SPECT in Radiotherapy Planning
Experience at the WBRC

Ryan Smith

William Buckland Radiotherapy Centre
The Alfred Hospital
Melbourne, Australia.

wb rc

the **william buckland** radiotherapy centre

Overview

- The WBRC & The Alfred NM Department
- Radiotherapy Treatment Planning
- SPECT in Radiotherapy
- Phantom Tests
- SPECT Treatment
- Future

wbrc

the **william buckland** radiotherapy centre

The William Buckland Radiotherapy Centre

External Beam :

2 x Varian 21EX (EPI, MLC, etc)

1 x Varian 2100C (EPI. MLC, etc)

1 x Varian 600C (BrainLAB mMLC, EPI, etc)

Stereotactic Radiosurgery / Radiotherapy Program

GE Fxi Single Slice CT

Brachytherapy :

Nucletron HDR (~ 50 prostate patients per annum)

I-125 Seed Program (~70 prostate patients per annum)

RT Planning Systems :

Varian Eclipse

Nucletron PLATO

BrainLAB Brainscan

Radionics XKNIFE

wb rc

the **william buckland** radiotherapy centre

The Alfred Nuclear Medicine Department

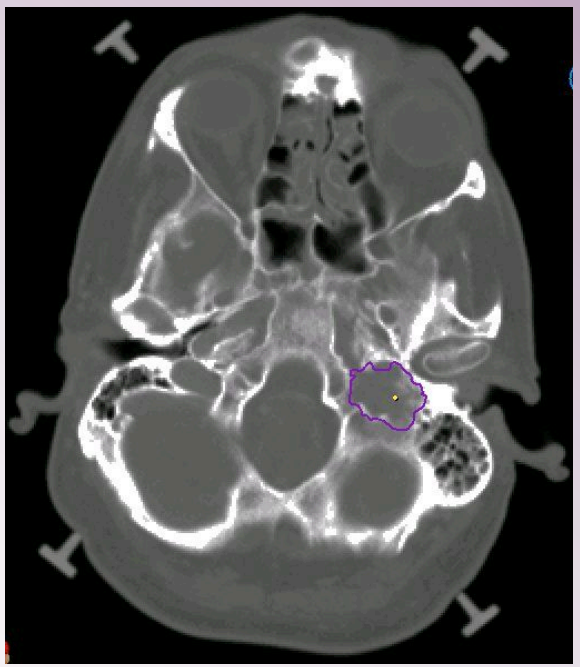
GE Discovery VH Integrated Hybrid SPECT-PET/CT System

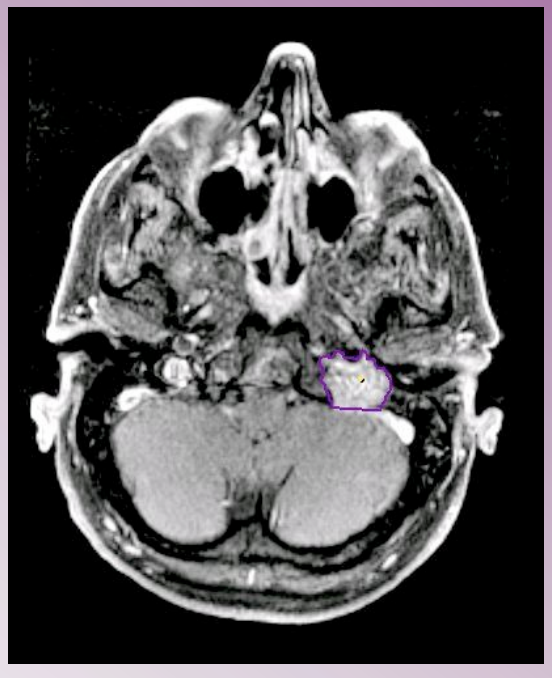
Duel-head PET & SPECT camera
1”(25.4mm) thick Nal Crystal
Energy Range 40 – 520keV

10mm slice CT “low-dose” scanner
Image FOV 450mm

wbrc the **william buckland** radiotherapy centre

Radiotherapy Treatment Planning





wb rc

the **william buckland** radiotherapy centre

SPECT in Radiotherapy

LUNG CANCER

SPECT Lung Perfusion scans provide in 3-D the functionality of lung tissue, and may provide feedback to the RT planner as to where to place treatment beams to avoid this high perfusion zone.

A study from the Duke University showed that SPECT was useful in detecting 48% of patients with hypoperfused regions. In 11% of patients, the RT beams were moved to avoid highly functional lung tissue.

BRAIN

Hamilton et al, from the University of Chicago have used functional areas of the brain, provided by SPECT to design treatments that spare 'functional' regions in the treatment of brain tumors.

Iodine-123-alpha-methyl-L-tyrrosine (IMT) is an amino acid that has been shown to be actively accumulated in brain tumors and not in normal brain tissue. IMT uptake in the brain can be visualised by SPECT.

Grosu et al, Munich, 30 patients studied with non-resected glioma, found that 23% had IMT tumor uptake 2cm outside the GTV volume defined by a T2 weighted MRI. Suggests that IMT-SPECT imaging may result in target modifications compared to when planned with MRI alone.

Phantom Tests

Test the connectivity of the NM and RT Planning system

File format, data transfer and RT system worth

Test the RT image fusion, Co-registration status

Assess the localisation methods

Phantom Tests

RANDO Head Phantom

Phantom Tests

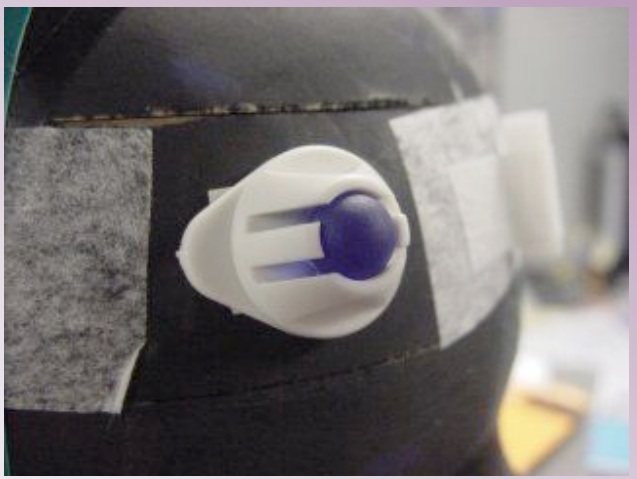
Localisation

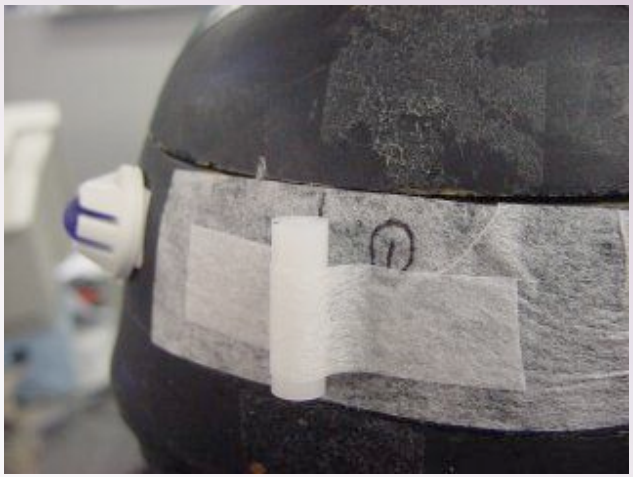
wb rc

the **william buckland** radiotherapy centre

Phantom Tests

Localisation



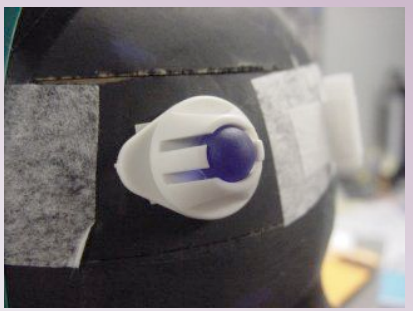


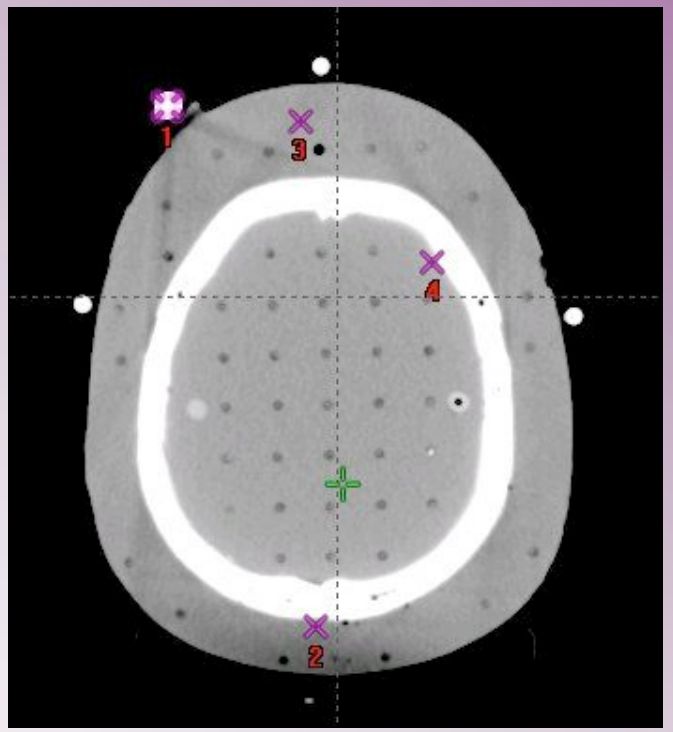
wb rc

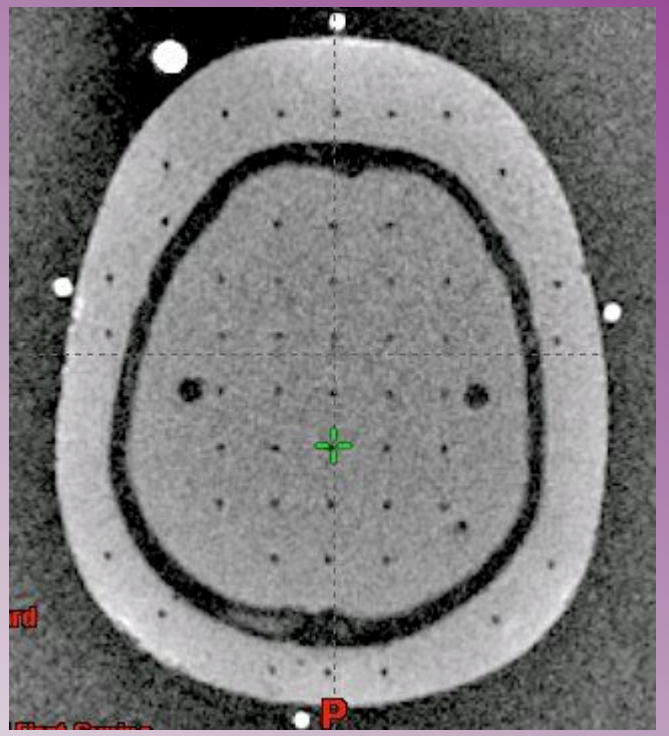
the **william buckland** radiotherapy centre

