Purpose: To evaluate the dosimetric impact of catheter-position uncertainty prior to each fraction in balloon high dose rate (HDR) brachytherapy for breast cancer.

Methods: For 30 balloon HDR patients, each dwell position of the catheters was manually shifted distally (+) and proximally (−) with a magnitude of ±1 mm, ±2 mm, ±3 mm and ±4 mm. A total of 240 plans were retrospectively produced and compared to clinical treatment plans to simulate catheter-position uncertainty. The following dosimetric data were evaluated: PTV_EVAL V90[%] after subtracting air/seroma volume, skin and rib maximal dose (Dmax[%]) and normal breast tissue V200[cc].

Results: PTV_EVAL V90 was decreased in 93% of cases while increased with maximum value of < 0.7% in 7% of cases. Average/maximal reduction was increased from 0.3%/1.2% (±1 mm), 1.0%/3.5% (±2 mm) and 2.6%/6.2% (±3 mm) to 5.0%/9.2% (±4 mm) as catheter-position error was increased. Change of skin and rib Dmax values was case-specific. They were increased in 52% of cases while decreased in 48% of cases. As catheter-position error was increased, the average/maximal deviation was increased from 1.6%/9.3% (±1 mm), 3.1%/19.1% (±2 mm) and 4.6%/29.1% (±3 mm) to 6.3%/40.2% (±4 mm). Normal breast tissue V200 was increased in 90% of cases while decreased with maximum value of < 0.4cc in 10% of cases. Average/maximal increase was elevated from 0.3cc/1.2cc (±1 mm), 0.8cc/2.9cc (±2 mm) and 1.8cc/4.8cc (±3 mm) to 2.9cc/6.7cc (±4 mm) as catheter-position error was increased.

Conclusions: The catheter-position tolerance of ±2 mm set by the AAPM TG 56 is clinically acceptable for most clinical cases. However, in a case where the dosimetric data of treatment plan are close to the dosimetry limits of the clinical protocol, smaller tolerances such as ±1 mm or zero tolerance is clinically recommended to minimize delivered dose discrepancy from the planned dose.