Purpose:
Small field dosimetry is challenging in homogeneous medium and extremely difficult in an inhomogeneous medium. Monte Carlo dose calculation algorithms are considered as the most accurate for treatment planning. We present our validation of the Monte Carlo algorithm in the Accuray Multiplan system using measurements in a cork phantom. We also recalculated Ray Tracing treatment plans with the Monte Carlo algorithm and compared to SBRT dose tolerance limits.

Methods:
In our validation measurements with a cork phantom, an Exradin A16 ion chamber was used for collimators from 60mm to 20mm on a CyberKnife, and a PTW 60012 stereotactic diode for collimators from 60mm to 5mm. A literature review of more than 500 published SBRT dose tolerance limits was partitioned into high-risk and low-risk categories. Two hundred CyberKnife treatment plans were recalculated using Monte Carlo and compared to the dose limits. The DVH Evaluator software tool was used to generate DVH Risk Maps for 25 critical structures throughout the body, which superimpose a) published dose tolerance limits b) unified high-risk and low-risk trends and c) published adverse event doses, onto Monte Carlo patient doses to assess risk of adverse events.

Results:
The Monte Carlo calculations matched the Exradin A16 measurements to within 2.5% for field sizes down to 20mm, and matched the PTW 60012 measurements to within 2.5% for all field sizes down to 5mm. Recalculated treatment plan data is within the expected range of published SBRT dose tolerance limits, providing optimism for clinical use.

Conclusions:
The Accuray MultiPlan Monte Carlo algorithm is accurate even for small fields in heterogeneous media. The range of doses calculated by Monte Carlo for our patient data is compatible with published SBRT dose tolerance limits. SBRT dose tolerance limits should be fine-tuned by Monte Carlo dose calculations in long-term statistical followup studies.

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Disclosure: The first author has developed the DVH Evaluator software.