Phantom Tests

Localisation





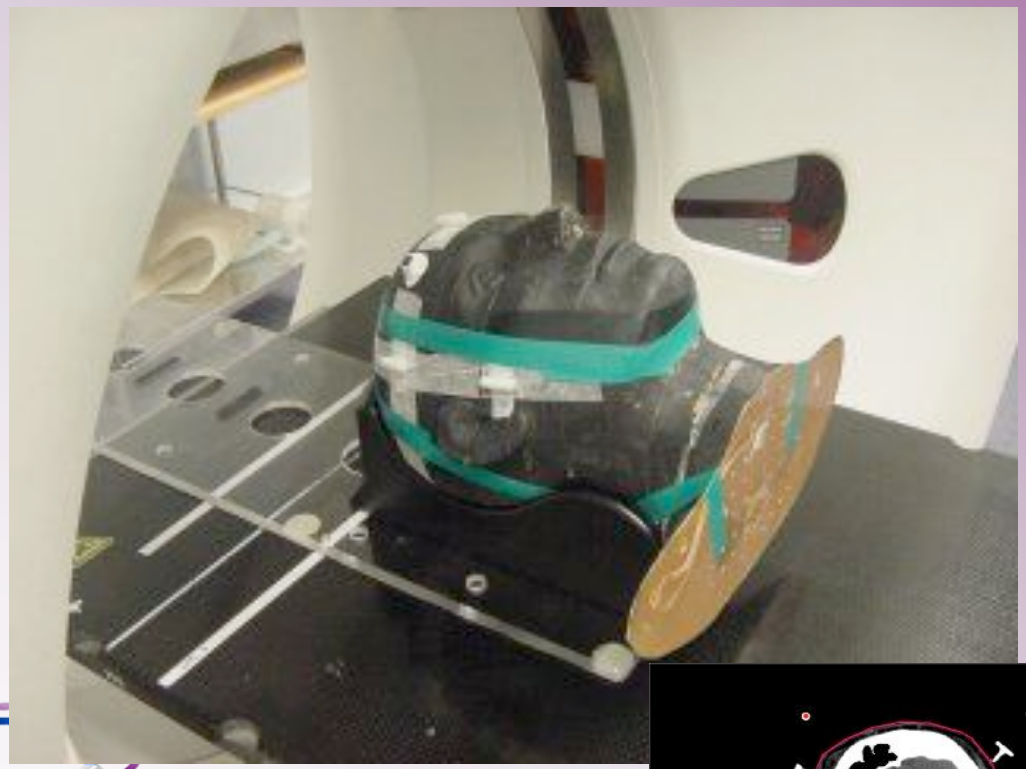


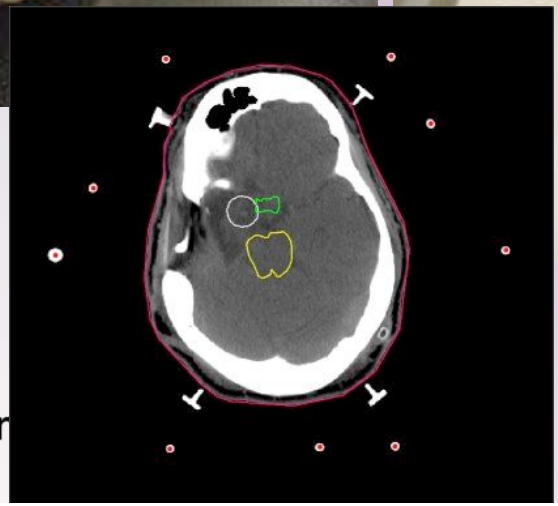
Phantom Tests

SPECT / CT Scan

Phantom Tests

Radiotherapy CT Scan





wb rc

the william bucklan

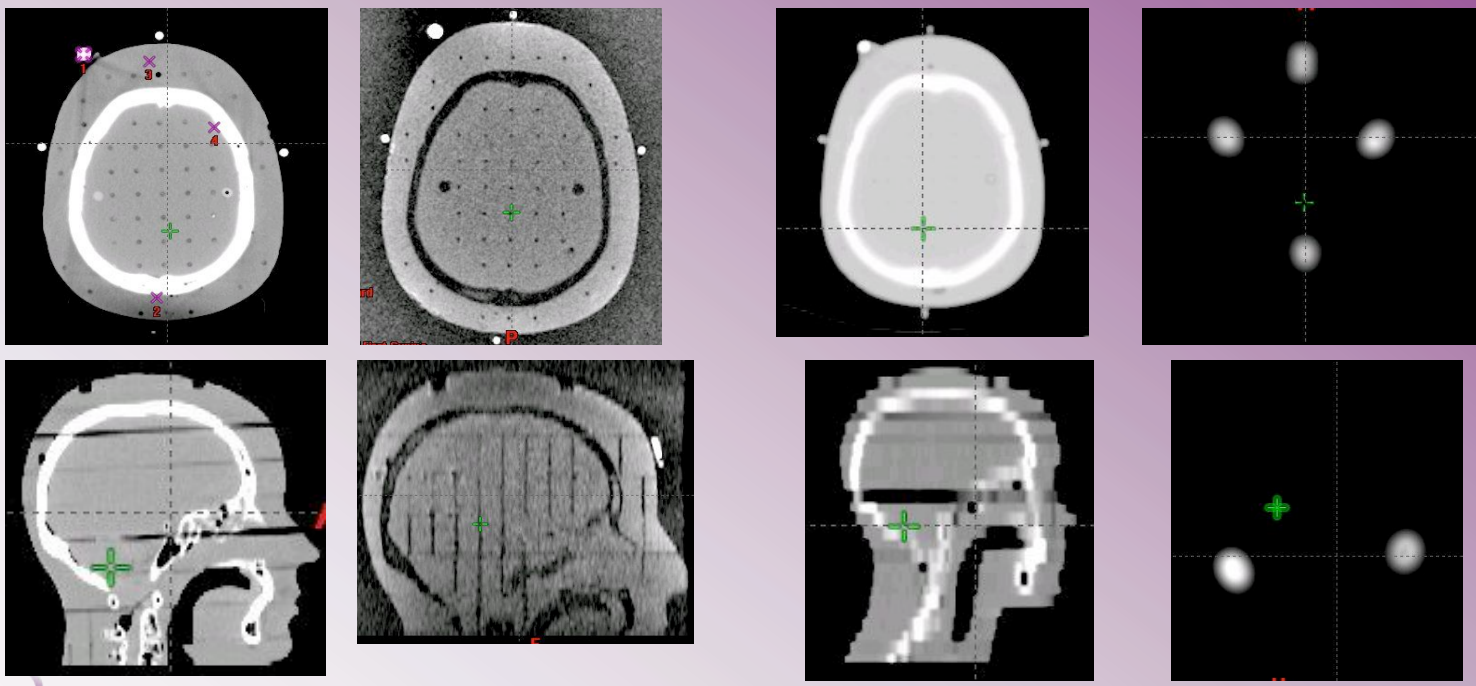
Phantom Tests

wb rc

the **william buckland** radiotherapy centre

Phantom Tests

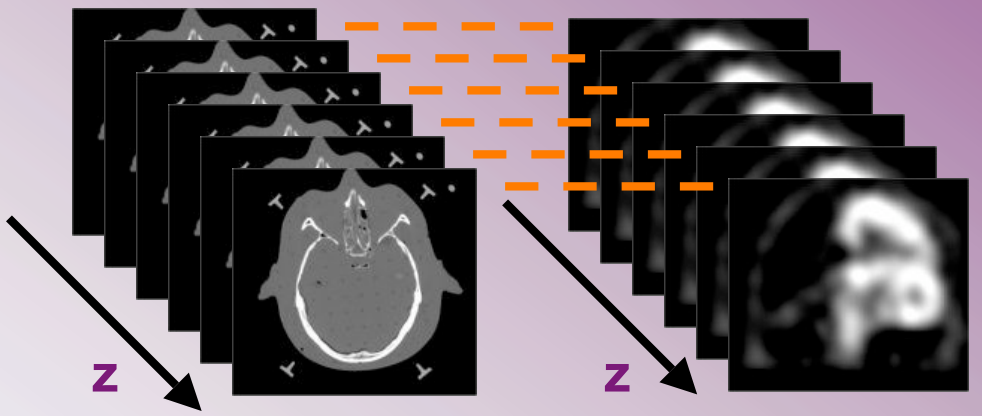
Image Sets

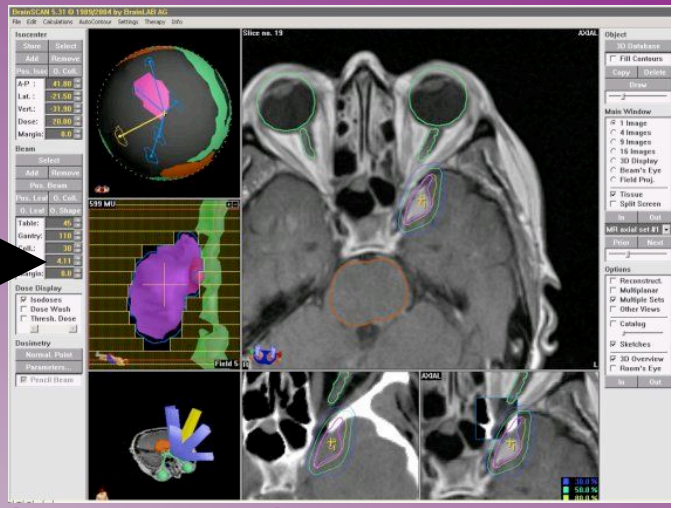


wb rc

the **william buckland** radiotherapy centre

Co-registered Data Sets





Re-sampled CT axial ---------- SPECT data set (128 slices)

Slice to slice equivalence.

