Introducing setup of stereotactic radiotherapy treatment of patients with intracranial tumors with open-face mask using Surface Guided Radiotherapy (SGRT) and head adjuster

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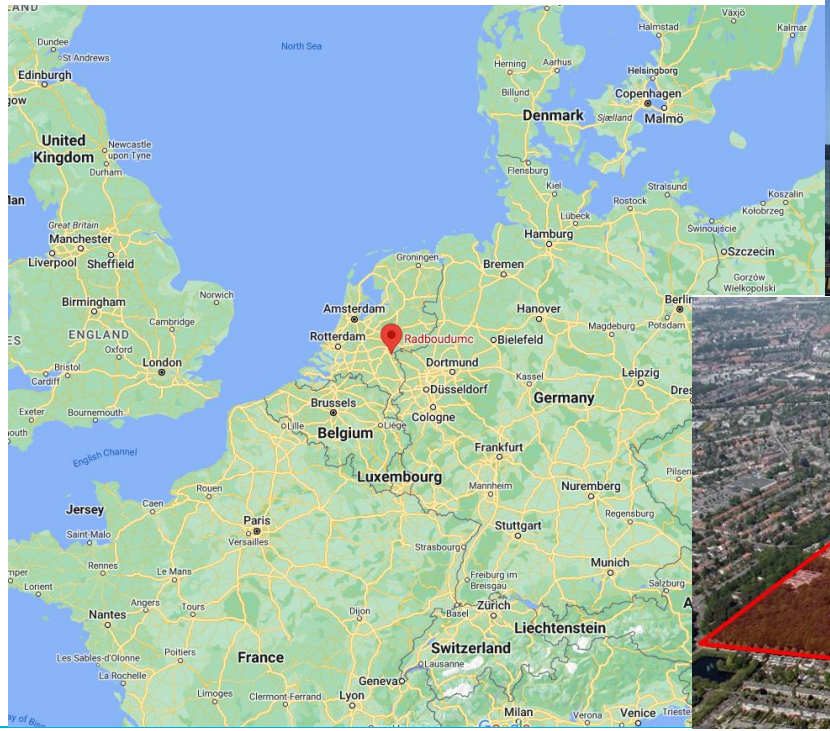
2023

Radboudumc

Overview Department Radiation Oncology Radboudumc

Where are we?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Rotterdam
Amsterdam
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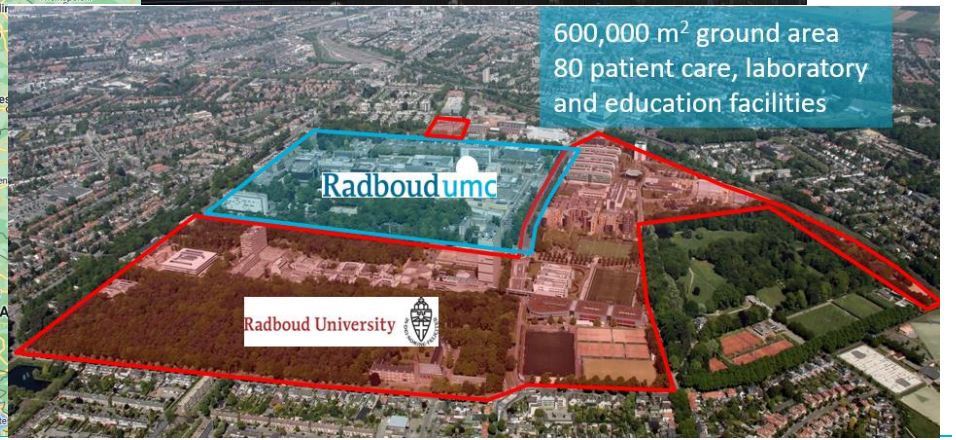
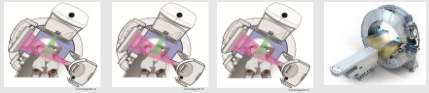
Lyon
Zürich
Jersey
North Sea

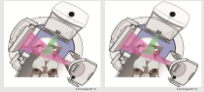

600,000 m² ground area
80 patient care, laboratory and education facilities
Radboudumc
Radboud University

Radboudumc Radiotherapy

Location Radboud



Location CWZ



- 2 locations

- 5 CBCT Linacs
- 1 MR Linac
- 1 SGRT
- 1 Flexitron brachy
- 1 CT scan

- 153 FTE
- 16 radiation oncologists
- 7 clinical physicists
- 5 specialized nurses
- 66 RTT’s

