AbstractID: 9526 Title: Parameter Optimization for Brachytherapy Robotic Needle Insertion and Seed Deposition

Purpose: To investigate influence of different needle insertion and seed deposition techniques for robotic brachytherapy. To find optimal sets of low, normal and high translational and rotational velocities of the needle for decreasing insertion force, needle deflection and OR time, and increasing seed placement accuracy. **Method and Materials:** We have developed EUCLIDIAN – a fully automatic robotic prostate brachytherapy system. Robotic system parameters were optimized via preclinical experiments using two types of polyvinylchloride and tissue phantoms, cannula and stylet single-axis force sensors, and six-axis force-torque sensor. Cannula sensor measures the force on the cannula during insertion, withdraw, and axial force exerted by tissue at rest. Stylet sensor measures the force while seed is expelled from the cartridge, during seed travel through the cannula, and at the moment when seed is deposited into tissue. Position of the needle tip and consequently deposition depth into the phantom was measured using optical encoders on the cannula and stylet motors. Cannula and stylet translational velocity range was 5-120 mm/s, and cannula rotation range was 0-30 rev/s. Force patterns were analyzed based on the experimental data. **Results:** According to the criteria for minimizing insertion force and OR time while maximizing seed deposition precision, it was found that best performances were achieved when cannula and stylet normal speed was 70 ± 10 mm/s and optimal high speed was 100 ± 10 mm/s. Optimal cannula rotation speed range was 15-25 rev/s. In order to avoid seed jam in the cartridge, optimal speed for pushing seed out of the cartridge was 2-5 mm/s. **Conclusion:** Optimal parameters were programmed in the EUCLIDIAN configuration files. Seed deposition techniques have significant influence on reduction of insertion force, needle deflection and seed deposition accuracy. Future investigation will be on adaptive parameter tuning for specific clinical encounters. **Acknowledgement**: Supported by NCI-R01-CA091763.