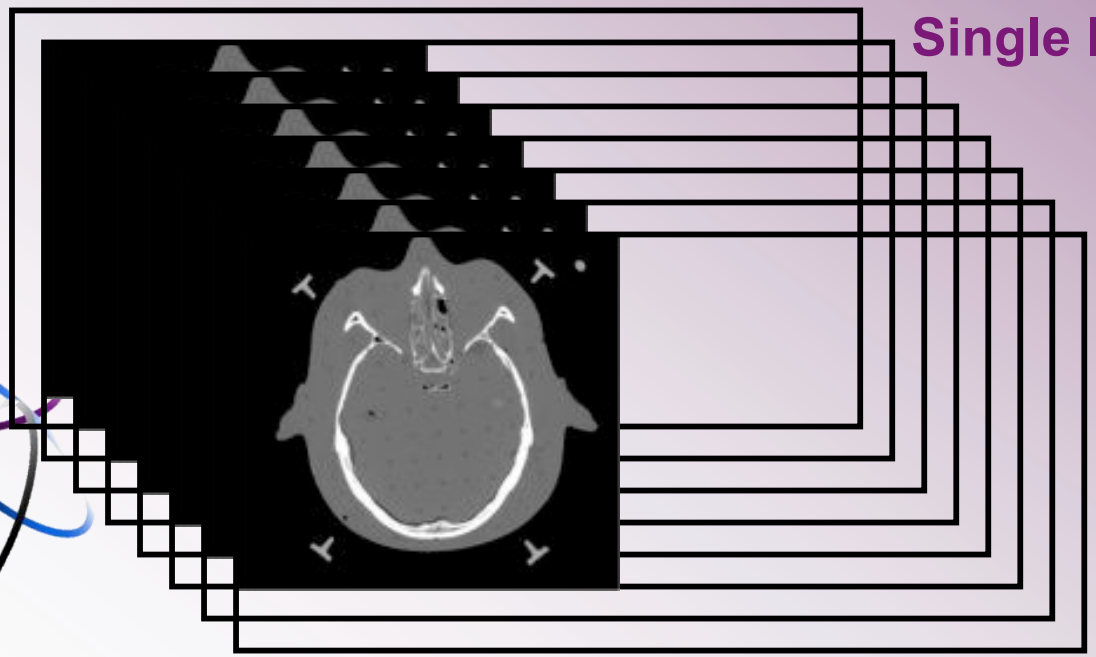
z positions match.

wb rc

the **william buckland** radiotherapy centre

Data Formats

Multi-Frame Image File



Single Image File

DICOM

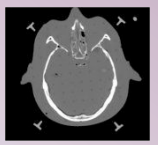
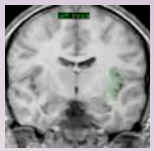
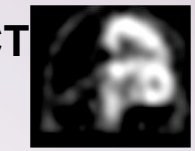
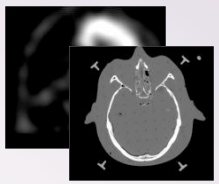
Vendor Specific

TIFF

wb rc

the **william buckland** radiotherapy centre

RT Planning System Image Import

CT		Axial, No Gantry Tilt	DICOM, Vendor Specific(FIlter)
MR		Axial, Cor., Sag.,	DICOM, Vendor Specific(FIlter)
SPECT PET		Axial, Cor., Sag.,	DICOM + Function Image Support (Multi-Frame)
Co Reg.		Axial	DICOM + (?)

Share DICOM origin ?

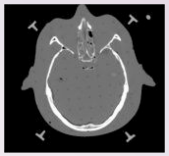
wb rc the william buckland radiotherapy centre

RT Image Import Work-around

Convert the multi-frame single image SPECT data sets into multiple single CT image files

Unique Identifier(UID) – Service-Object Pair Class (SOP Class)

UID 1.2.840.10008.5.1.4.1.1.20



UID 1.2.840.10008.5.1.4.1.1.2

Extreme caution:

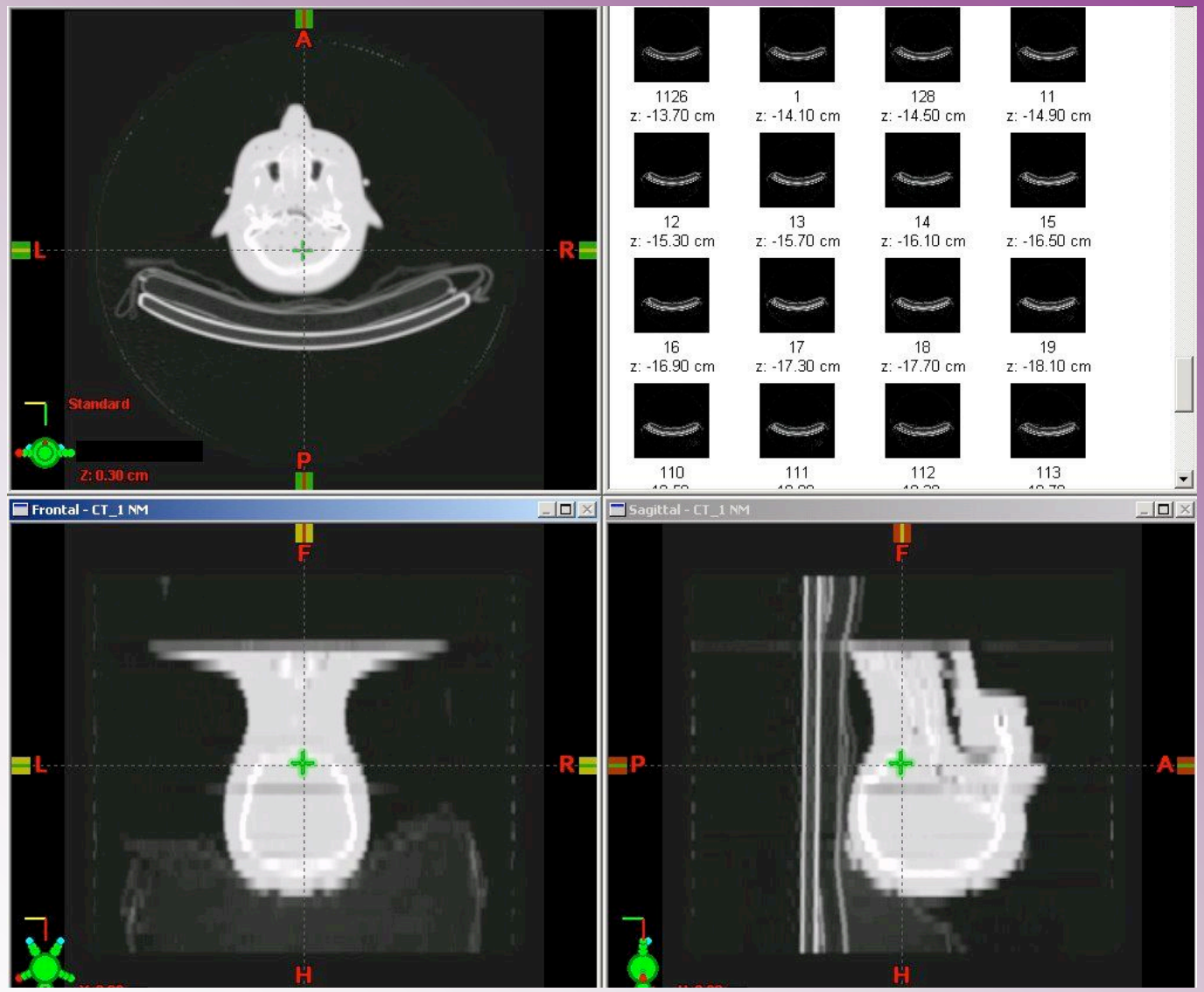
- **Ensure Image orientation is maintained**
- **Pixel scaling is not compromised**
- **Grey scale levels are not re-sampled**
- **Patient information is not lost or switched**