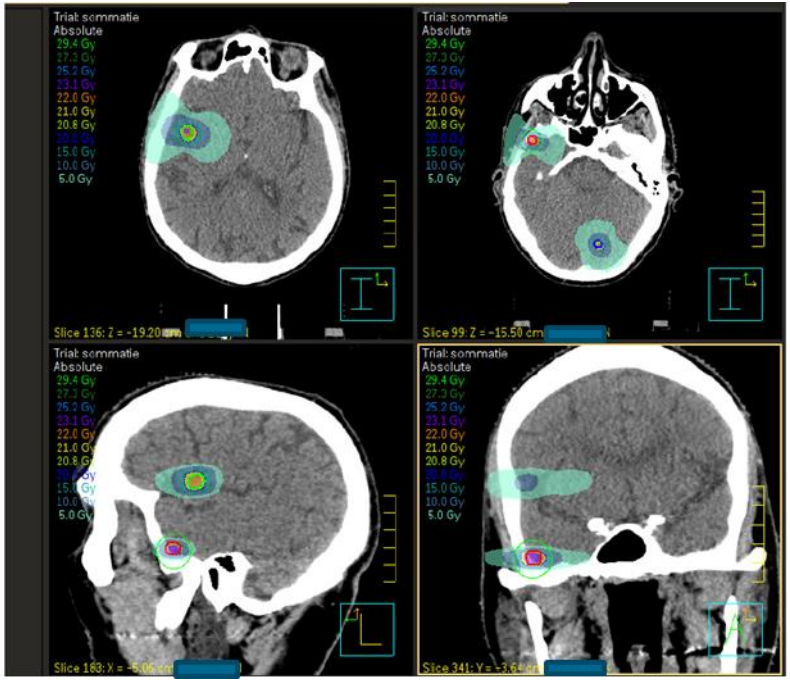
- 2044 new patients
- 2562 patients

Background

Goal:

- Treating multiple intracranial tumors with 1 isocenter
- Rotations below 1 degree

- PTV margins are 2mm



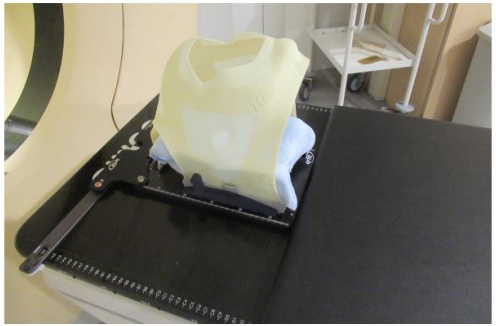
Old workflow

- Planning CT in closed face mask
- Treatment plans with separated isocenters for each PTV
- Fixed table with adjustable translations
- 2 CBCT’s prior to treatment for each PTV
- Treatment time for 3 PTVs = 60 minutes
- Tolerances: 1mm translations and 3 degree on rotations

New workflow

- Planning CT in open face mask
- Treatment plans with single isocenter for all PTV's
- SGRT + Head adjuster to correct for translations and rotations before and after CBCT
- 2 CBCT's prior to treatment of all PTV's
- Treatment time for 3 PTVs = ?
- Tolerances: 1mm translations and 1 degree on rotations

NEW: Patients get open face mask and individual head support



SGRT (alignrt)

+ head adjuster to correct for rotations

The Head Adjuster consists of two plates composed of Carbon Fiber and Carbon Fiber Reinforced Polymer (CFRP) connected by the adjustment mechanism.

