Purpose:To evaluate a deformable registration system for modalities applied in radiotherapy. A phantom study and clinical images were used to assess the software's tendencies and limitations.

Methods:An in-house phantom was constructed with various shapes and known size inserts. Commercially available software was used for image registration (Velocity Medical Solutions, Atlanta, GA). The capabilities of the algorithm were evaluated by various combinations of inserts' translation, rotation and replacement. Patient images were also applied to assess the deformable registration. Two cases are chosen: pelvic MR study with CT images and head-and-neck CBCT scan with planning CT images. The quality of registration was examined by visual inspection and using the Dice Similarity Coefficient (DSC) values for each objects.

Results:Images correlated well among CT, MR and CBCT images after registration. The deformable algorithm is able to move displaced object, up to 2-cm translation, back to its original location. However, the deformable results were highly dependent on field of view (FOV) which defines the region for deformable registration. In general, the DSC can be improved to above 0.8 in various combinations of object translation, rotation, size changed and shaped changed with adequate FOV selection. Sample pelvic MR images were registered with CT images. The deformable results would be different with variation in bladder filling and rectal prep. The volume of deformed prostate is 10% larger than the volume based on the rigid registration. Visual inspection of the deformed CBCT images correlated well with re-planning CT with high DSC for all the structures.

Conclusions:It is important to understand the extent of deformable registration algorithm's capabilities and limitations in various clinical applications before using it clinically. A simple phantom study is developed for deformable registration validation. The optimal results of deformable registration can be achieved by careful FOV selection.