http://www.rsna.org/Technology/DICOM/intro/

wb rc

the **william buckland** radiotherapy centre

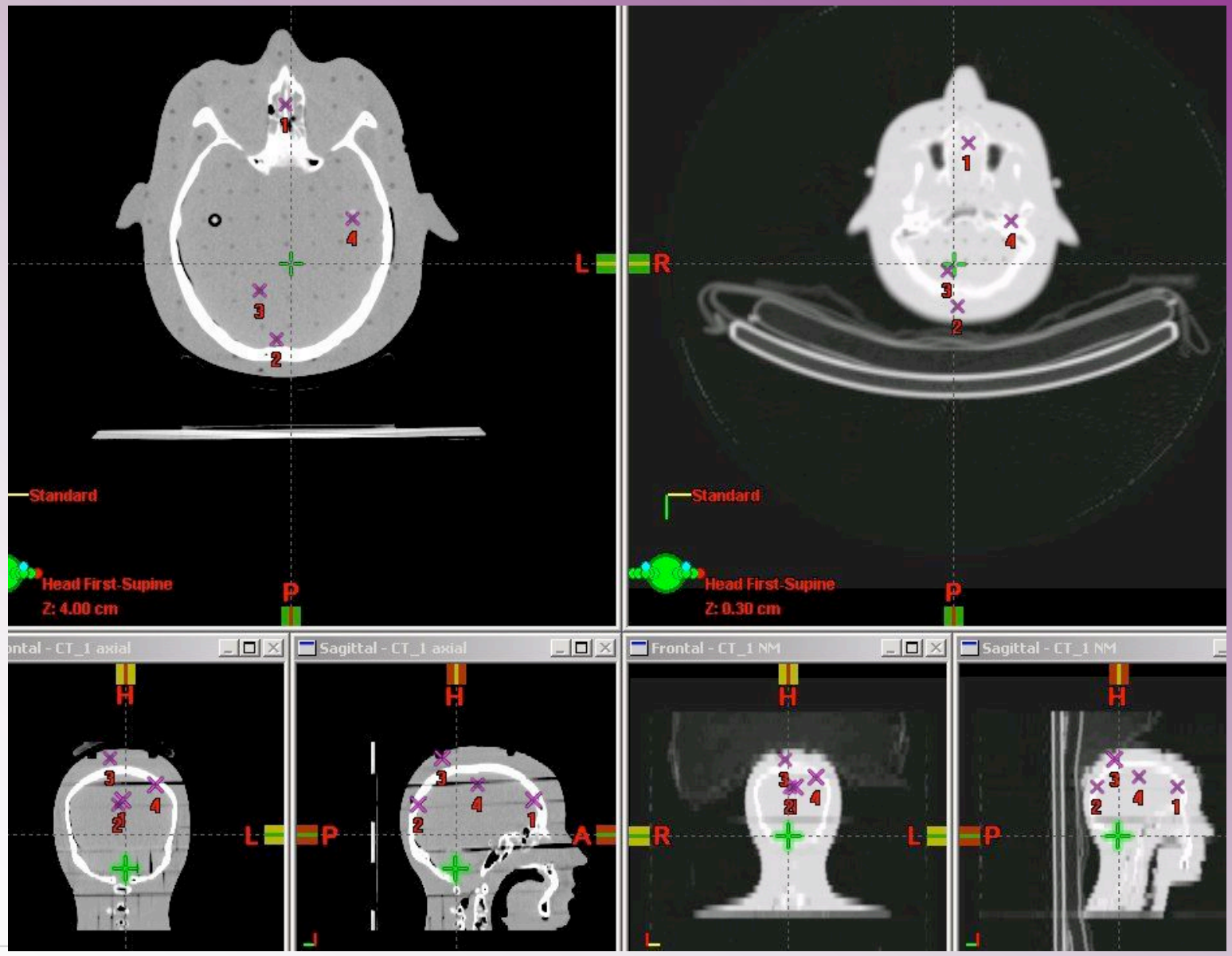
Planning System



wb rc

the **william buckland** radiotherapy centre

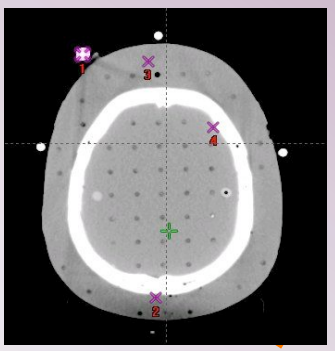
Planning System



wb rc

Planning System

Proposed alignment method of co-registered data sets

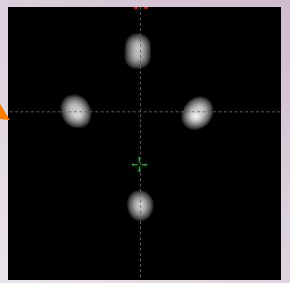


Fuse

Anatomical pairs

Fiducial Markers

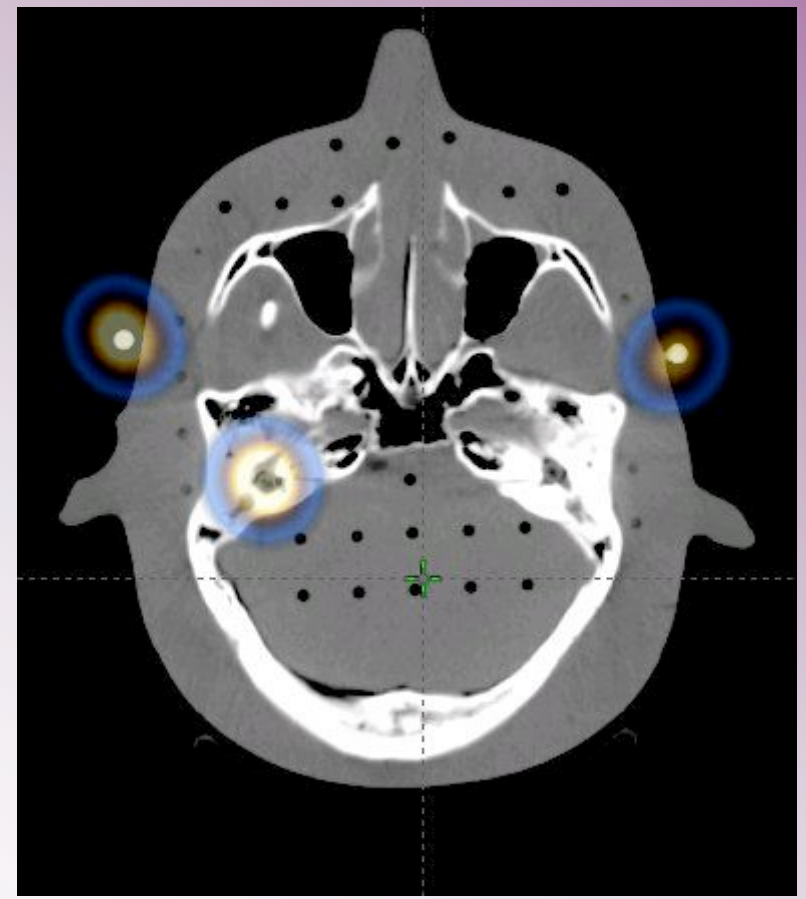
Transform Matrix

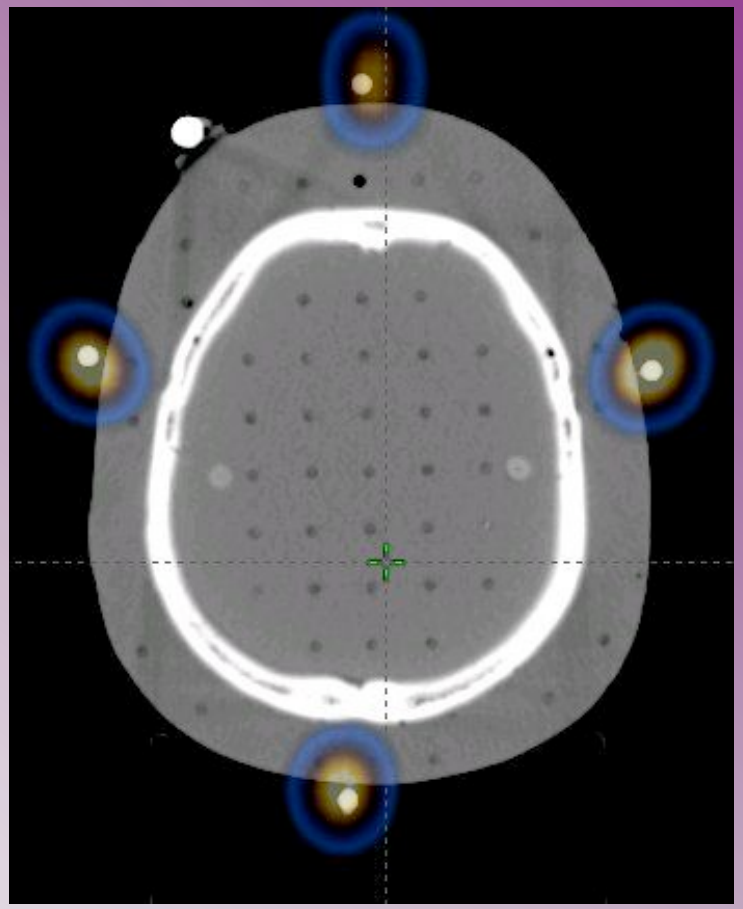


wb rc

the **william buckland** radiotherapy centre

Blended Result

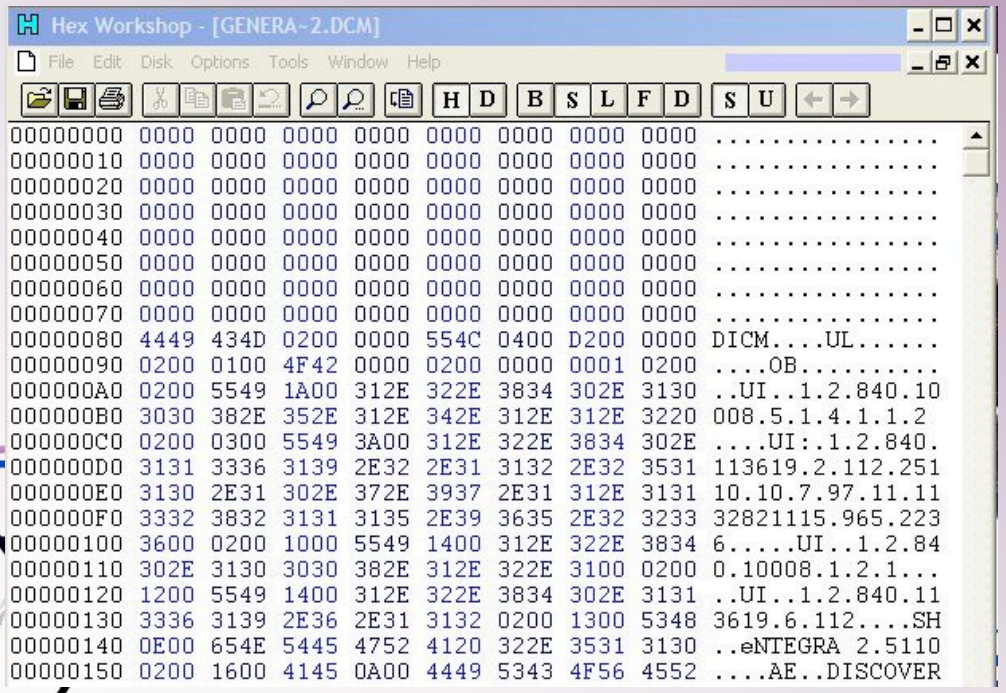


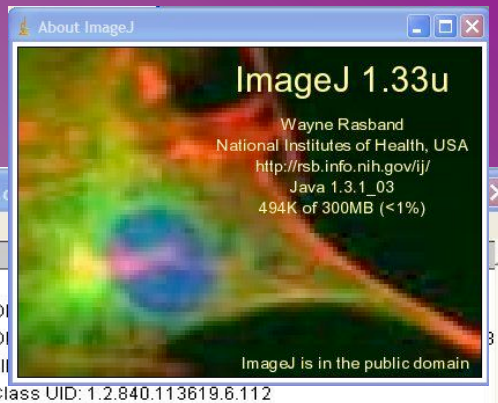


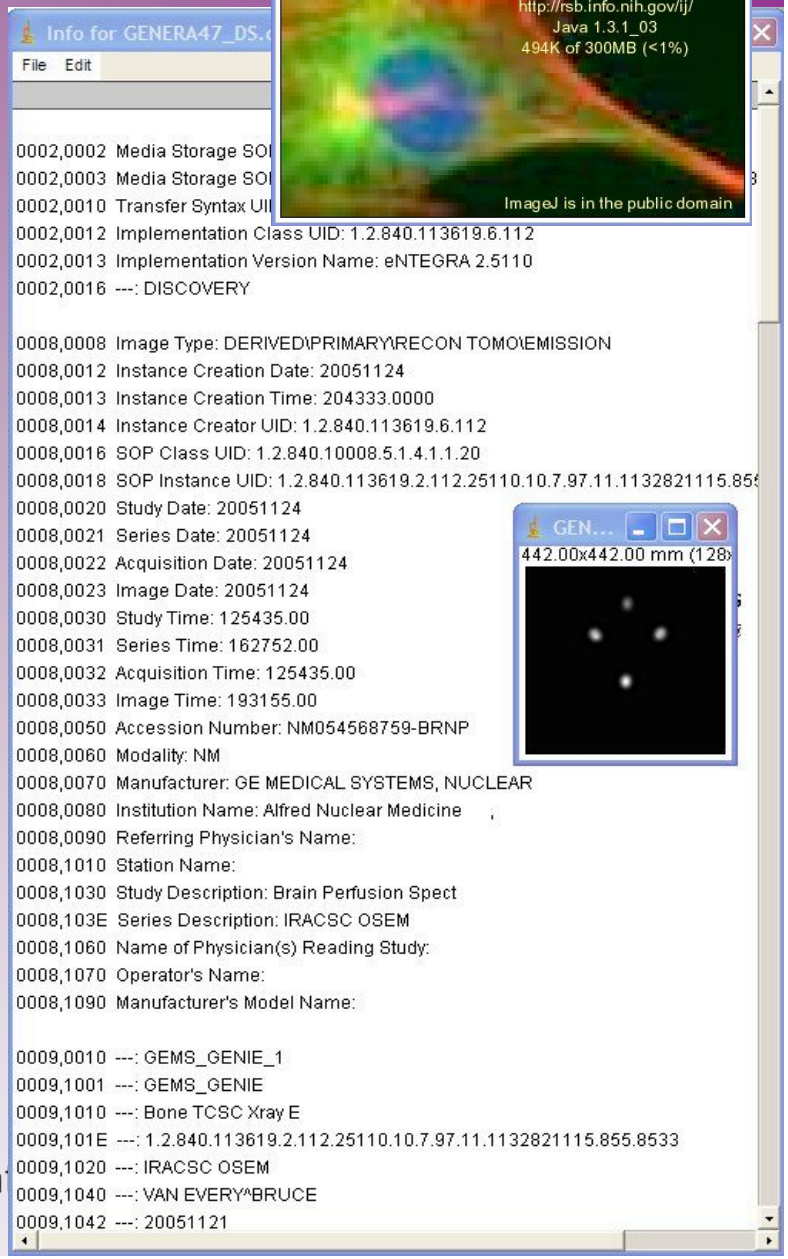
wb rc

the **william buckland** radiotherapy centre

DICOM Tools