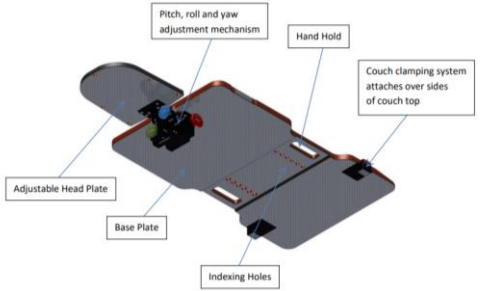


Figure 2.1 Head Adjuster (viewed from below) with main features identified

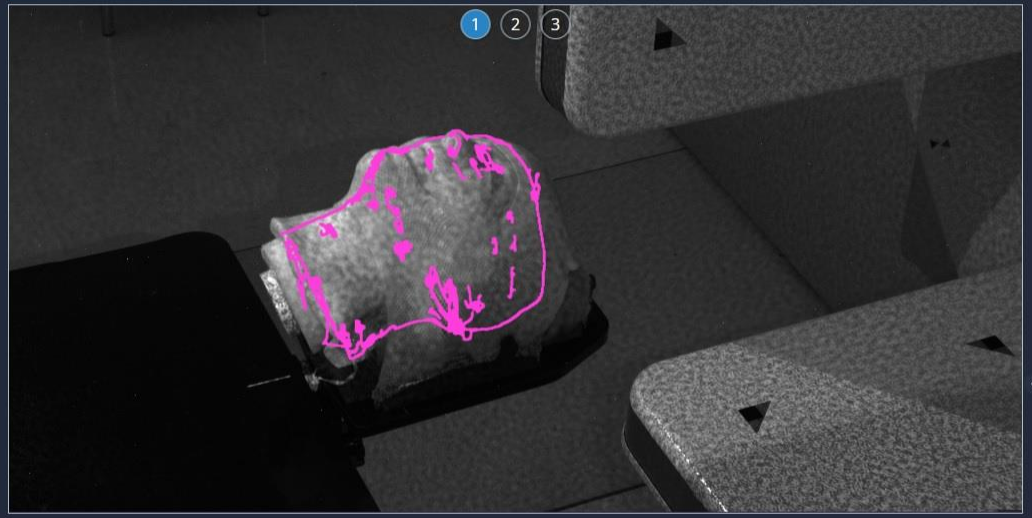
Plan SGRT.0 ISO 1

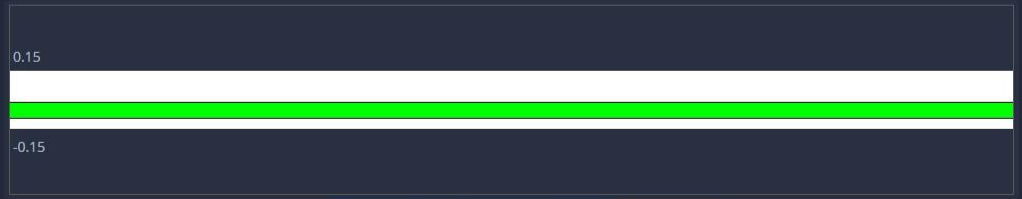
CT SIM External

ROI1

VRT cm	0.04
LNG cm	0.04
LAT cm	0.02
MAG cm	0.07
YAW °	0.6
ROLL °	0.4
PITCH °	0.4

Reference | Treatment | Couch 0.0° | Send to Couch | Beam Control OFF





Coaching

Surface | Deformation | Video

Plan SGRT.0 ISO 1

SGRT External

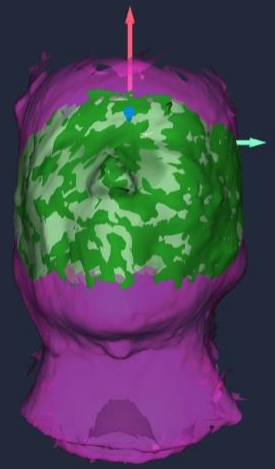
ROI1

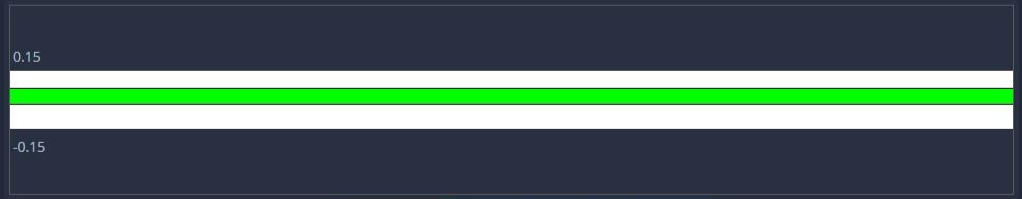
VRT cm	-0.02
LNG cm	0.01
LAT cm	-0.04
MAG cm	0.04
YAW °	0.1
ROLL °	-0.1
PITCH °	0.0

