RTOG Medical Physics Committee
Test Accuracy of Siemens, IMPAC, and Varian Alignment SW Packages
A Work in Progress

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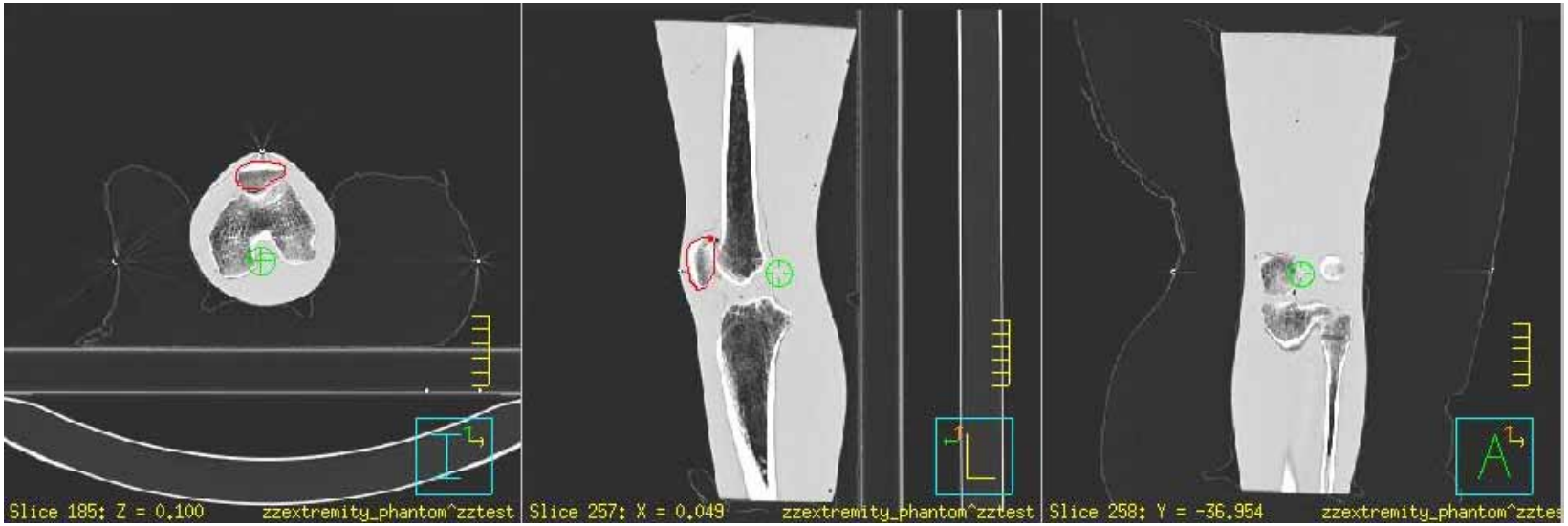
Alignment Software Test

- Goal: Test the accuracy of different commercial and institution written patient alignment software based on in-treatment room imaging using an extremity phantom.
- Characteristics of extremity phantom: relatively small, rugged, relatively cheap anatomical phantom.

MDACC Set up: Phantom in Vac Loc Bag

Note beebees placed for reference purposes.

MDACC Approach



CT images were imported into Eclispe, Kneecap was contoured manually. Two fields were created. The plan contours, and DRRs were then sent to Mosaiq

Alignment SW Tested Up/Down, In/Out, Lt/Rt, Rotation

- MCW (Siemens does not support rotation)
  - Siemens Adaptive targeting
  - Siemens CT on rails
- MDACC
  - CAT (3D/3D)*
  - DOG (2D/3D)**
  - Mosiaq (2D/2D)
  - Varian (2D/2D)
  - Varian (3D/3D)

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  - ** Peter Balter

Known couch correction, as determined by couch readouts

Test	Up/Down cm	In/Out cm	Lt/Rt cm	CW/CCW degrees
1	1	0	0	0
2	1	-1	0	0
3	1	-1	-1	0
4	0	0	0	1
5	1	-1	-1	1
6	1	-1	0	1

Known couch correction, as determined by couch readouts

Test	Up/Down cm	In/Out cm	Lt/Rt cm	CW/CCW degrees
7	-0.3	0.3	-0.3	-0.5
8	-0.5	1.5	2	0
9	-1.5	2	0.5	0
10	2	-0.5	-1.5	0
11	2	-2	-2	0

MDACC Process

- Phantom aligned on Trilogy treatment couch, based on BBs, and Vac-Loc bag markings.
- Initial couch position recorded.
- Shifts made from this position using couch readouts.
- Two orthogonal kV images and one CBCT were taken for each shift.

MDACC Process

- kV images with DRRs (Mosaiq 2D/2D, Varian 2D/2D)
- kV images with reference CT (DOG 2D/3D)
- CBCT with the reference CT (CAT 3D/3D and Varian 3D/3D)

MCW Process

- Linac 1 (L1) CBCT shifts came from phantom shifts off isocenter based upon physical table position changes relative to BB fiducials.
- Linac 2 (L 2) CT on Rails shift came from moving the ‘Machine Isocenter’ of the daily CT in software to a known offset relative to the true isocenter of the plan.

MCW L 1 CBCT in centimeters

L1 CBCT	Initial Table	Auto-registration	Manual registration
Lat.	0	-0.2	-0.1
Long.	0	-0.1	-0.1
Vert.	0	-0.2	-0.1
Lat.	-1.0	0.8	0.9
Long.	-1.0	1.2	1.0
Vert.	-1.0	0.7	0.9
Lat.	1.0	-1.1	-1.0
Long.	1.0	-0.8	-1.1
Vert.	0	-0.1	-0.1

MCW L2 CT on rails in centimeters

L2 CT on rails	Isocenter Offset	Auto-registration	Manual registration
Lat.	0	-0.1	-0.1
Long.	0	0.3	0.2
Vert.	0	-0.1	-0.1
Lat.	-1.0	1.2	1.1
Long.	2.0	-1.8	-1.9
Vert.	0	-0.1	-0.1

Conclusion from MCW Data over the offsets studied.

- 1. Setup of this phantom using CBCT has a 2 mm uncertainty in initial setup and a maximum 3 mm error on image guided setup.
- 2. Setup of this phantom using a CT on rails approach has a 3 mm uncertainty in initial setup and a maximum 2 mm error on image guided setup

Conclusions for MDACC Tests on commercial SW

- Mosaiq 2D/2D – Only manual alignment package studied. Residual shifts were 2 to 3 mm.
- Varian 2D/2D – Automatic alignment failed 8 of 11 times. Semi-automatic residual corrections of 2 to 3 mm for shifts < 2 cm. Technique did not successfully measure couch rotations.

Conclusions for MDACC Tests on commercial SW

- Varian 3D/3D – automatic alignment performed well using bone matching alignment. Residual corrections were within 2 mm.
- Varian 3D/3D – if soft tissue alignment target was required, manual alignment would have to be used as opposed to automatic alignment.

General Conclusions

- A simple phantom has been used to test in-room patient alignment commercial software from three different vendors at two different institutions.
- Over a limited but clinically valid range, all SW tested performed well for translational offsets.
- There are limitations in some commercial packages in supporting rotations.l