Purpose: To develop an optimal shield-sequencing algorithm and evaluate its feasibility of a rotating shield intensity shield intensity modulated brachytherapy (RS-IMBT) with a fixed emission angle.

Methods: We use an electronic brachytherapy source (Xoft Axxent) with a tungsten (gold) partial-shield, and test a range of emission angle (32 ~ 76). Large tumor (>= 40cc) at BT was tested for cervical cancer. In shielding sequencing optimization, a nontrivial network transformation scheme was utilized which makes the global optimum is efficiently achieved with the shortest path and network flow algorithms. We employed the objectives that based upon GEC-ESTRO recommendations. D90 of high risk CTV receives a prescription dose (Rx) while organs-at-risk (OAR: rectum & sigmoid (bladder) D2cc <=75 (90) EQD2 (equivalent dose in 2Gy fraction) Gy from external beam radiotherapy and BT. The feasibility was tested using the metric of plan conformality (D90 in high risk CTV and D2cc in OAR) and treatment delivery time.

Results: The shielding sequencing algorithm improves significantly tumor coverage (D90) with favor OAR sparing in an acceptable delivery time increase. The D90 (100% Rx) was improved from 41% Rx from conventional, Point-A plan. D2cc of OAR was kept under the recommended limits. The increase of delivery time was recorded as less than 5 times higher when 72 degree emission angle and with unshielded source combined. Optimization time was less than 2 seconds.

Conclusion: Globally optimal shielding-sequencing with beamlets overlapping significantly improves tumor coverage of high risk CTV for large tumor without compromising OAR sparing but with less than 5 times delivery time increase. RS-IMBT technique shows promising approach for large, non-isotropic shape tumor that is currently investigated using intracavitary plus interstitial approach or performed by conventional interstitial technique.

Funding Support, Disclosures, and Conflict of Interest:

The research was supported, in part, by NIH grants R01-EB004640 and K25-CA123112, and NSF grants CCF-0830402 and CCF-0844765.