Reference | Treatment | Couch 0.0° | Send to Couch | Beam Control OFF

05/04/2023 14:47:00

Setup Surface





Coaching

Surface | Deformation | Video

Import DICOM

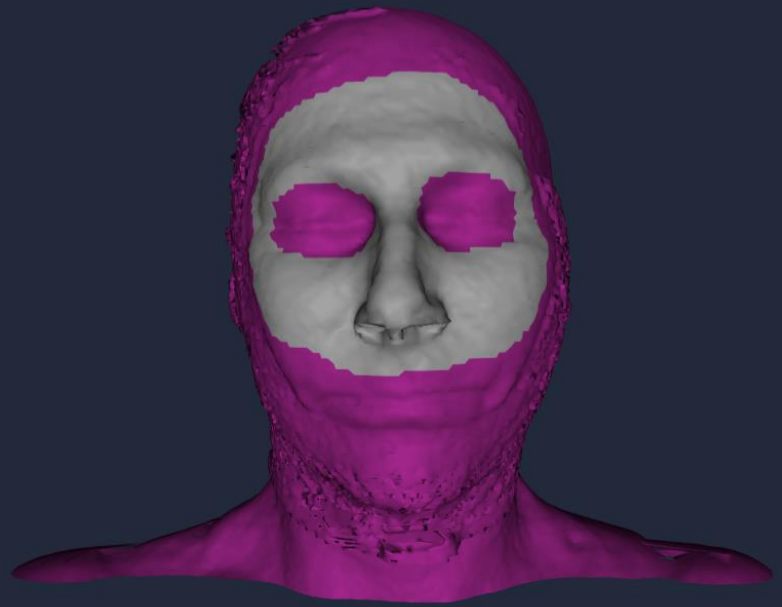
Set Treatment

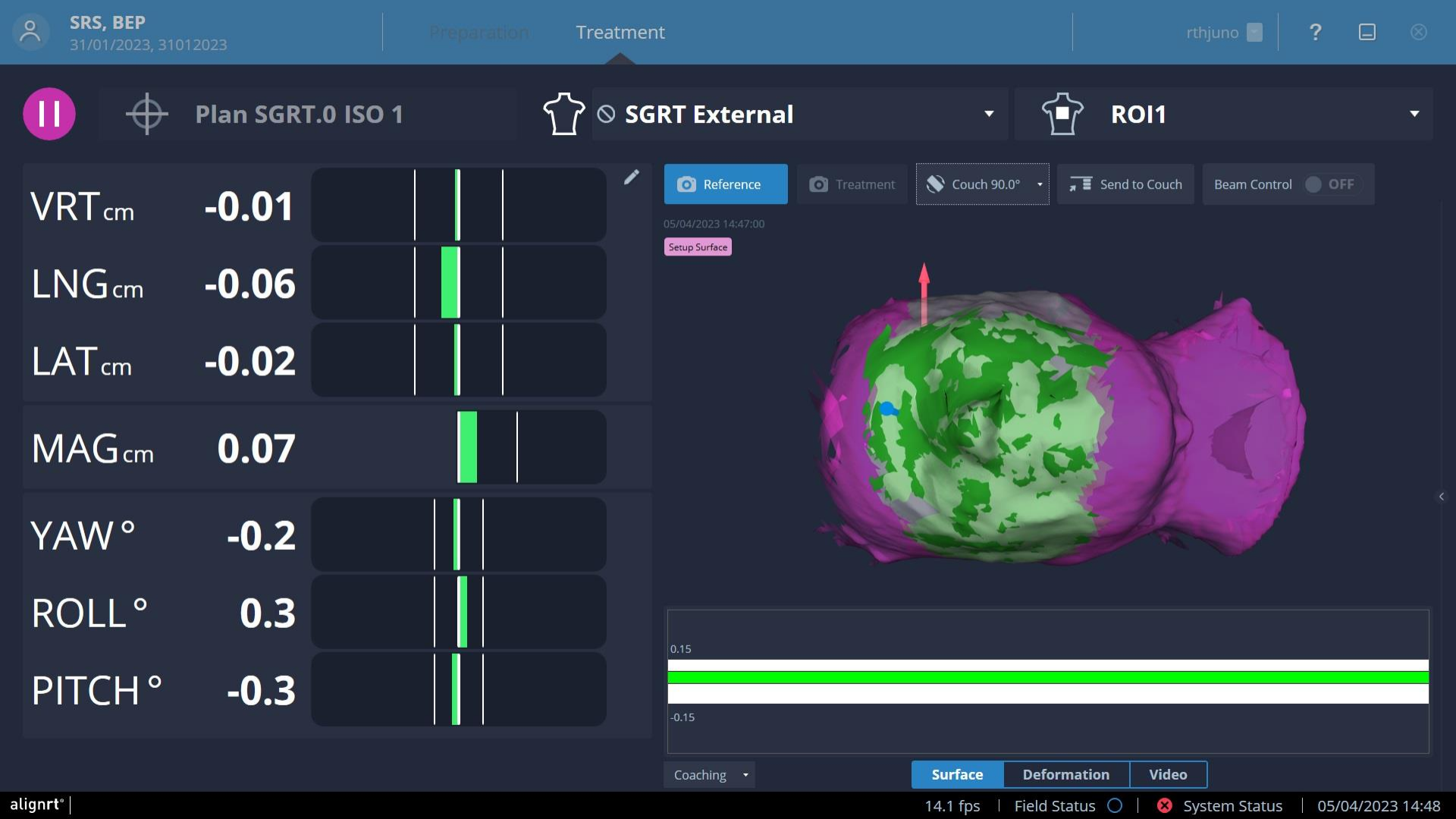
Treatment Course

Plan Name | Active

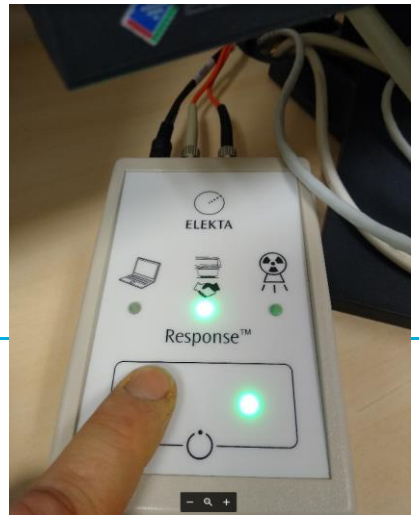
- SGRT.0 [Intracranial SRS]
  - ISO 1 [-28.2, -173.9, 154.5] ☑
    - CT SIM Ex 02/11/2023 14:50:20 ☑
      - Treat With Beam Control
      - ROI1 [Isocentric]
      - Add ROI

