Purpose:
To determine the optimal location of catheters in multichannel vaginal applicators to appropriately cover the vaginal cuff target and minimize dose to the organs at risk (OARs) and hot spots in the target.

Methods:
A new multichannel vaginal applicator with a diameter of 30 mm consists of a single central catheter and an outer array of eight catheters. A total of 20 plans were generated from 5 patients by using different outer catheter locations at r = 4, 8, and 12 mm. The target was defined as a 5 mm circumferential shell extending 4 cm in length around the applicator, excluding the bladder, rectum, and bowel. An inverse planning simulated annealing algorithm and graphical optimization was applied to ensure the prescription dose (7.0 Gy per fraction) covered >97% of the target and minimized dose to the OARs. Target coverage (D90 and V100), hot spots (V150 and V200), and OAR doses (D0.1cc, D1cc, and D2cc) from the various catheter placements were compared to single catheter plans.

Results:
By study design all plans had the same target coverage D90 (105.0-108.3%) and V100 (97.1-97.2%). The V150 and V200 were 16.1% and 3.4% (r=0mm), 17.3% and 4.2% (r=4mm), 20.1% and 2.2% (r=8mm), and 30.1% and 6.0% (r=12mm). The D0.1cc to the OARs from the various catheter placements at r = 4, 8, and 12 mm was reduced by 4.0%, 8.6%, 11.9% (bladder), 7.4%, 13.2%, and 17.4% (rectum), when compared to the central catheter plans.

Conclusions:
Multichannel vaginal applicators provide better dosimetry than single channel applicator. The catheter array located closest to the applicator surface most significantly reduces dose to the OARs at the expense of larger hot spots in the target. The array in the middle of the applicator radius provides significantly decreased dose to the OARs and gave relatively smaller hot spots.