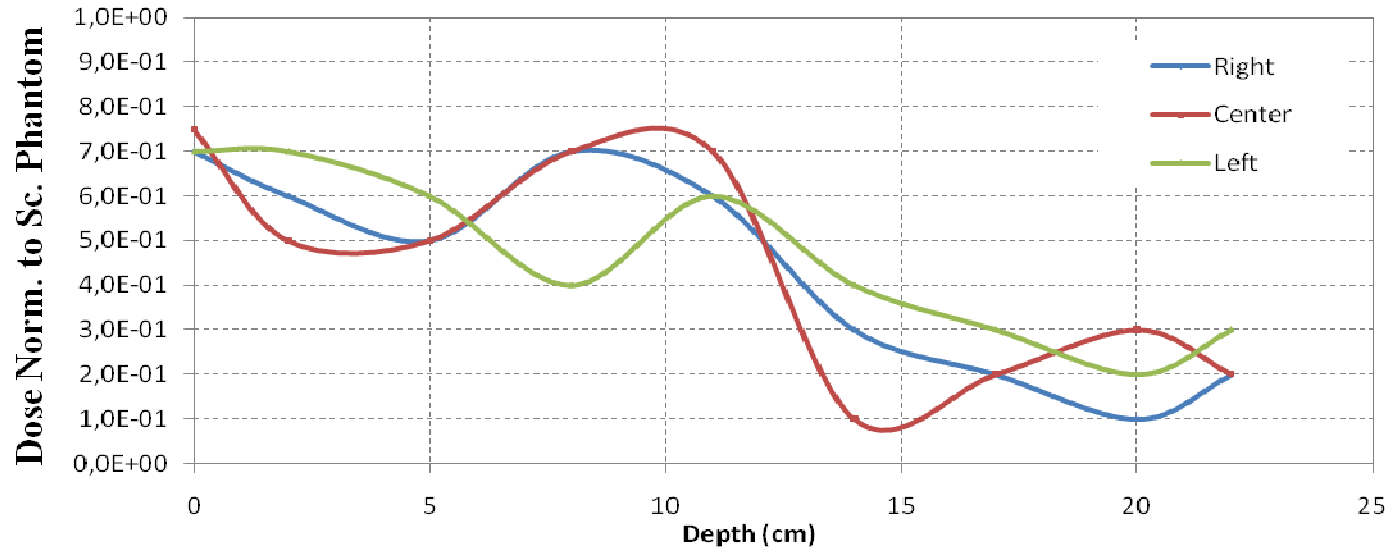
- Monte Carlo N-Particles extended (MCNPX) transport code was utilized.
- Rando Phantom was scanned, segmented and transformed into MCNPX voxelized Geometry. Only a slice of 7.8 cm thickness was used in the simulations, for computing time reduction.
- A rectangular mesh tally was used for scoring purpose.



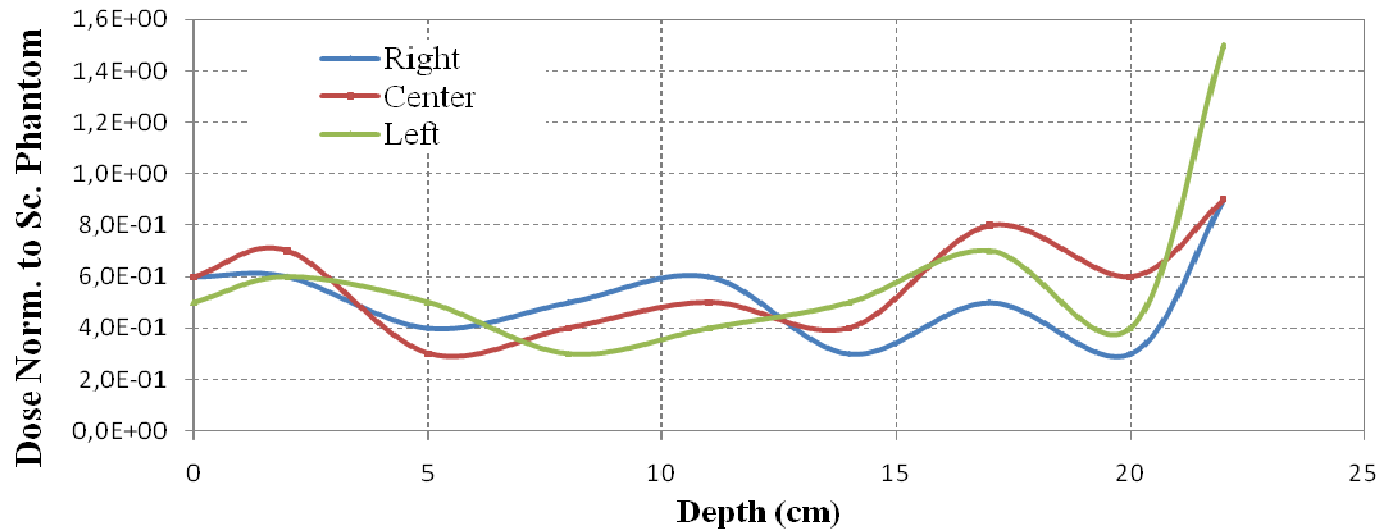
Segmented Phantom

Experimental Results:

