A Simplified Total Body Irradiation Scatter Dose Calculation

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Purpose: To commission a simplified total body irradiation (TBI) scatter dose calculation.

Methods: Our TBI patients are positioned semi standing for AP/PA treatments and lying down in a crib for lateral and decubitus treatments at 340 cm source-to-axis distance (SAD). An extended SAD dose reference is utilized, which is measured with a stack of solid water at this SAD (see Fig. 1). Scatter, depth, and off-axis corrections are made to this reference. The scatter correction is made with dose calculations in Pinnacle after density overrides of elliptical contours (see Fig. 2), with various widths and thicknesses, relative to a contour of the solid water stack. The depth corrections were made with solid water based tissue phantom ratio measurements. Our TBI treatment field is divided into fixed sectors for the use of dose compensators. Off-axis measurements were performed at these sectors across the field.

End-to-end measurements were performed in solid water stacks and in an anthropometric phantom (see Figs. 3), using both ion chamber and optically-stimulated luminescent dosimeters (OSLDs). Dosimeter measurements were performed on the phantom surface, to replicate the in-vivo measurement setup for our patients, and additionally at the phantom midline. Our final dose equation included all correction factors previously mentioned and was computed in Excel from the measured patient width and thicknesses, which yielded the number of beam monitor units necessary for treatment and compensator thickness for each sector.

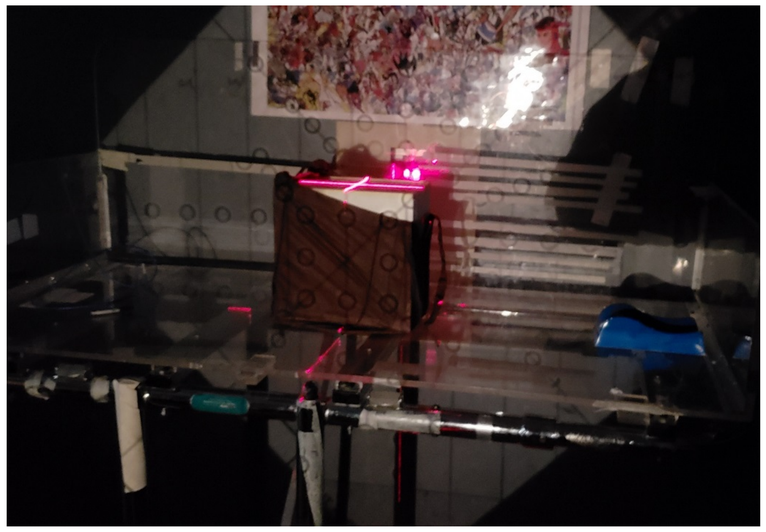


Figure 1: Lateral off-axis measurements being performed in solid water with an ion chamber. Vertical lines show different sectors

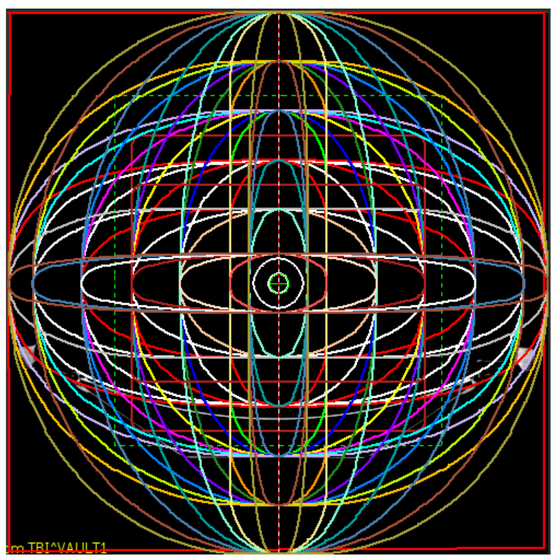
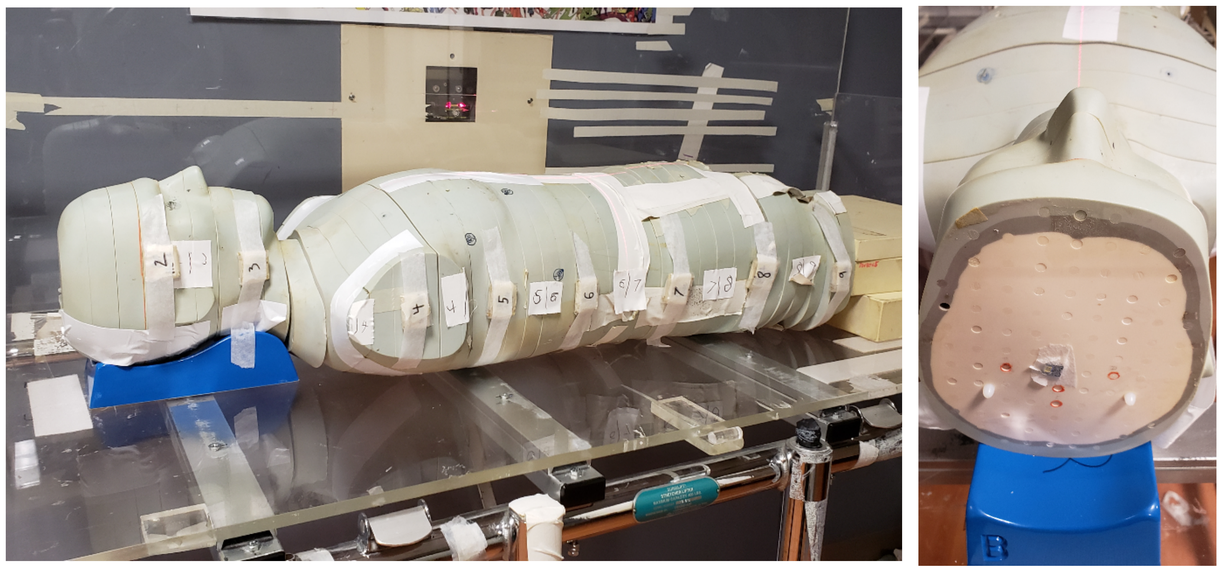