wbrc the **william buckland** radiotherapy cen

SPECT Treatment

PATIENT :

1998 presented with severe epilepsy

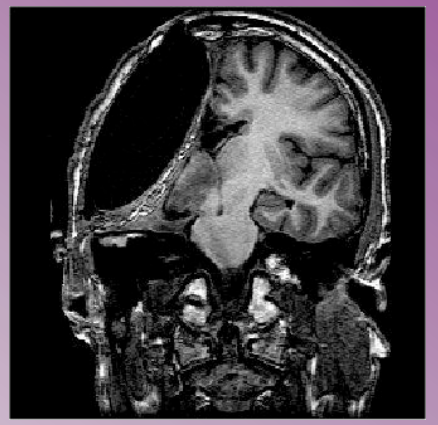
Front right hemispherectomy, cavity filled with prosthesis

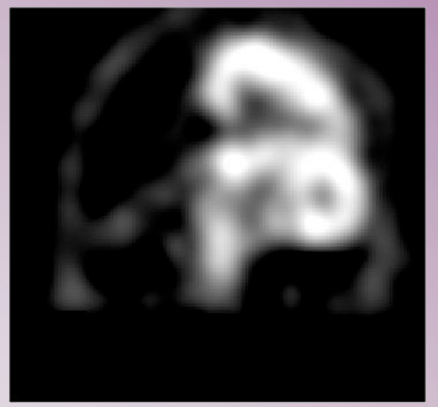
5 to 10 events per day (vague & slow)

left arm seizure, no loss of consciousness

Not living independently

Referral from Royal Melb. Hosp., provided co-registered MRI & SPECT data

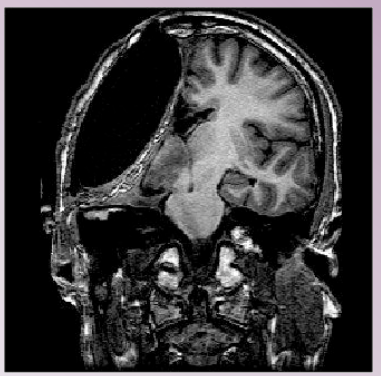


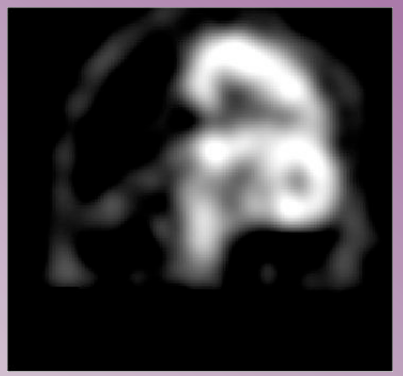


wb rc

the **william buckland** radiotherapy centre

Patient Data Sets





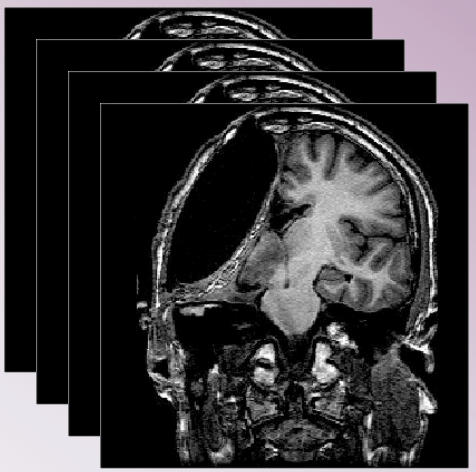
Co-registered data sets in a vendor specific format.

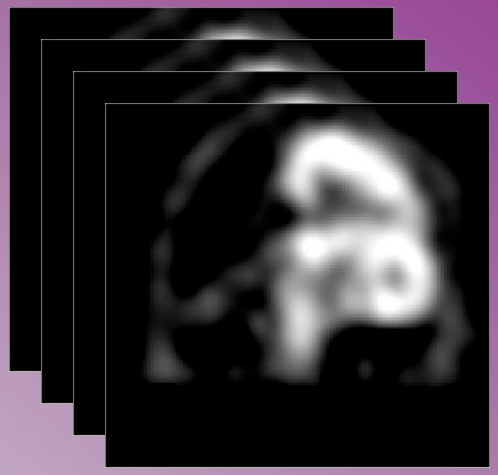
Re-sampled & formatted into DICOM Coronal and Axial.

Trevor Ackerly – PMCI, Melbourne.