No Apron

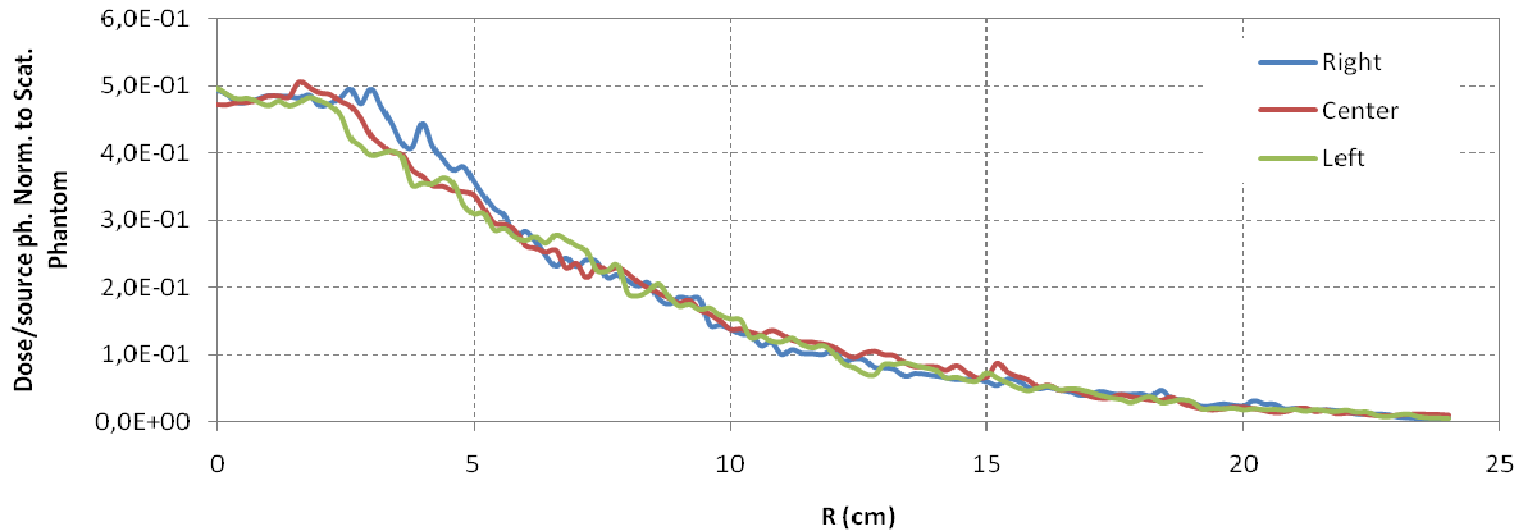


With Apron

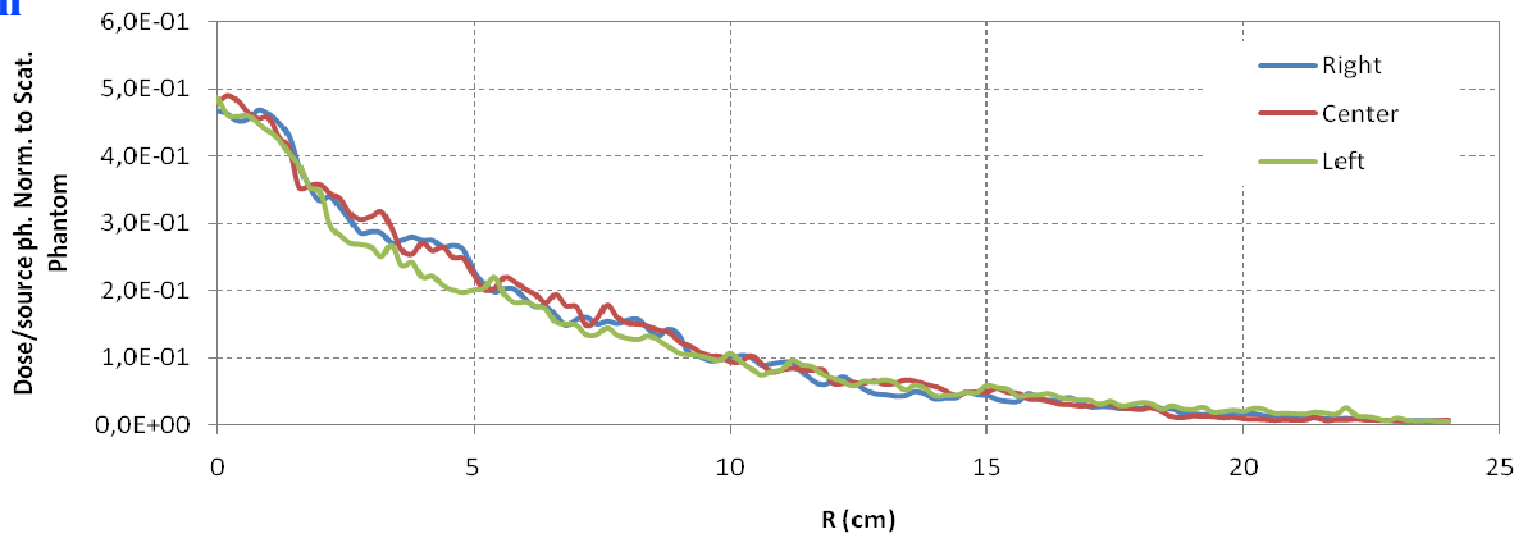


Monte Carlo Results:

