Purpose: To evaluate the accuracy of dose calculation for intensity modulated radiation therapy (IMRT) based on Pencil Beam (PB) and Analytical Anisotropic Algorithm (AAA) computation algorithms.

Methods: IMRT plans of twelve patients with different treatment sites, including head/neck, lung and pelvis, were investigated. For each patient, dose calculation with PB and AAA algorithms using dose grid sizes of 0.5 mm, 0.25 mm, and 0.125 mm, were compared with composite-beam ion chamber and film measurements in patient specific QA. Discrepancies between the calculation and the measurement were evaluated by percentage error for ion chamber dose and $\gamma>1$ failure rate in gamma analysis (3%/3mm) for film dosimetry.

Results: For 9 patients, ion chamber dose calculated with AAA-algorithms is closer to ion chamber measurement than that calculated with PB algorithm with grid size of 2.5 mm, though all calculated ion chamber doses are within 3% of the measurements. For head/neck patients and other patients with large treatment volumes, $\gamma>1$ failure rate is significantly reduced (within 5%) with AAA-based treatment planning compared to generally more than 10% with PB-based treatment planning (grid size=2.5 mm). For lung and brain cancer patients with medium and small treatment volumes, $\gamma>1$ failure rates are typically within 5% for both AAA and PB-based treatment planning (grid size=2.5 mm). For both PB and AAA-based treatment planning, improvements of dose calculation accuracy with finer dose grids were observed in film dosimetry of 11 patients and in ion chamber measurements for 3 patients.

Conclusion: AAA-based treatment planning provides more accurate dose calculation for head/neck patients and other patients with large treatment volumes. Compared with film dosimetry, a $\gamma>1$ failure rate within 5% can be achieved for AAA-based treatment planning.