wbrc the **william buckland** radiotherapy centre

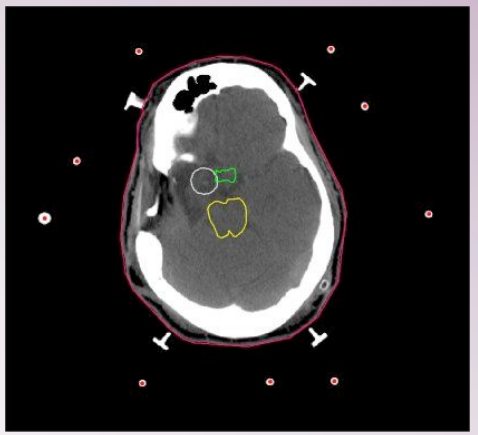
Patient Data Sets





Fusion

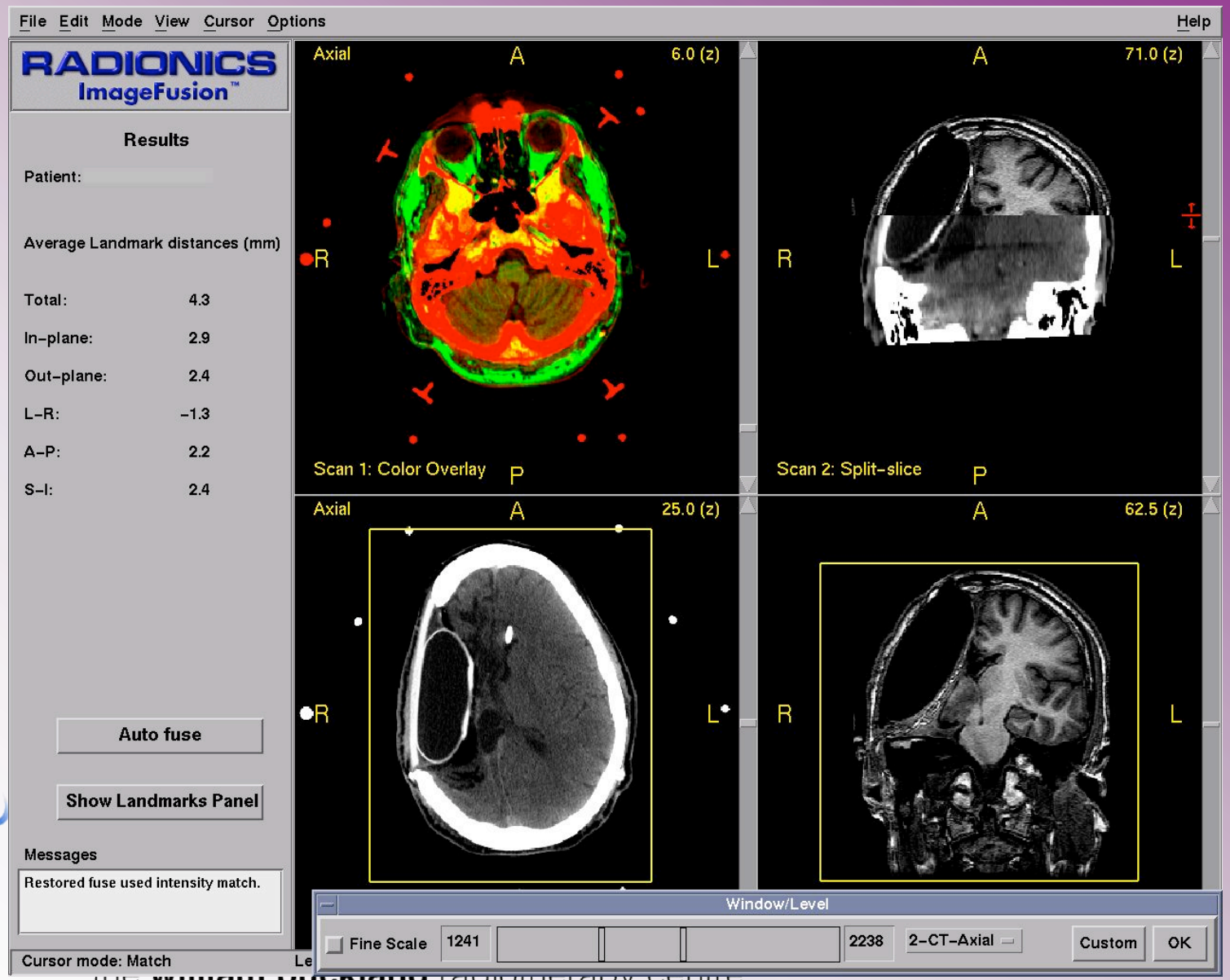
Fusion



wb rc

the **william buckland** radiotherapy centre

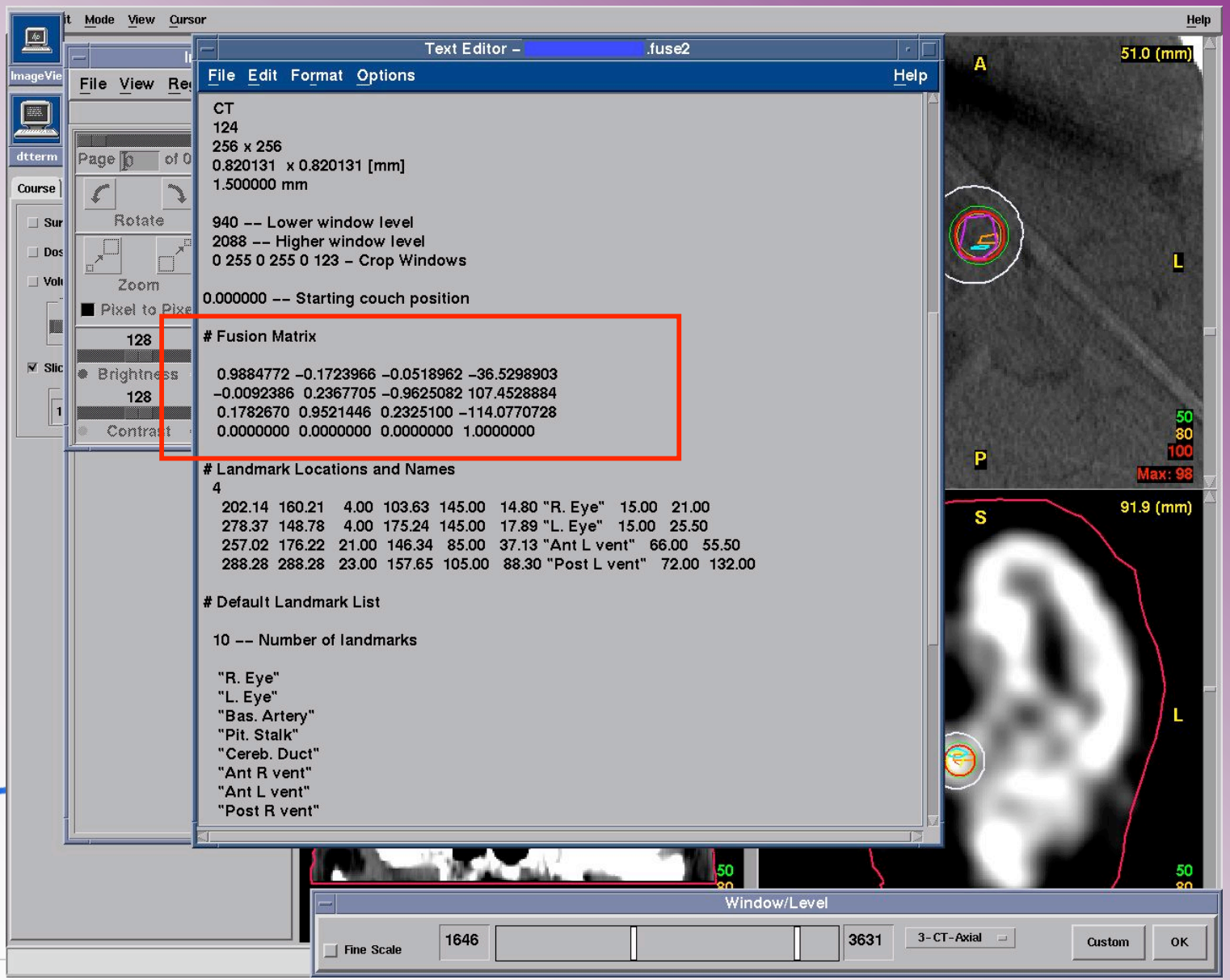
CT – MR Fusion



wb rc

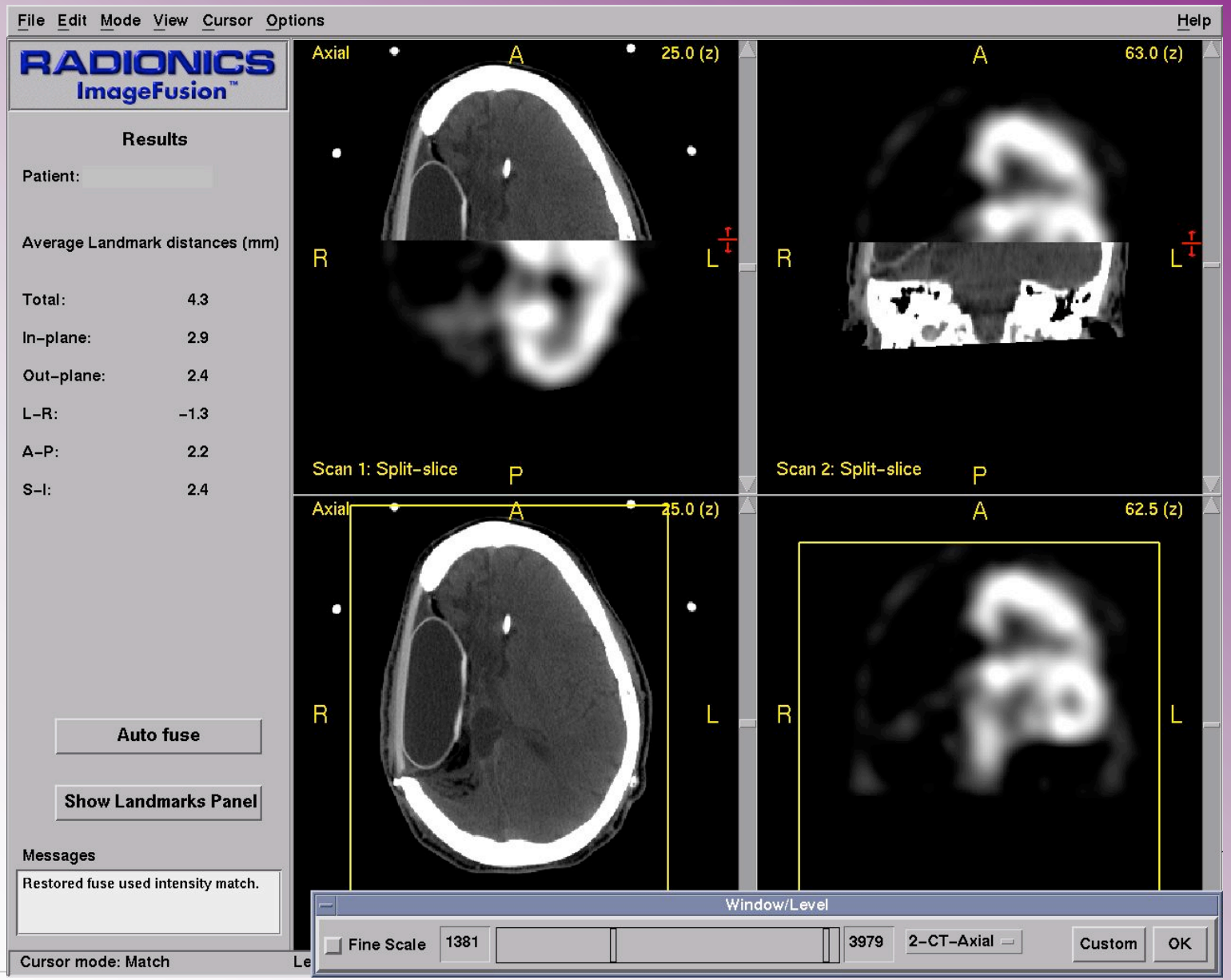
the William Buckland radiotherapy centre

