Assessment of Velocity and Mirada: auto-segmentation tools

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INTRODUCTION

Several commercial software tools are available for auto-segmentation and evaluation of patient changes during treatment. Two such software packages (Mirada Embrace:CT v1.6 and Varian Velocity V3.2) have been assessed for auto-segmentation, adaptive re-contouring and dose evaluation.

METHODS

Auto-segmentation

- 15 CT scans previously contoured by a clinician (5 pelvis, 5 thorax, 5 head and neck (H&N)) were used.
- A consultant oncologist carried out a blinded evaluation of the H&N nodal groups and organs-at-risk (OAR).
  - The OARs included were: Optic nerve, spinal cord, lenses, orbits, brainstem, parotid and brain.
  - Quality scored from1 (very poor) to 5(excellent) for original manual contours and auto-contours.
  - Potential time savings were also estimated.
- The remaining sites were assessed by a physicist/planning radiographer.

Adaptive re-contouring

- 7 patients previously rescanned and re-contoured (3 H&N, 2 thorax, 2 pelvis) were used. See Fig. 1
- An evaluation was conducted as detailed in the previous section.

Adaptive dose-recalculation

- 8 patients previously rescanned and recalculated during treatment (3 H&N, 4 pelvis, 2 chest) were used.
- Delivered dose was calculated using the CBCT geometry to generate a synthetic CT, and compared to dose previously calculated on a CT rescan.

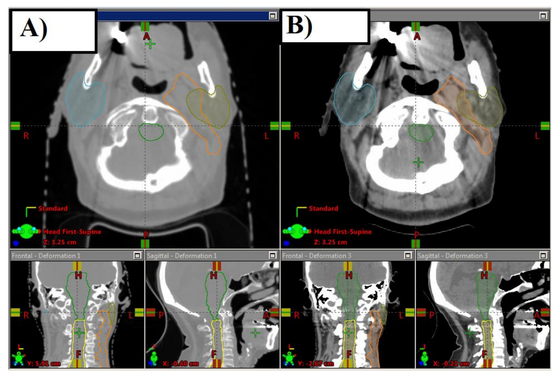

Fig. 1: Adaptively re-contoured patient
A) Clinician contours
B) Mirada deformed contours

RESULTS

Auto-segmentation

- Clinician H&N OAR scores can be found in Table 1. Potential time saving for OARs was approximately 20 mins per patient.
- H&N nodal group were not considered clinically useful.
- Chest and pelvis OARs required extensive editing with limited time saving.

Adaptive re-contouring

- H&N deformation:
  - The clinician considered the deformations were reasonable, but would need some adjustments.
  - Scores can be found on Table 2.
- Chest: the brachial plexus, heart and oesophagus required large adjustments. GTV and spinal cord could be useful.
- Pelvis: Bone marrow and femoral heads could be useful; bowel, rectum and bladder required large adjustment.

Adaptive dose-recalculation

- Mirada and Velocity predict doses within 1-2% of calculation on rescan.
- Changes due to differences in gas are not well modelled.
- Changes in pitch and contour are modelled well.

Patient	Mirada	Velocity	Clinician
1	4	2	5
2	4	2	4
3	3	2	4
4	3	3	5
5	3	2	4

Table 1: Quality of H&N OAR segmentation (scored 1-5).

Patient	clinician	Velocity	Mirada
6	3	3	4
7	4	3	4
8	3	3	4

Table 2: Quality of H&N CTVs and OAR re-contouring (scored 1-5).

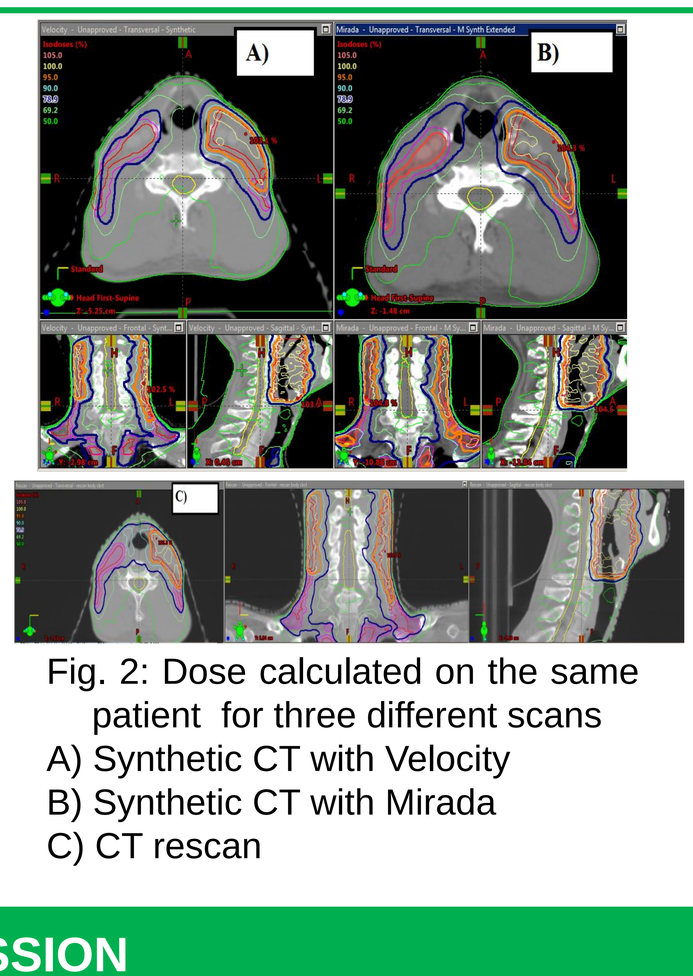

Fig. 2: Dose calculated on the same patient for three different scans
A) Synthetic CT with Velocity
B) Synthetic CT with Mirada
C) CT rescan

Site	Mean PTV dose difference (%)	
	Velocity	Mirada
H&N (9)	-0.7	-0.3
H&N (10)	-0.1	1
H&N (11)	-0.6	0.1
Pelvis (12)	2	1.8
Pelvis (13)	-1	-0.9
Cervix (14)	0.3	-0.3
Cervix (15)	-2.5	-0.3
Chest (16)	0.3	0.2
Chest (17)	3.7	4.2

Table 3: Dose difference: Synthetic CT compared with CT rescan.

DISCUSSION

- **Auto-segmentatio**n: Both packages could provide clinician time savings if used for contouring H&N OARs. For pelvis and thorax patients, automatically generated contours required extensive editing and did not provide a significant time saving.
- **Adaptive re-contouring**: Both packages were helpful for H&N, with Mirada showing a slight advantage in the patients considered.
- **Dose re-calculation** using CBCT was similar for both packages (within 1-2% of CT rescan calculation). This gave a fairly accurate method to assess the impact of anatomical changes during treatment.

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REFERENCES

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