Geometric agreement check for imaging system with radiation beam by kV and MV-CBCT

Introduction:
As a gantry-mounted kilo-voltage image-guided radiotherapy (kV-IGRT) system using a cone-beam CT (CBCT) is to verify and correct a patient position for the radiation therapy, the spatial accuracy of the image reconstruction is paramount and emphasized. The recommended frequency of the geometry check is daily from Task Group 142 of the AAPM. Therefore, the verification method of the geometry agreement between a light field and/or a laser coordinate and treatment beam should be easy and quick. In this presentation, we propose a novel QA method by using both kV- and MV-CBCT for kV-IGRT system. This method confirms the temporal unchanging the agreement of geometry in the kV-IGRT system with the treatment beam geometry.

Method and Materials:
1) MV-flexmap: Sequential MV-projection images were acquired during gantry rotation by iViewGT (Elekta) and MV-CBCT was reconstructed by in-house software with a flexmap correction. The flexmap is displacement of gantry and detector panel related with gantry sag. The geometric change affects the deranging reconstructed image. To evaluate how much displacement of EPID panel and gantry was detectable, the images of 8mm diameter ball-bearing (BB) located at the radiation isocenter were reconstructed with improper Flexmap.
2) A comparison between the kV-CBCT and MV-CBCT: The kV-CBCT was provided by X-ray Volume image (XVI) system (Elekta). To confirm the agreement for the geometry between kV-IGRT system and treatment beam, the kV-CBCTs of BB are compared with that of MV-CBCTs.

Result:
The Figure 1(a) is the axial view of MV-CBCT with the correct flexmap, while (b) and (c) are shifted 1mm and 3mm to the rotation direction, respectively. Figure 1(d) is coronal view of with the correct flexmap and (e) is shifted 2mm to rotational axis. The residual displacement error between kV-CBCT and MV-CBCT was less than 1mm.

Conclusion:
Less than 1mm of the geometrical changing to rotation direction for MV-detector panel could be recognized by reconstructed images of BB. Using kV- and MV-CBCT enable us to perform the simple comparison for geometrical non-idealities between the kV-IGRT system and the treatment beam.