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IMRT Isodose Distribution Change due to CT Number Uncertainty in Moving Organ

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Purpose: In IMRT treatment, Isodose distribution is important to determine the treatment plan. Respiratory motion, however, induces CT number uncertainty in computed tomography (CT) scanning, specifically in the lung. CT numbers deviates from real values, depending on scanning condition, and it causes changes of isodose distribution. This study evaluated the change of isodose distribution quantitatively in the treatment of IMRT. Material and Method: We have developed a thorax phantom that can be programmed with various patterns and frequencies of motion. The phantom was scanned using a multi-row helical CT scanner in light respiration mode (amplitude 4 cm, period 4 seconds in cranio-caudal direction) as well as in static mode. The motion approximates the pattern of organ movement in patients during light breathing. After CT images were obtained in high speed mode at incremental phases of respiration, they were transferred to our RTP system (Pinnacle3, Philips, USA). Isodose distribution for an IMRT plan using images scanned in motion was compared with those in images obtained in respiratory motion. Subtractions of two isodose distributions on each set of axial, coronal, and sagittal plans that intersect the isocenter were made using RIT dosimetry software. Result: More than 3% of difference was observed in 7.38% (1867 pixel of total 25265 pixel) in axial isodose distribution, while it was detected in 16.96% (2178 pixel of total 12840 pixel) and 8.76% (1052 pixel of total 12000 pixel) for coronal and sagittal isodose distribution, respectively. And difference of mean dose was 0.7493% (std. dev.: 2.78198), 2.6966% (std. dev.: 5.15442), 1.8214% (std. dev.: 4.99892) and difference of maximum dose was 20.13%, 31.17%, 35.3% in axial, coronal, sagittal isodose distribution. Discussion: The isodose distribution change on axial and sagittal planes was small, but it was relatively large on coronal plan due to it was parallel to organ movement. The uncertainty of isodose distribution on coronal plan should be taken into account in IMRT planning evaluation.

Keywords : IMRT, Organ Motion, CT Number Uncertainty