Purpose: A dedicated stereotactic gamma irradiation device, GammaPod from Xcision Medical Systems, has been developed to treat breast cancer. An optimization of the collimator design is presented for the hemi-spherical source carrier housing the Co60 irradiators.

Methods: The GammaPod unit contains 36 Co-60 sources modulated by 36 tungsten collimators positioned along 6 columns in a non-coplanar and isocentric arrangement. The rotating collimator structure accommodates two different sizes of circular holes in addition to a position where sources are fully blocked. 9 dual-collimator arrangements with diameter combinations of 5-15, 5-25, 5-30, 10-20, 10-25, 10-30, 15-25, 15-30 and 20-30 millimeters were investigated. Treatment plans were generated for five patients using MC dose distributions following a pre-operative SBRT strategy and dose fractionation of 3x20Gy. The collimator arrangements are evaluated in terms of treatment plan quality and treatment efficiency.

Results: Of the nine different arrangements, four (5-15, 5-25, 5-30 and 10-20 milllimeters) resulted in treatment lengths in excess of 30 minutes (range 40.6-59.7). In the remainder, treatments required 16.4, 21.9, 22.6, 27.4, 28.7 minutes for 20-30, 15-25, 15-30, 10-25 and 10-30 millimeter collimators respectively. All arrangements achieved target dose coverage goals (D95=DRx). Low dose spillage to ipsilateral breast, defined as V50% and V25% were least for the 15-25mm collimator, 8.3% and 15.6% respectively, while 20-30mm was only slightly higher, 8.4% and 16.3% (V50%=[8.3-9.0%] and V25%=[15.6-19.3%]). Among all five patients, the differences in all dosimetric parameters were statistically insignificant for these two collimators ($p=0.47$, 0.50 and 0.47 for V25%, V50% and V100%). The only significant parameter was treatment duration with population averages of 14.6 minutes for 20-30mm versus 26.7 for 15-25mm ($p < 0.01$).

Conclusions: Among all collimator arrangements, no significant dosimetric advantage was observed with any collimator size. However, the 20-30mm collimator set was deemed most practical due to shortest treatment time required.

Funding Support, Disclosures, and Conflict of Interest:

Some co-authors declare employment and shareholder interests with Xcision Medical Systems.