Figure 2. Different elliptical contours (in Pinnacle) simulating patients of varying widths and thicknesses. Up/down is anterior/ posterior and left/right is patient right/left.



Figures 3. The left and right images show OSLD dose verification at the surface and at our prescription point (patient midline), respectively.

Results: Figure 4 shows measured dose deviations for both ion chamber and OSLDs. A total of 92 internal and external dose verification readings were made and only one of these was outside of the 10 percent dose deviation tolerance recommended by TG-29. This point had a 10.7% deviation and was from an OSLD. Our previous dose calculation, which excluded off-axis and patient scatter correction factors, had an average absolute dose measurement deviation of 6%. This same number is reduced to 2% with the new technique.

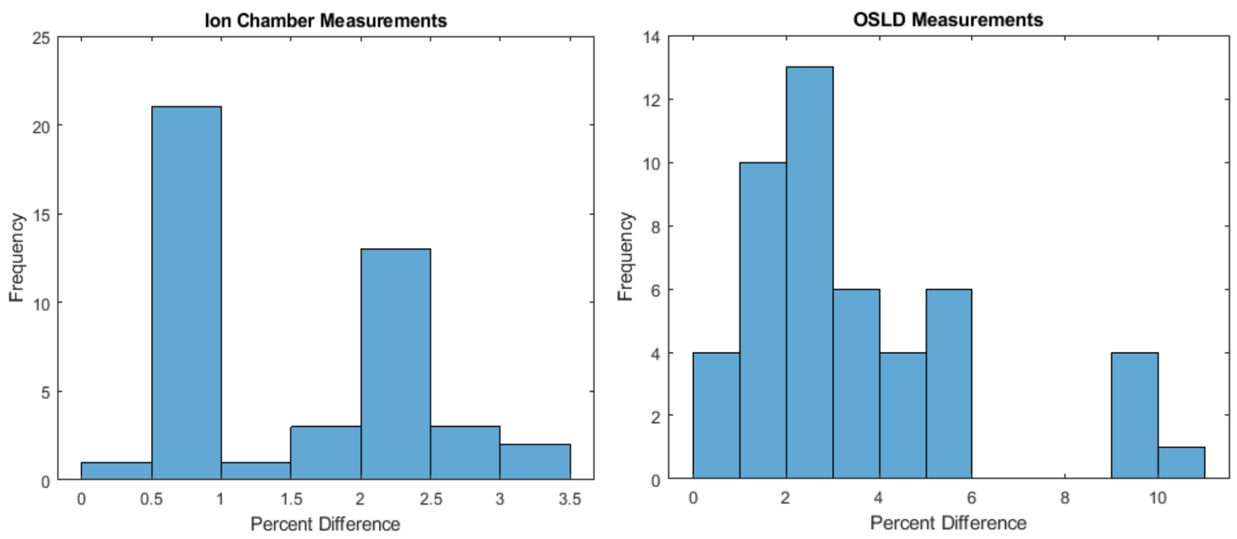


Figure 4: Histograms of the relative absolute dose deviations for the OSLD and ion chamber end-to-end measurements.

Conclusion: The lateral scatter correction factor improved dose accuracy. We have implemented a simplified procedure for commissioning of a total body irradiation program with scatter corrections.

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