AbstractID: 1739 Title: Inverse Problem Solution for Dose Prescription of Deformed-Shape MammoSite® Balloon Applicator

The MammoSite® catheter-balloon device utilizes a single dwell position of Ir-192 source positioned at the geometric center of the balloon. The dose is prescribed at 1 cm from the surface of a well-conformed surface of the spherical balloon. Significant deformity of the balloon is one of the limiting factors for termination of the procedure.

We present here the preliminary work for the inverse solution of elliptical and deformed balloon cavity dosimetry. The algorithm detects for balloon major axis. The linear source (Ir-192) is placed at the bisectional point of the axis. Rays are traced from major axis center to different marking points on the balloon edge for every π/12 polar angle. Prescribed dose points, Pi (r,θ), are specified at 1 cm pointed radially from marking points at balloon surface.

Dose, D (r,θ), is calculated using numerical computation with polynomial Pn (r,θ), such that

$$D(r,\theta) = P_n(r,\theta) + \frac{f^{n+1}(r')}{(n+1)!}(r-a)^{n+1}$$

for some r' between r and a

$$\int_{\theta 1}^{\theta 2}\int_{a}^{b} f(r,\theta)\,dr\,d\theta = \int_{\theta 1}^{\theta 2}\int_{a}^{b} Pn(r,\theta)\,dr\,d\theta + En$$

with $|Em| = \int_{\theta 1}^{\theta 2}\int_{a}^{b} \frac{f^{n+1}(r^1)}{(n+1)!}(r-a)^{n+1}\,dr\,d\theta \le \frac{M(b-a)^{n+2}}{(n+2)!}$

The computed dose value is dependent on source activity, distance, and dwell times. Using multidwell source positions, χ2-minimization technique is used to solve for optimum dwell times for equal dosage at radial distance δi where 1 <δi< 1.5 cm away from marking points at deformed circumference.