Characterization of a new Cervical Applicator for use with the Axxent 50kVp eBx Source

Introduction:
Xoft is introducing a cervical applicator for use with its Axxent™ Electronic Brachytherapy (eBx) System. This applicator will complement the existing vaginal applicators for endometrial treatments. The Axxent Cervical Applicator is designed to treat advanced stage cervical cancer in combination with external pelvic radiation. The applicator consists of a set of four central tandems with curvatures of 0°, 15°, 30°, and 45° to accommodate varying uterine cavity tilt. Two colpostats with ovoids of 2.0, 2.5, or 3.0 cm diameter are positioned laterally, as shown in Figure 1.

Method and Materials:
Three X-ray sources, three tandems of each curvature, and three colpostats with 3.0 cm ovoids were tested using the Solid Water™ apparatus designed to be used for previous balloon applicator dose validation measurements (Figure 2). This was used in various configurations for the test. The fixture was immersed in a water tank and enclosed in radiation shielding prior to measurement. A Xoft Axxent Controller was used to administer the treatment plans. GAFChromic EBT2 radiochromic film and a PTW 34013 soft x-ray ionization chamber were used to record the dose distributions. The absolute dose and isodose contours were determined from analysis of the radiochromic film, which was previously calibrated. New TG-43 parameters were developed to describe the titanium-filtered x-ray source.

Results:
The ratio of the dose 0.5 cm from the central axis of each tandem to the dose at 2.0 cm was calculated along axes perpendicular to the applicator. A maximum ratio of 6.8 was calculated, so a prescription of 1.8 Gy at 2.0 cm, would produce a surface dose of 12.3 Gy. The filtering of the 50keV x-ray beam by the titanium tandem produces a radial dose profile which is equivalent to Ir-192 out to 3 cm. For target volumes of 3 cm or less, the dose deposition is similar to both Ir-192 and Cs-137, with a reduced dose to critical structures beyond 3 cm. Dose rates at 2.0 cm from the tandem and ovoids averaged 24 Gy/hr and 35 Gy/hr respectively, indicating that a treatment with a 6.0 Gy prescription to point A can be delivered in less than 20 minutes. Isodose contours (Figure 3) agree well with predictions; analyses of these are ongoing.

Conclusions:
A new applicator has been developed for the treatment of cervical cancer in conjunction with the Xoft 50kVp eBx system. Dose rates and distributions from this applicator produce modest surface doses for a given dose at depth, with reduced dose to critical structures outside of the treatment volume. Characterization of this applicator is ongoing.