Purpose: To calculate the dose distribution with Monte Carlo (MC) around an intracavitary brachytherapy (ICBT) ovoid type applicator and compare these calculations with radiochromic film (RCF) measurements acquired in a liquid water phantom.

Methods: Detailed physical measurements of a CT-MR compatible Fletcher ovoid applicator (Nucletron Co.) were performed in-house to facilitate construction of a MC model of the device. MC calculations were simulated utilizing MCNPX version 2.7.b of a microSelectron version 2 (mHDR v2) Ir-192 source (Nucletron Co.) at multiple dwell-positions within a single ovoid. Oncentra brachytherapy treatment planning system (Nucletron Co.) was used to determine the dwell-time required for three active dwell-positions to deliver 10 Gy to a prescription point taken as the center of each film. RCF measurements were performed in two perpendicular planes, (a) 1 cm beyond the distal end and (b) 3.3 cm from, and parallel to, the long axis of the ovoid. RCF measurements were performed in a liquid water phantom. The ovoid, liquid water phantom, and RCF were physically aligned using in-room patient setup lasers. The MC model application was confirmed superimposing simulated dose distributions resulting from three active dwell-positions and comparing with RCF.

Results: Brachytherapy measurements could be acquired in a liquid water phantom consistent with AAPM TG-43 protocol. For both planes, 96% of the absolute simulated and measured dose points agreed within 2% or 2 mm distance-to-agreement.

Conclusions: The MC model is sufficient to predict measured RCF dose distributions acquired in a liquid water phantom accurately.