Transform Matrix



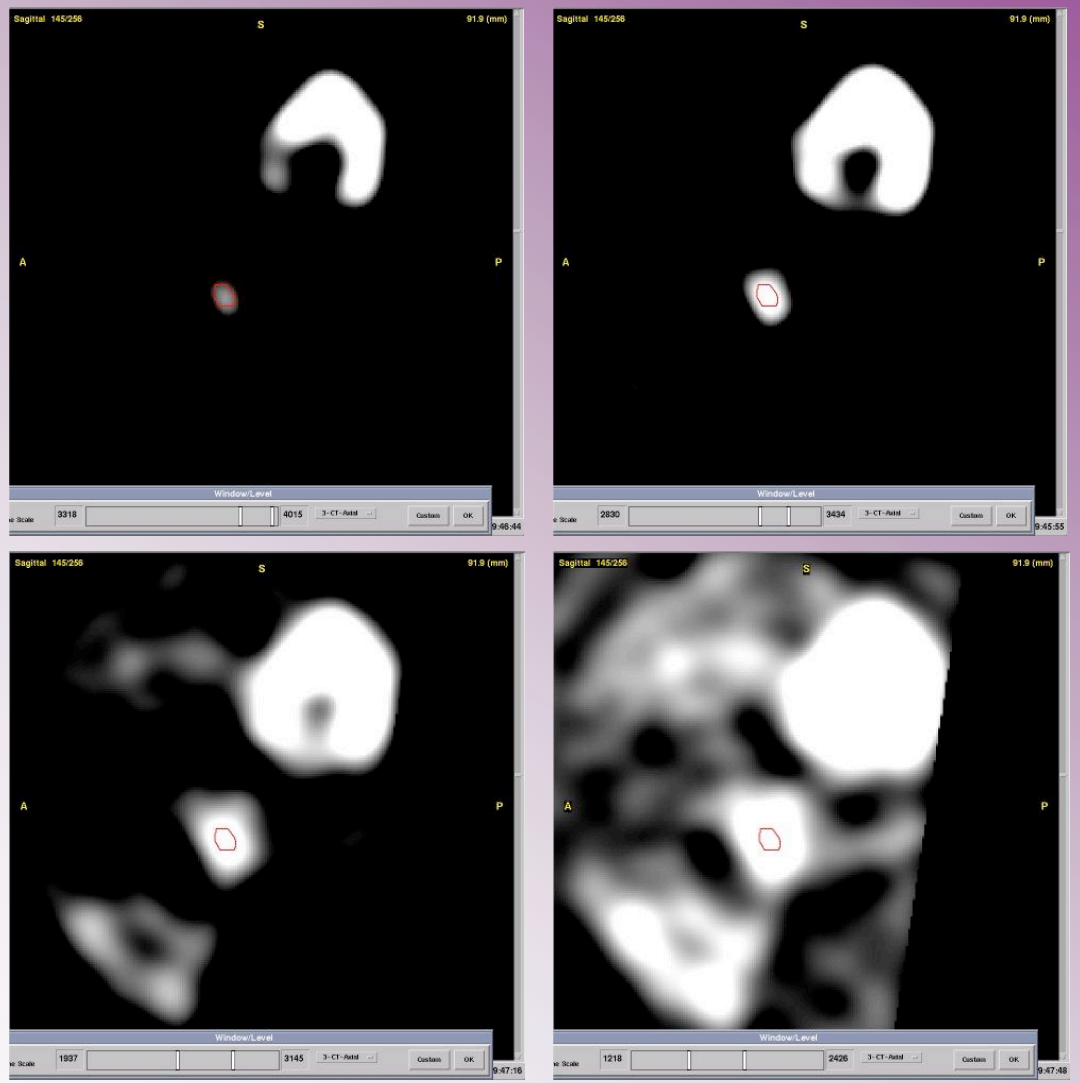
wbrc

CT – SPECT Fusion



wb rc

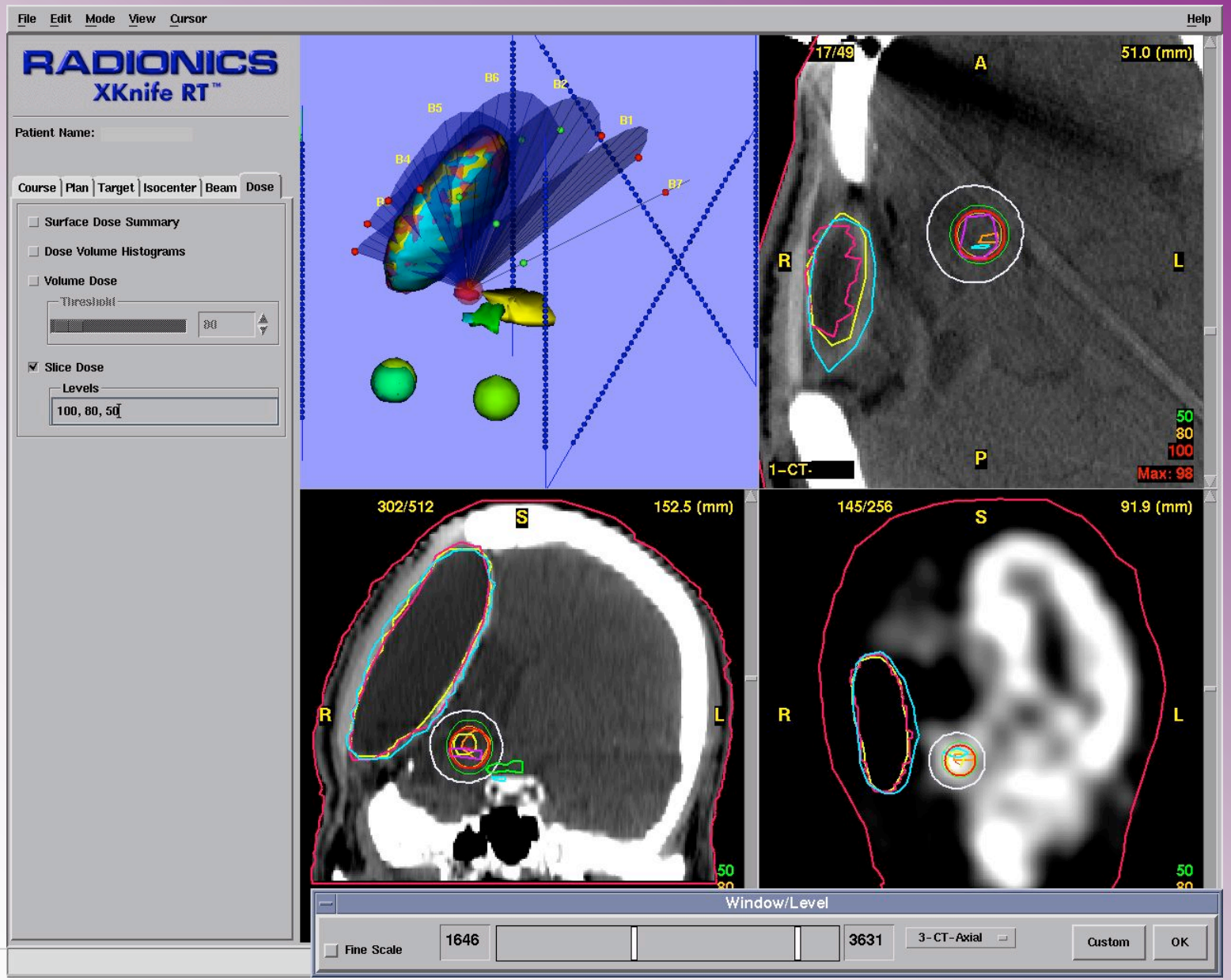
Target Definition : How to define target?



wb rc

the **william buckland** radiotherapy centre

Treatment Planning



wb rc

Treatment Planning

TREATMENT :

June 2003

20Gy to 80% isodose

1.5cm circular collimator

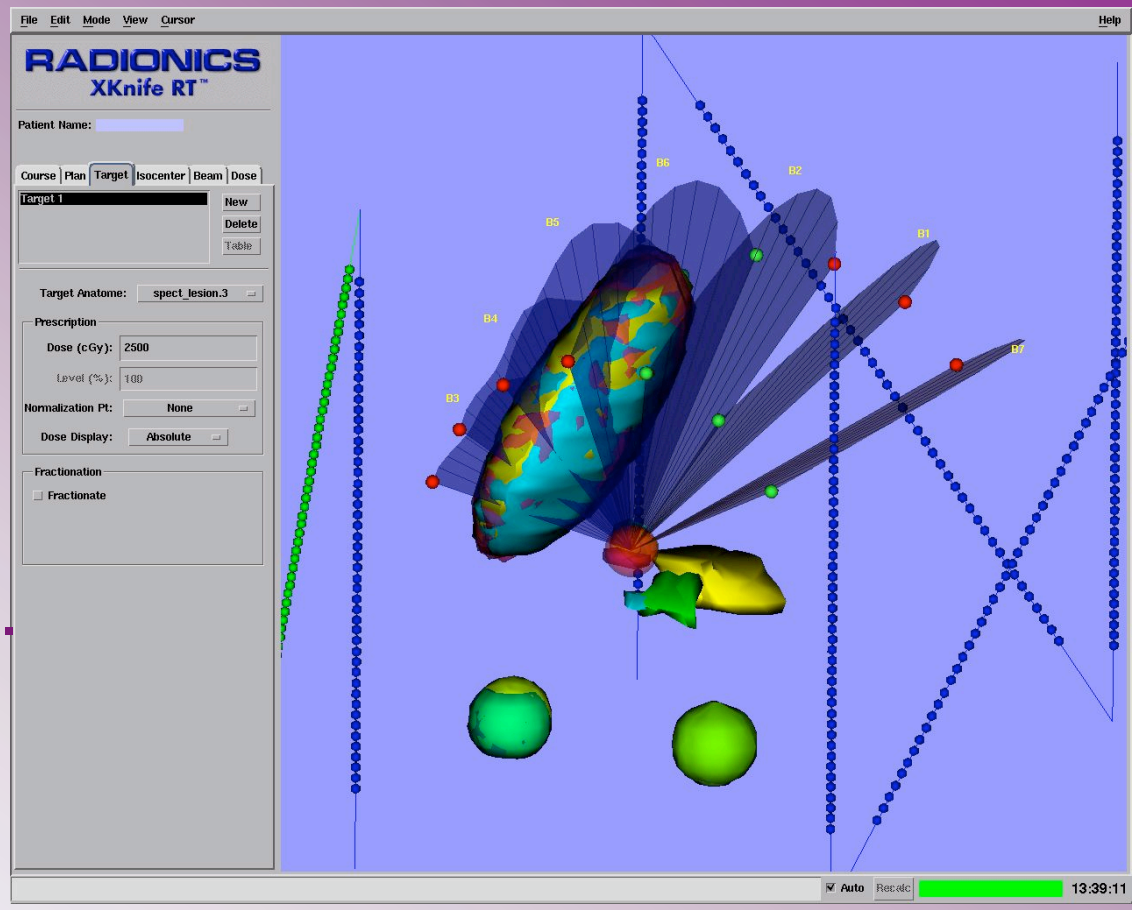
7 Arc Beams

1 to 3 events per day

less intense seizures

reduced anit-epileptic med.