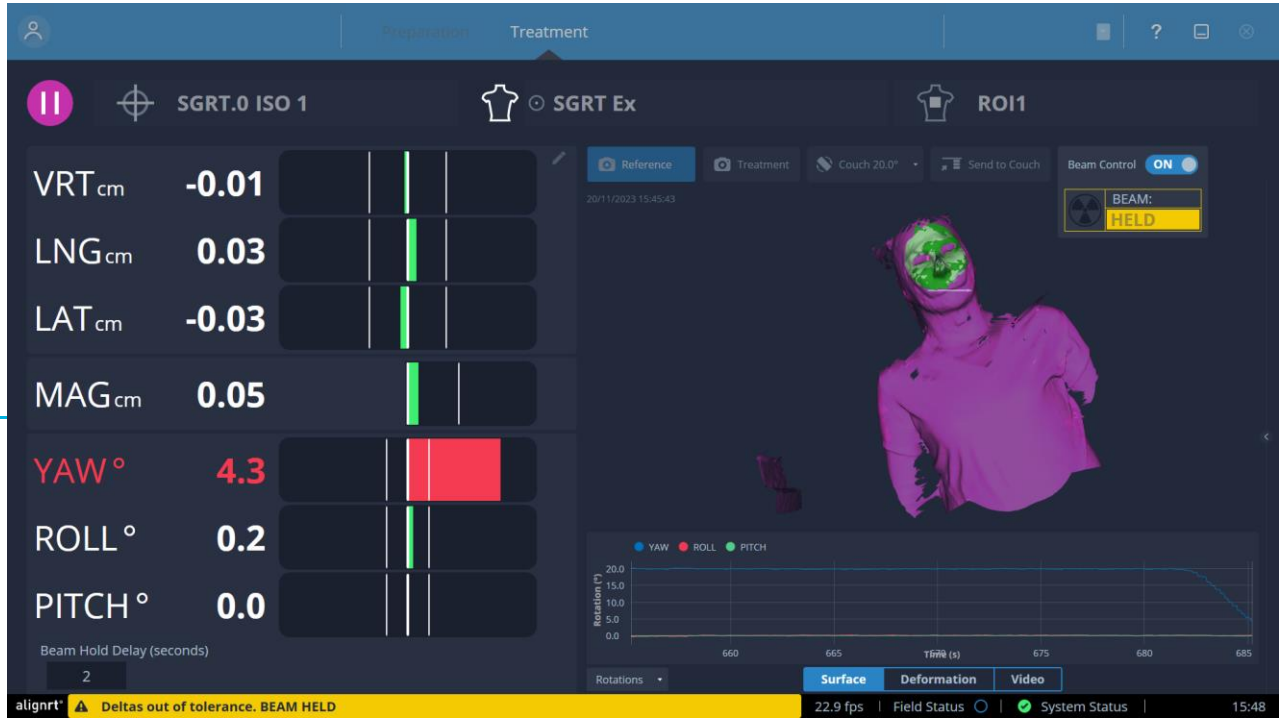
Done




SRS, BEP
31/01/2023, 31012023
Preparation
Treatment
rthjuno
Plan SGRT.0 ISO 1
SGRT External
ROI1
VRT cm -0.01
LNG cm -0.06
LAT cm -0.02
MAG cm 0.07
YAW ° -0.2
ROLL ° 0.3
PITCH ° -0.3
Reference
Treatment
Couch 90.0°
Send to Couch
Beam Control OFF
05/04/2023 14:47:00
Setup Surface
0.15
-0.15
Coaching
Surface
Deformation
Video
alignrt°
14.1 fps
Field Status
System Status
05/04/2023 14:48

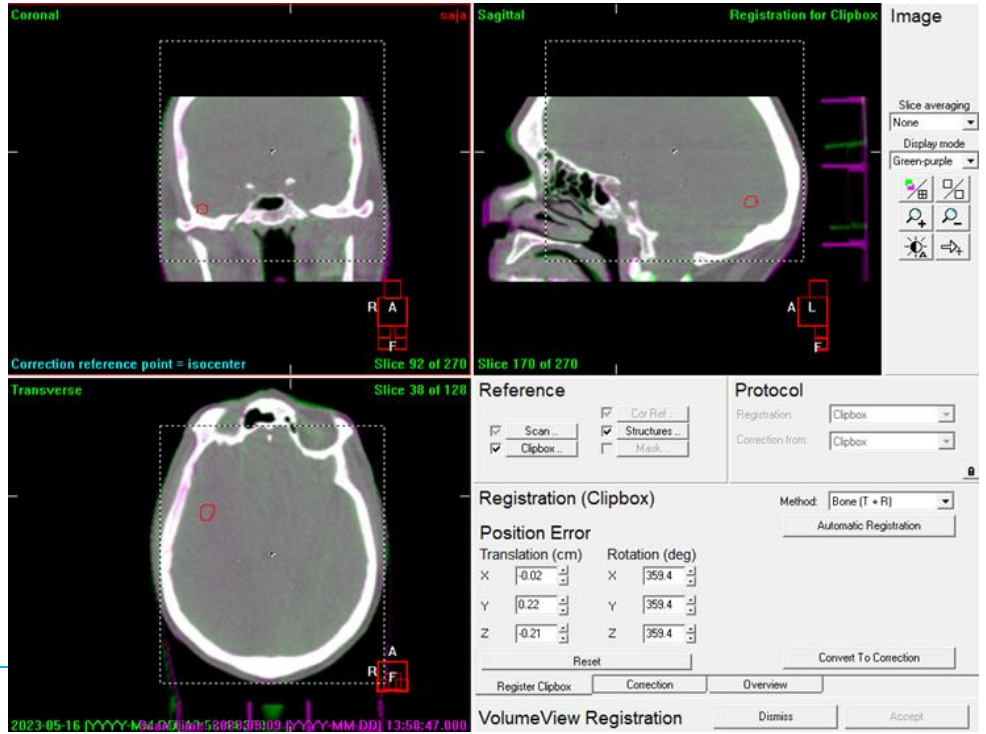
Elekta response interrupts treatment when patients moves out of tolerance





