AbstractID: 10861 Title: Automated planning volume definition for HDR brachytherapy: Application to intraluminal treatment of the bile duct

Purpose: Although surgery remains the treatment of choice, patients with carcinoma of the extrahepatic bile duct who are not candidates for surgical resection(~75%) are treated palliatively with radiation therapy and/or chemotherapy. Intraluminal LDR or HDR brachytherapy has the well-documented advantage of delivering a large target dose, while significantly sparing surrounding healthy tissues. Typically, treatment planning is performed with respect to source-guide catheter(s) inserted along the biliary canal under fluoroscopic guidance. The prescription hull refers to a volume at a distance of 0.5-1.0 cm from catheter(s). Because of the irregular shape of the source guides, manual contouring of the prescription hull is time consuming and subject to errors. We describe, and illustrate with actual treatment plans, an automatic algorithm to outline the planning volume.

Methods and Materials: The contouring of a single catheter can be considered as the trajectory generated by a moving ball. The path of the ball forms a *guide curve,* which is given by the digitized-coordinates of the source-guide catheter. Given a radius *r* that defines the thickness of the PTV, our volume-definition algorithm applies curve fitting via Ferguson spline interpolation, followed by circle generation and sphere generation. For multiple catheters, the algorithm is more complex, requiring curve fitting, warping, slicing, and linking to obtain the resulting tumor shape.

Results: For the biliary intraluminal case, the algorithm takes only seconds to generate a 3D-planning volume. Applying it to complex hypothetical cases reveals that it handles irregular tumor volumes and shapes well, and returns a 3D-planning volume within 1 CPU-minute.

Conclusion: The automatic volume-definition algorithm works reliably and quickly, and results in plans that are demonstratively superior to those obtained by manual planning. Furthermore, the planning volume is a necessary input to computer-based plan optimization. The volume-definition algorithm improves the treatment dosimetric conformity, a factor that may contribute to improved clinical outcome.