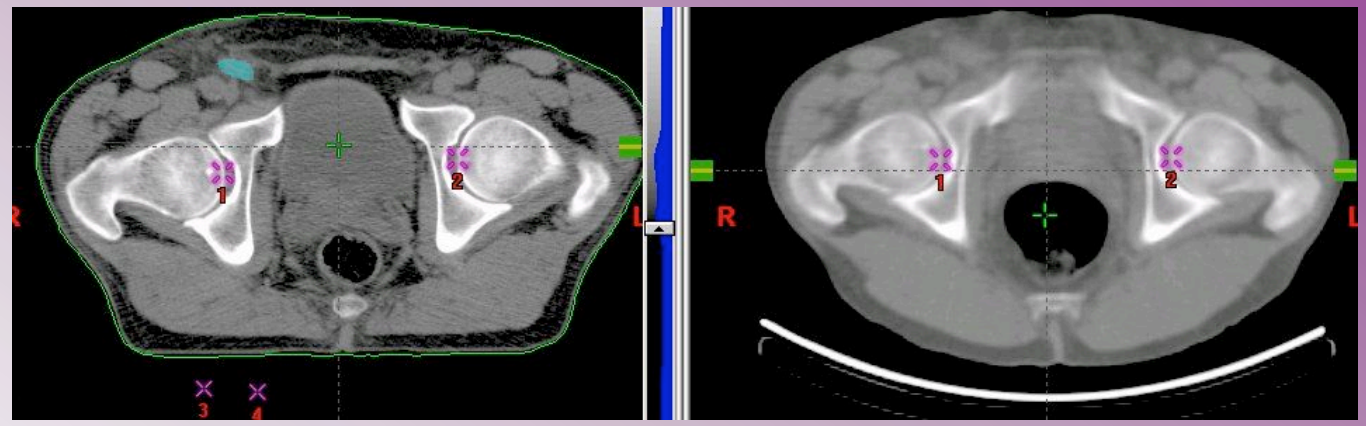
Now living on his own

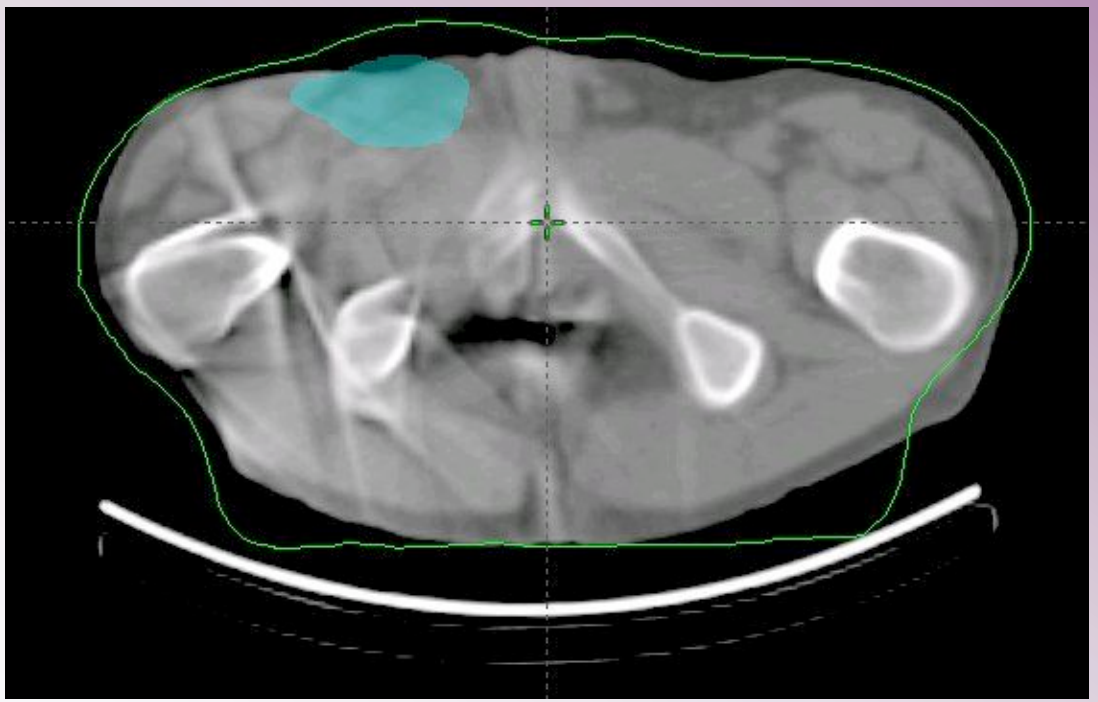


wb rc

the **william buckland** radiotherapy centre

Patient Setup

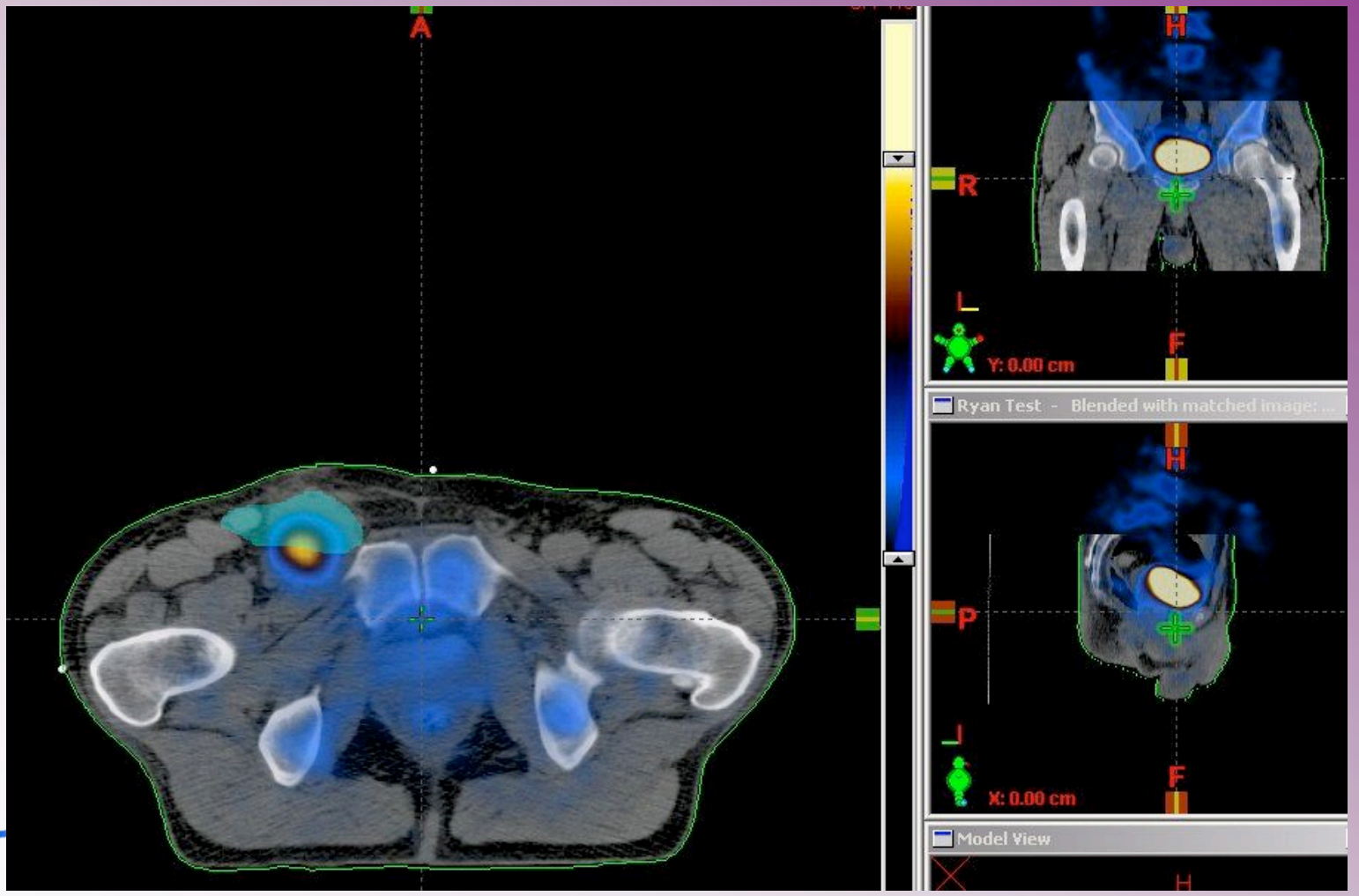




wb rc

the **william buckland** radiotherapy centre

Patient Setup



wb rc

the **william buckland** radiotherapy centre

Future

Overcome the data transfer issues with the external beam planning system.

Simplify the data conversion process :

- **Dedicated Workstation**
- **In-house software**
- **Vendor Specific Import filter**

Integrate PET (SPECT) data into regular virtual simulation sessions.

Points

Co-registered data

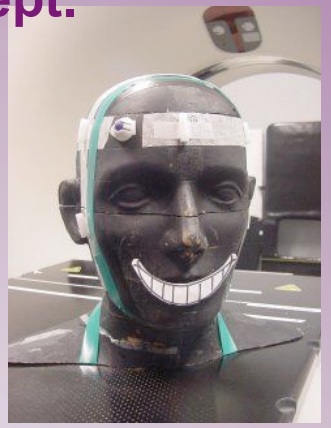
transfer and incorporation into RT planning systems

Window Width/Level determination for target definition in RT planning systems

Localisation systems used and patient setup

Acknowledgments:

Mr Bruce Van Every, Physicist, The Alfred NM Dept.



wb rc

the **william buckland** radiotherapy centre