Virtual Simulation and Verification in Total Body Irradiation using ACQSIM and an EPID with Extended Image Detection Unit

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- 2 Varian Clinac 2300C/D + 1 Clinac 600C
  - 2 static + 1 dynamic MLC
  - Enhanced Dynamic Wedge
  - Varis R&V
  - Portal Vision (Mark 2)
- Picker CT PQ5000
  - 2 VoxelQ & AcQSim
- 2 CadPlan TPS Servers

Objectives

- Overview: Treatment Planning and Verification with AcQSim and CadPlan
- TBI protocol at the University of Ulm
- TBI treatment facility
- EPID with extended Image Detection Unit for TBI
- Integration in VARiS Vision
- TBI Treatment Planning with AcQSim
- TBI Delivery and Verification

3D Treatment Planning and Verification with CadPlan and AcQSim (Step 1)
CadPlan Dose Optimization
BEV for adjustment of MLC

CadPlan Dose Calculation
axial
coronal
sagittal
3D

3D Treatment Planning and Verification
with CadPlan and AcQSim (Step 2)

Digitally Reconstructed Radiographs (DRR)

Digitally Composited Radiographs (DCR)

3D Treatment Planning and Verification
with CadPlan and AcQSim (Step 3)
Isocenter Verification with PortalVision

Digitally Reconstructed Radiograph

Electronic Portal Image

Multimodality Image Fusion

MRT Image

CT Image

Total CNS Irradiation

Sagittal Reconstruction

DRR

Interim Summary

- AcQSim is an essential tool for many clinical situations
- Virtual Simulation provides more information
- CadPlan can be used more efficiently

Virtual Simulation
- (adjustment of beams)

Verification
- (import beams from TPS)

Provision of reference DRR

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Total Body Irradiation

University of Ulm

- Conditioning patients with leukemia for BMT
- Total Dose: 12 Gy
- 6 Sessions within 3 days
- Lung Dose: 10 Gy

AML and ALL: Radio-Immuno Therapy (Rh-188):
- Kidney Dose: 10 Gy (RIT) + 7 Gy (TBI)
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**Total Body Irradiation**

**Machine and Treatment Room Layout**

- ap beam: prone position
- pa beam: supine position
- SSD = 5.10 m

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**Portal Vision XL:**

**An EPID with Extended Image Detection Unit**

- 2 x 2 standard PortalVision IDUs
- Sensitive Area: 65 x 65 cm²
- 512 x 512 Electrodes = 262144 pixels
- Spatial Resolution: 1.27 x 1.27 mm²
- Build Up Plates Optimized for 6 MV

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**Portal Vision XL:**

**An EPID with Extended Image Detection Unit**

- Lead shielding for electronic parts
**Portal Vision XL:**
An EPID with Extended Image Detection Unit

- Fully closed housing
- mounted on rails

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**VARiS Vision Network Layout**

**PortalVisionXL User Interface**

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Lung tissue density

\[ \rho_{\text{Lung}} [\text{g/cm}^3] = 1 + \frac{\text{HU}}{1000} \quad \text{(for } \text{HU} < 0) \]
Clinac ready for Beam On

- Gantry rotated
- Couch retracted
- TBI Accessory
- TBI Flatness Filter

Online Matching

Digitally Reconstructed Radiograph

Electronic Portal Image

Online Matching (cont’d)

Digitally Reconstructed Radiograph

Electronic Portal Image

Final Summary and Conclusion

- Extended SSD beam setups and improved localization
- AcQSim is smoothly integrated to VarisVision network
- EPID image acquisition time of approximately 2 seconds
- Image quality suitable for verification of shielding blocks
- Monitoring of patient during the treatment

Combination of AcQSim and EPID is a good investment for fast and precise TBI

The city of Ulm and the river Danube