Purpose: Output factor measurements in small fields are challenging: While diode detectors tend to over-respond, even small ion chambers tend to under-respond in very small fields. We propose making CyberKnife TSF measurements using two classes of detectors – a small volume ion chamber for larger fields, and a diode detector for very small fields.

Methods: TSF was measured as a function of collimator diameter (5-60mm) for three small volume ion chambers (A16, Pinpoint, CC01) and the EDGE diode on a CyberKnife G4. A comparison was made with the Accuray average data (mostly PTW 60008 diode). TSF for collimator diameters 10mm and smaller were corrected for detector effects using published Monte Carlo derived correction factors.

Results: All corrected TSF measurements agree within 5.2% for all detectors and collimators. For field sizes measuring 12.5mm and larger, ion chamber measurements agree within 0.5%. The stereotactic EDGE detector agrees with the Accuray average data within 1%, however EDGE diode data is systematically higher than averaged small volume ion chamber data by as much as 3% in this range. Therefore, if stereotactic EDGE TSF data is used for planning, a systematic dose error of up to 3% compared to A16 (correction factor 1.01, 10mm collimator) is introduced.

Conclusion: For collimator diameters of 12.5mm and greater, dosimetric error in the measurement of TSF is minimized by using a small volume ion chamber. Since for a 5mm collimator, published correction factors are 0.95 and 1.096 for the EDGE and A16 detectors respectively, the magnitude of correction, if any is used, is minimized by using the stereotactic EDGE diode for TSF measurements for collimators 10mm and smaller. We recommend that a small volume ion chamber is used for TSF measurements for collimator diameters greater than 10mm and that a diode detector used for collimator diameters 10mm and smaller.