



PURPOSE

- The objective of this study was to investigate the correlation between the dose to the healthy tissue and clinical outcome using rigid vs. deformable registration.

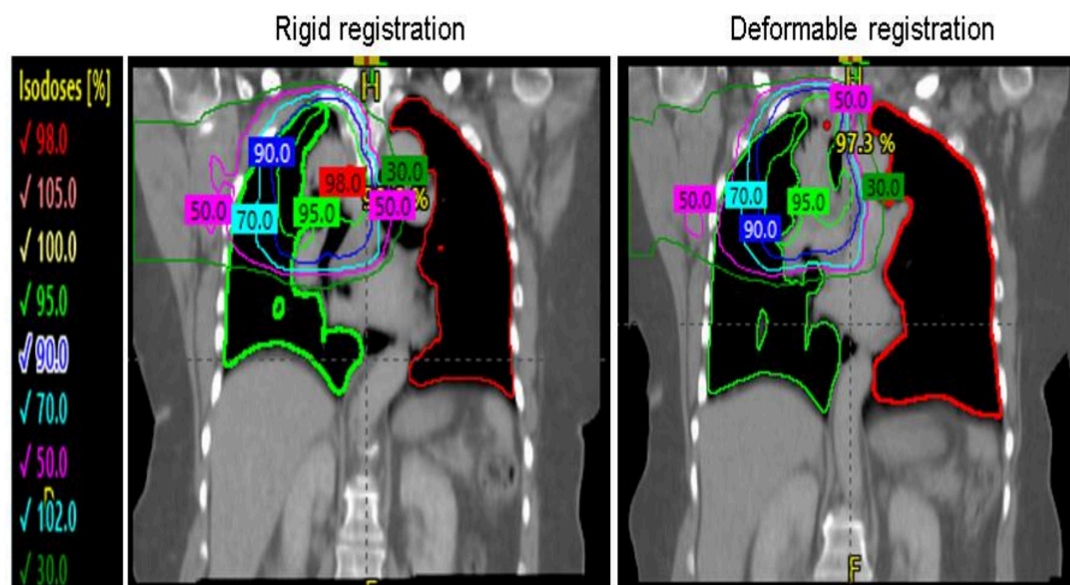
INTRODUCTION

- Dose warping following deformable image registration (DIR) allows the identification of specific organ subregions that are associated with a high risk of toxicity and is useful for predicting toxicity.
- Registration is essential to map the position of each voxel to a reference CT image for dose tracking.
- The impact of uncertainties associated with deformable registration on dose calculations are still not well understood.
- The aim of this study was to investigate how different dose registrations effect the correlation between the dose and clinical outcome.

METHODS

- Eighty-six patients treated for locally advanced lung cancer treated with three-dimensional conformal radiation therapy
- Patients treated with 30-33 fractions of 2Gy/fraction
- Patients had follow-up CTs (at about 3-6 months post-RT) as well as radiation pneumonitis (RP) scores.
- Planning CTs were registered to the follow-up CTs using rigid and deformable registrations.

Fig 1: Rigid and deformable registration from the planning CT to the follow-up CT along with the associated dose distribution.



METHODS

- Dose distribution from the planning CT was then mapped onto the follow-up CTs using the deformation matrix achieved from the deformations.
- Contours were deformed from CT1 to CT2 and modified when necessary but the clinical tumor volume (CTV) was rigidly registered from planning CT to the follow-up CT
- Patients were grouped into RP CTCAE grades ≤ 1 and grades ≥ 2 indicating normal tissue complication;
 - Forty-four patients had RP grade ≤ 1
 - Forty-one patients had RP grade ≥ 2
- Dosimetric parameters (MLD, V13, V20, V30) were obtained from the dose volume histograms (DVH).
- Mann-Whitney test was performed between the two registration groups for MLD, V13, V20, and V30 obtained from both dose registration techniques.

RESULTS

- Results from the Mann-Whitney non-parametric test showed no significant differences between the dosimetric parameters of rigid and deformable dose registrations.
- The two different registrations resulted in differences in MLD, V13, V20, and V30 of $< 4.0+1.1\%$.
- The correlation between the MLD of the deformed dose with RP was 47% higher than between the MLD of the rigid dose with RP.
- Considering the change in lung volume from pre-treatment to the follow-up;
 - When the lung volume increased, the dosimetric parameters were higher for deformable vs. rigid registration.
 - When the lung volume decreased, the dosimetric parameters were smaller for deformable vs. rigid registration.
 - When the lung volume stays the same, these parameters were similar in both registrations.