Multiple PTV's in 1 isocenter: CBCT

- Setup patients within 1 degree



Analysis first 19 patients

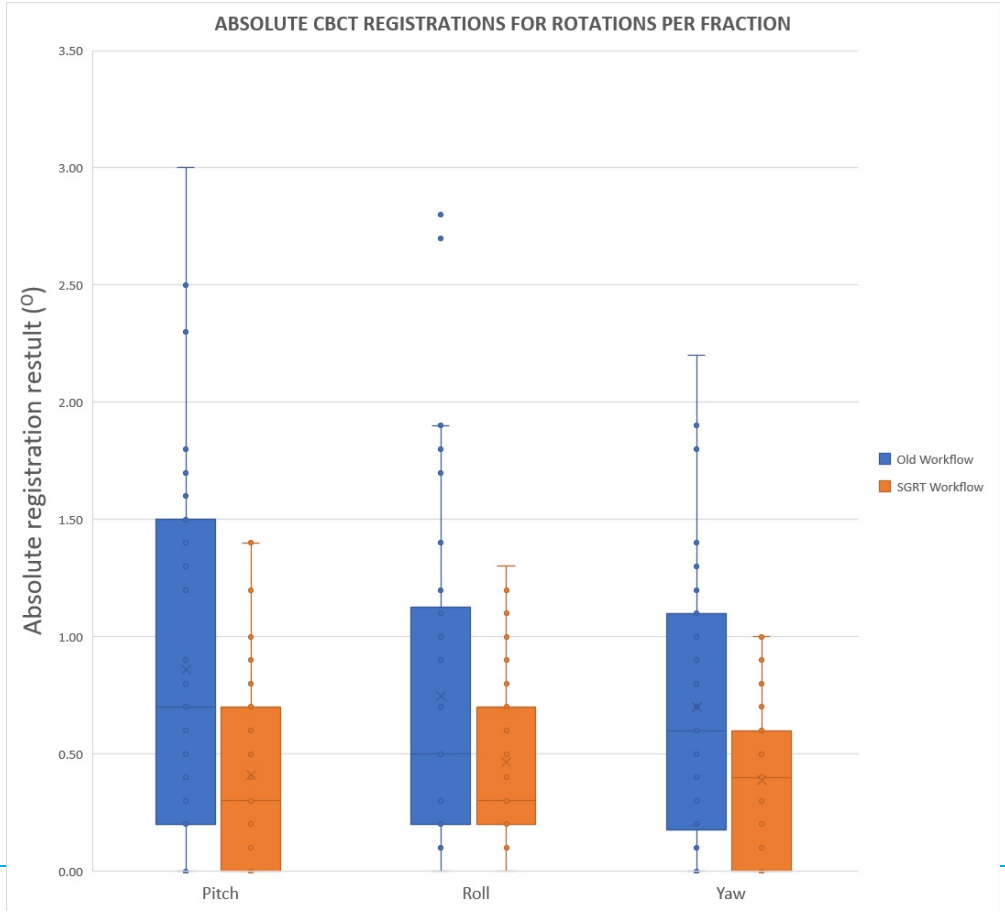
Methods

- Absolute CBCT registrations for rotations

- 10 patients (42 fractions) old workflow
- 19 patients (41 fractions) new workflow

- Patients with 1 up to 3 intracranial tumors with fractionation schedules of 3x8 Gy, 1x16 Gy or 1x21 Gy were included

Results



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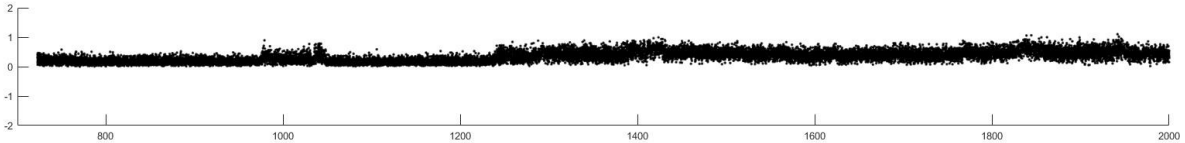
First patient:
SGRT during treatment

