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Preliminary Study of a Simple Intensity-Modulated Arc Therapy Optimization Algorithm Using a Aone-Beam 3D Reconstruction Algorithm

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Purpose: To developed an Intensity-modulated arc therapy(IMAT) inverse planning algorithm which was a preliminary study prior to patient treatment employing cone-beam 3D reconstruction algorithm for the fast and efficient intensity-modulated radiation therapy (IMRT). Methods and Materials: It was assumed that beams were delivered at every 5 degree angle thus there were 72 beam directions. Two kinds of phantoms (one is slab type and the other is cylindrical type) were CT scanned and those images were transferred into the Pinnacle3(Philips Medical Systems, USA) radiation therapy planning system. Virtual targets and critical organs were described inside the phantoms. After converting contours of the structures to masks using IMAT inverse planning solver(IPS), then desired doses were specified for each structures. Fluence maps for each beam direction were calculated using cone-beam 3D reconstruction algorithm and simple gradient based optimization algorithm. The maximum level for each fluence map was restricted to three. Obtained fluence maps were decomposed into a few segments respectively. Film measurement was compared with the computed result to verify the validity and accuracy of the proposed algorithm. Plan quality was evaluated using proposed plan quality factor(PQF) and modified conformality index(MCI). Results: Among the pre-defined 72 beam directions, we could select or omit beam directions to form arcs. For the simple phantom case, 5 arcs were enough to cover the target well while satisfying the dose criteria for the critical organs as well as keeping an acceptable level of PQF and MCI values. Calculation time was within a minute. Maximum discrepancy between a film measurement and the calculated result was up to 5%. Conclusions: Proposed algorithm showed a good performance and it is expected to alter the paradigm of the IMRT even though it needed to be improved further.

Keywords : Intensity-Modulated Arc Therapy, Optimization, Fluence Map