

AbstractID: 5357 Title: Influence of air gap on dosimetric characteristics of uniform and composite clinical  $^{90}\text{Y}$  plaques for dural irradiation

**Purpose:** A semi-cylindrical polycarbonate plaque incorporating a  $^{90}\text{Y}$  foil has been developed and used to irradiate the dura in 14 spinal tumor patients. It has been hypothesized that inadequate fitting of the irradiator plaque to the dural surface could adversely affect the area of therapeutic dose delivery at the 90% level. A differentially-loaded composite treatment plaque has been designed to ameliorate potential air gap effects and maximize therapeutic dose delivery.

**Method and Materials:** Two clinical plaque designs were evaluated, including a "standard" plaque containing a single foil of uniform activity, and a "composite" plaque containing a differentially-loaded  $^{90}\text{Y}$  source created by placing a single activated square foil under an activated foil frame of the same outer dimensions in a titanium shell. Two dosimetry phantoms surrounded by a layer of radiochromic film (GafChromic HS) were constructed with radii approximating a perfect fit (matched to inner plaque radius) and a gap fit (80% of inner plaque radius) and irradiated with the two plaques.

**Results:** Analysis of the irradiated film demonstrated that the effective treatment width to 90% of the plaque along the arc in the standard plaque is 65.8% when fitted and 58.1% in the presence of a gap; for the composite plaque, the corresponding treatment widths to 90% are 88.6% when fitted and 69.4% in the presence of a gap. Thus, in the presence of a gap the composite plaque delivers dose at the 90% level to a 19.6% greater arc width than the standard plaque with a gap, and 5.5% greater arc width than a perfectly fitted standard plaque.

**Conclusion:** Differentially-loaded composite  $^{90}\text{Y}$  plaques deliver therapeutic dose to a substantially larger treatment area than standard plaques currently used, and completely resolve treatment area to the 90% level potentially lost to inadequate fit with standard plaques.