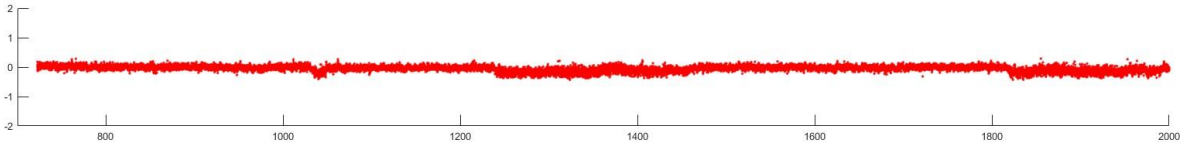
Treating 4 arc's in 1300 seconds

Difference within 1 mm

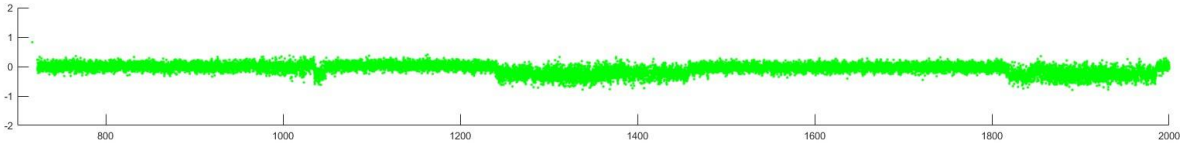
Total 3D vector



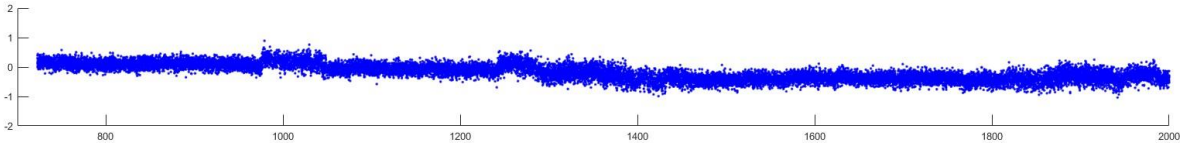
Vertical direction



Lateral direction



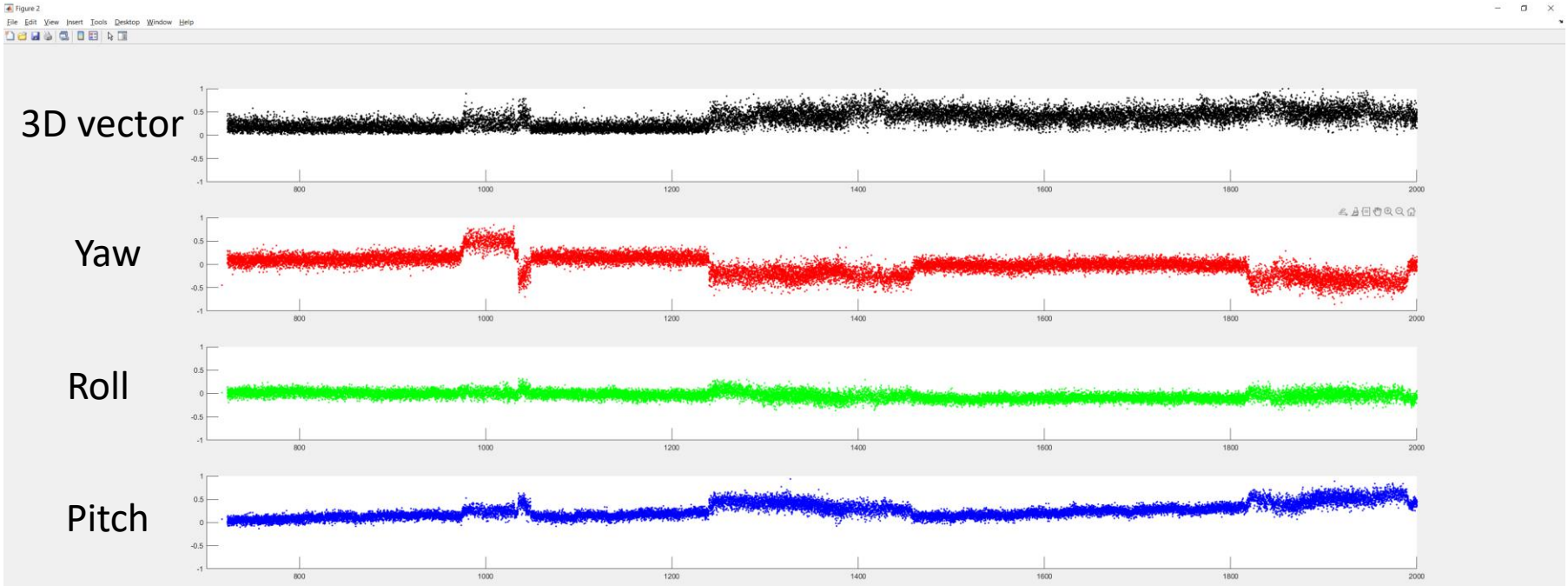
Longitudinale direction



SGRT during treatment

Difference in rotations within1^{o}

Treating 4 arc's in 1300 seconds



Conclusion

- Open face masks gives patients more comfort
- Rotations can be easily corrected with the head adjuster within 0.1°
- Less deviations in new workflow
- Shorter treatment time from 60 to 30 minutes!
- Less CBCT scans
- Monitoring patient position during treatment
- Further research for margin reduction