Purpose: In this work a general method is presented that enables clinicians to rapidly select Rotating shield brachytherapy (RSBT) emission angles based on the patient-specific tradeoff between delivery time and tumor dose conformity. Cervical cancer cases are used as examples.

Methods: Anchor plans with high dose conformity but infeasible delivery times are generated with a fine emission angle, with simulated annealing. The RSBT emission angle selector determines the optimal emission angle for each case by efficiently solving a globally-optimal quadratic programming problem that closely reproduces the angular distribution of beam intensities from the anchor plan. Pareto plots of the dosimetric plan quality metrics, such as D90 versus the delivery time, are generated for clinicians. In this work two cervical cancer cases were considered for verification. The RSBT system was assumed to be a Xoft AxxentTM electronic BT(eBT) source with a 0.2mm tungsten shield. The intent for each treatment plans was to maximize tumor D90 while respective the GEC-ESTRO recommended constraints on the D2cc values to OARs.

Results: Generating anchor plans with simulated annealing takes 10-20min while emission angle selection can finish within seconds. The shield sequencing algorithm also ensures the balance between D90 and delivery time. One case shows that the D90 can achieve 98.3Gy10 with emission angle 202.5 degree with 8.64min delivery, while the conventional intracavitary plan has D90 65Gy10 with 2.86min delivery. Another case shows RSBT with emission angle 67.5 degree can produce D90 108.7Gy10 with 44min, and the conventional plan uses 2.2min for D90 48.9Gy10.

Conclusions: The RSBT emission angle selection algorithm enables the users to rapidly determine the best emission angle for a given cervical cancer case by selecting the most appropriate D90 and delivery time. RSBT may be a less invasive alternative to intracavitary and supplementary interstitial BT for the treatment of cervical cancer tumors.

Funding Support, Disclosures, and Conflict of Interest:

supported in part by NSF grants CCF-0830402 and CCF-0844765, the NIH grant K25-CA123112.