

Quality Assurances for an On-Board Imaging System of a Linear Accelerator: Five Months Data Analysis

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Abstract : To ensure the radiation precisely delivering to the target of cancer patients, the linear accelerator equipped with the pretreatment on-board imaging system is introduced and through it the patient setup is verified before the daily treatment. New generation radiotherapy using beam-intensity modulation, usually associated the treatment with steep dose gradients, claimed to have achieved both a higher degree of dose conformation in the targets and a further reduction of toxicity in normal tissues. However, this benefit is counterproductive if the beam is delivered imprecisely. To avoid shooting critical organs or normal tissues rather than the target, it is very important to carry out the quality assurance (QA) of this on-board imaging system. The QA of the On-Board Imager® (OBI) system of one Varian Clinac-iX linear accelerator was performed through our procedures modified from a relevant report and AAPM TG142. Two image modalities, 2D radiography and 3D cone-beam computed tomography (CBCT), of the OBI system were examined. The daily and monthly QA was executed for five months in the categories of safety, geometrical accuracy and image quality. A marker phantom and a blade calibration plate were used for the QA of geometrical accuracy, while the Leeds phantom and Catphan 504 phantom were used in the QA of radiographic and CBCT image quality, respectively. The reference images were generated through a GE LightSpeed CT simulator with an ADAC Pinnacle treatment planning system. Finally, the image quality was analyzed via an OsiriX medical imaging system. For the geometrical accuracy test, the average deviations of the OBI isocenter in each direction are less than 0.6 mm with uncertainties less than 0.2 mm, while all the other items have the displacements less than 1 mm. For radiographic image quality, the spatial resolution is 1.6 lp/cm with contrasts less than 2.2%. The spatial resolution, low contrast, and HU homogenous of CBCT are larger than 6 lp/cm, less than 1% and within 20 HU, respectively. All tests are within the criteria, except the HU value of Teflon measured with the full fan mode exceeding the suggested value that could be due to itself high HU value and needed to be rechecked. The OBI system in our facility was then demonstrated to be reliable with stable image quality. The QA of OBI system is really necessary to achieve the best treatment for a patient.

Keywords : CBCT, image quality, quality assurance, OBI

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