Impact of dose evaluation using various gamma tools depending on grid size and searching range

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Introduction

The dosimeters for dose measurement have been grown 1D such as farmer ion chamber to 2D like radiochromic film and finally 3D such as polymerizing gels gradually and radiotherapy planning which is complicated and has steep dose gradient such as IMRT is under progress in these days[1]. Therefore, dose evaluation for assuring accuracy about comparison between measured and calculated dose distributions becomes more and more important.

The techniques of dose evaluation are several kinds of these. First, dose difference which is calculated by subtracting evaluation dose distributions from reference dose distributions is the most simple and intuitional method. Second, distance-to-agreement (DTA) is the distance between reference data point and the nearest point in the evaluation dose distribution that indicates the most similar dose. Last method is composite analysis gamma index which composes dose difference of DTA. However, limit of composite analysis is qualitative index which is evaluated by pass or fail, so advanced quantitative index is developed recently. Because dose evaluation cannot be known how different depending on grid size and gamma models, it is not clear how appropriately to use it. Therefore this paper desires to evaluate impact of dose evaluation method depending on variable parameters.

Materials and Methods

Conventional gamma index implying the dose difference, DTA, and composite analysis has been suggested by Low et al.[2]. General gradient based gamma index was suggested by Moran et al.[3] and the object of using this method is dose gradient compensation. The treatment planning information for patient specific QA was retrieved from the Ajou university hospital database: Eclipse RTP (VARIAN, USA). The reason for choosing prostate cancer patient case is simpler than other cases but, it has dose gradient.
Prostate cancer patient who had a prostatectomy had treatment planning using 3 arc therapy which was 360°, 360°, 180°. In this case, organs at risks (OAR) are rectum, bladder, and femoral head.

In this experiment, we used the VARIAN Clinac IX for RapidArc™ (Varian Medical Systems, Inc.) technology then delivered by a 10 MV with multileaf collimators (MLC). For wedge field, we utilized wedge whose physical angle was 45° and field size was 10 X 10 cm². Volumetric Modulated Arc Therapy (VMAT) was used by prostate field and all of fields were measured by using EBT2 (ISP, Wayne, NJ, USA) films. After 1 day, we scanned irradiated EBT2 films using flatbed scanner (Epson 10000XL).

결과 및 고찰

It is very important dose distribution is assessed at complex field having sharp gradient such as IMRT, VMAT. The commonly used dose analysis tools are gamma tools that included dose concept and distance concept. Figure 1 shows results of prostate field are similar to that of the wedge field. Therefore, we found pass ratio fell sharply as grid size increased because of gradually bigger gamma value.

This study estimated changes of images according to searching range and differences of gamma values in each searching range. As searching ranges became bigger, gamma value also was increased and visible noise of images got worse severely for two models

### Conclusion

This study evaluated difference according to gamma models and changes of gamma values according to grid size and searching range. The pass ratio fell down as grid size increased at all gamma models and all fields, however gap between 0.5 mm and 1 mm is not significantly different. For searching range, artifacts of images and gamma values increased when it rose at all gamma models and all fields.

### Reference