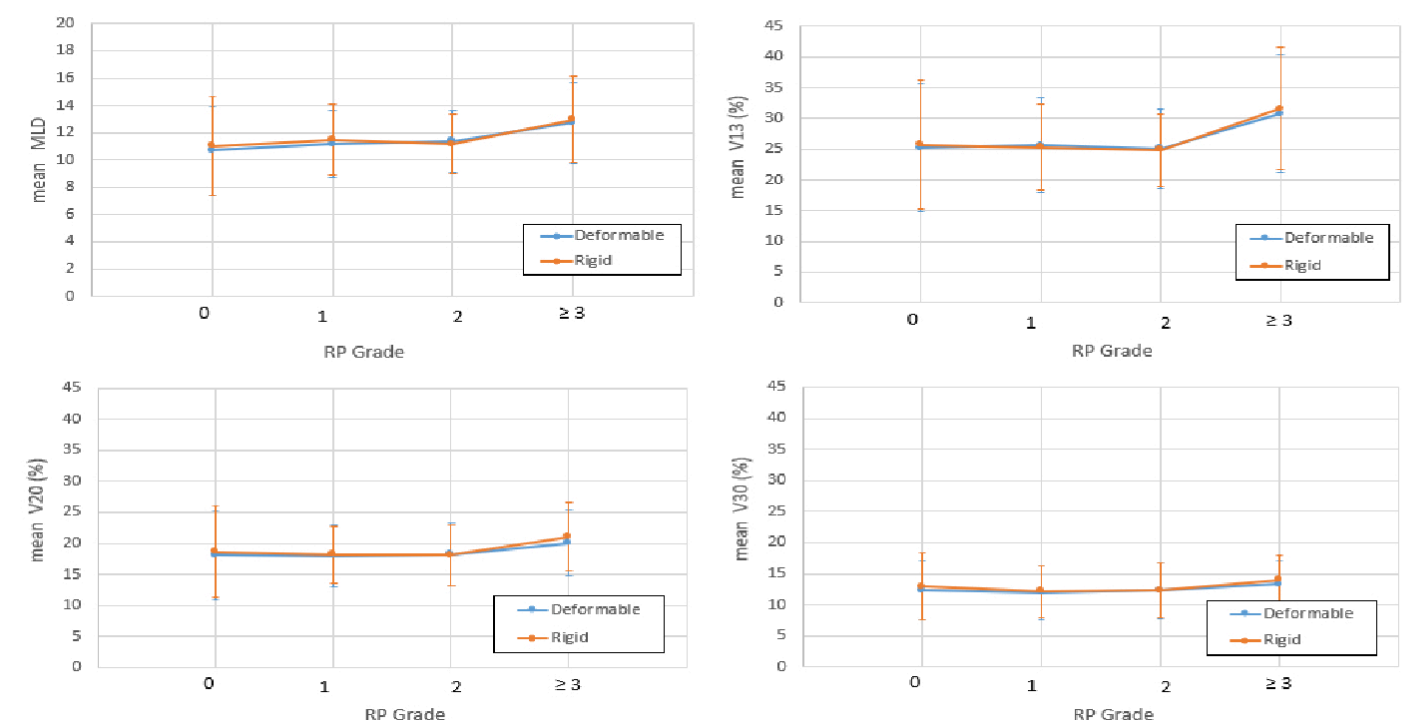


Fig 2: Mean of MLD, V13, V20, and V30 with respect to the radiation pneumonitis grade for rigid and deformable registrations over all patients. Error bars show the standard deviation of the dosimetric parameters over the patient population.

CONCLUSIONS & FUTURE WORK

- This analysis of dose mapping indicates that there are no significant differences when comparing rigid and deformable dose.
- However, differences in dosimetric parameters are seen in individual case depending on the change in lung volume from the planning CT to the follow-up CT.
- Future work will aim to include tumor control probability (TCP) and normal tissue complication probability (NTCP) models into analysis.

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