No Apron

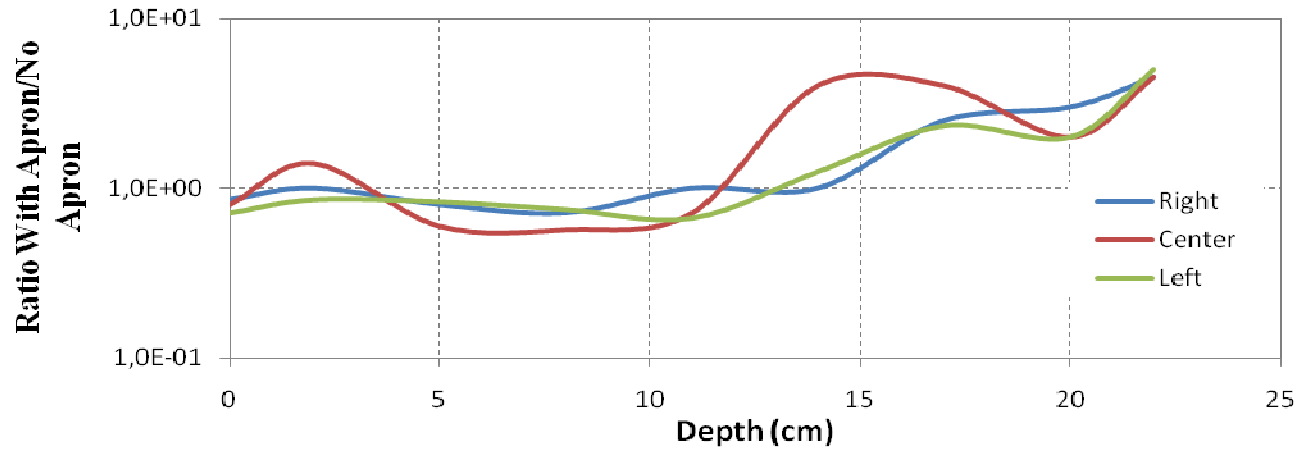


With Apron

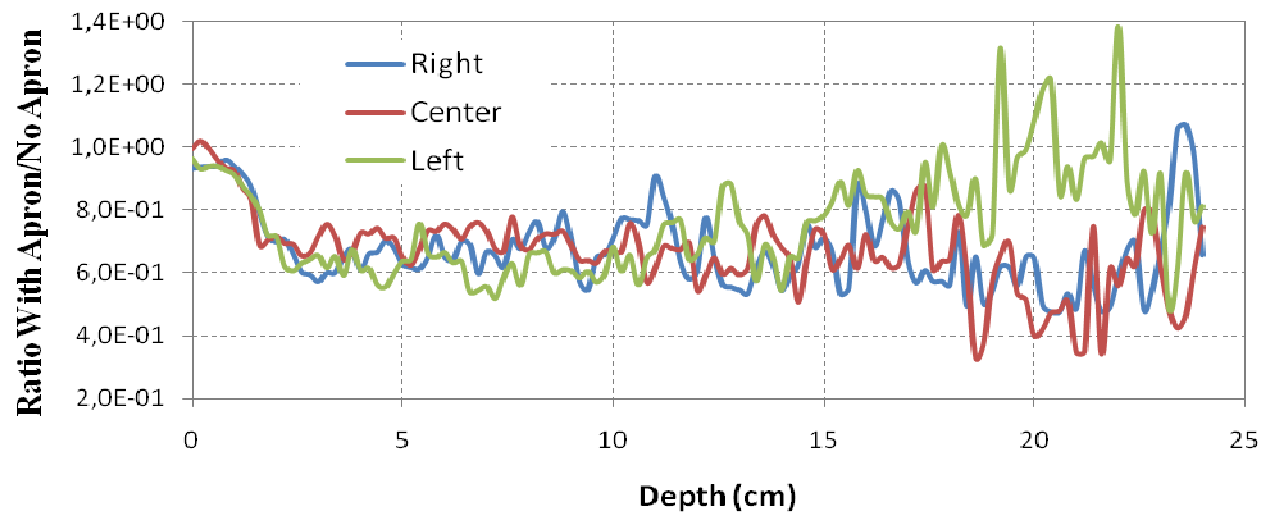


Experimental – Monte Carlo: Ratio Comparison

Experimental



Monte Carlo



Results

In both experimental and simulated methods we observe:

- Entrance Dose is reduced for about 15%-20%.
- With Apron to No Apron dose Ratio is increased with increased depth.

Conclusion

- A decrease in absorbed dose is observed, however, Apron should be worn with caution due to back injuries, and deterioration of the doctor's agility.
- Further investigation is considered, due to minor discrepancies in the results of the two methods.