AbstractID: 13524 Title: Shortening treatment time in robotic radiosurgery by novel node reduction techniques

Purpose: The CyberKnife robotic radiosurgery unit uses small circular beams that can be targeted from 117 node positions to obtain highly conformal dose distributions. Typically a large number of node positions, beams and monitor units (MUs) are used, resulting in long treatment times per fraction. The aim of this study was to develop and evaluate node reduction techniques to reduce the long treatment times for robotic radiosurgery. **Method and Materials:** Two node reduction techniques were implemented in our inverse planning algorithm developed in-house. This algorithm uses 'resampling': repeated inverse optimization, each time replacing candidate beams with zero weight by new candidate beams. In the first reduction technique (passive reduction), node positions that were not ascribed any dose after inverse optimization were excluded from successive resampling iterations. This process was repeated until the number of node positions remained constant. In the second method (active reduction), node positions were reduced by forced exclusion of node positions with the lowest contribution until a valid solution could no longer be found. Both techniques were evaluated for two lung cases of different complexity, one prostate and one oropharynx case. Obtained plans were compared with plans without node reduction by the number of node positions, beams and MUs. All plans fulfilled the clinical dose constraints. **Results:** Compared to no node reduction, both passive and active node reduction resulted in a lower number of node positions (passive:-23%, active:-68%) and MUs (passive:-3%, active:-3%). The number of beams increased during node reduction (passive:+3%, active:+13%). Increasing complexity lowered the reduction in node positions. **Conclusion:** Results showed a dramatic reduction in the number of node positions while still fulfilling clinical dose constraints. The most efficient treatment plans were obtained by active node reduction. This technique could be used to shorten the treatment time per fraction.