Purpose: Bulky (>40 cc) cervical cancer brachytherapy (BT) tumor dose conformity is often poor since symmetric BT dose is limited by the presence of the nearby bladder, rectum, and sigmoid. Rotating shield intensity modulated brachytherapy (RS-IMBT) can theoretically improve tumor dose conformity, but at the cost of significantly increased treatment times. We developed a time efficient method of improving cervical cancer dose distributions with multi-rotating-shield IMBT (MRS-IMBT) that drastically reduces the delivery times relative to RS-IMBT.
Methods: We developed a shield sequencing method that optimally divides a set of finely sampled IMBT shielding patterns into a combination of coarse and fine shields that delivers the same dose distribution but with a reduced treatment time. The resulting MRS-IMBT method was applied to eight cervical cancer patients who were treated with MRI-guided conventional BT. The treatment planning was done with an in-house treatment planning system.
Results: The MRS-IMBT method significantly reduced treatment times relative to finely-sampled IMBT without losing tumor coverage. When using shields that provided adequate coverage (22.5°), the sequencing method on average decreased the treatment time by a factor of 4. For the finest shields considered (5.625°), MRS-IMBT decreased the treatment time by a factor of 12 on average.
Conclusions: While RS-IMBT causes treatment times to rise exponentially with the number of emission directions when a single shield emission angle is used, treatment times for the MRS-IMBT method increase linearly with the number of emission directions. MRS-IMBT makes IMBT delivery clinically feasible, which could lead to mean better tumor dose conformity and improved outcomes.