A Standardized Approach to Patient Positioning for Radiation Therapy Treatments using DICOM

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Vice-Chair DICOM WG-07 “Radiotherapy”
Introduction

• **Basic problem in radiotherapy:**
  Where is the patient with respect to the treatment delivery device?

• **Basic solution:**
  Use some kind of patient landmark and align this with a reference from the planning data.
Required Steps

• Get planning data
• Acquire current patient reference
• Register against ideal reference
• Apply difference to current position
• If required, repeat to verify
• Perform post-treatment review
Real-World Set-Up

- Peer-to-peer Communication
- Proprietary Protocols
- Weak references to DICOM RT Plans
- No way to report correction
- Lots of error-prone user interaction
  - Assigning patients to procedures
  - Selecting treatment locations for verification
Ideal Set-Up

Treatment Management System (TMS)

Worklist Server

Treatment Session Manager (TSM)

Treatment Delivery Device (TDD)

Patient Positioning Device (PPD)

Patient Position Acquisition System (PPAS)

Patient Position Registration System (PPRS)

Patient Position Monitoring System (PPMS)
Definition of DICOM IODs based on

- Supplement 96 „Unified Worklist and Procedure Step“
- Supplement 147 „Second Generation Radiotherapy“

→ Supplement 160 „Positioning and Workflow“
Challenges

Not only a multi-vendor environment, but also multi-technique:

• kV/MV imaging (planar, volumetric)
• Ultrasound imaging
• Surface scanning (visible light, laser)
• Marker tracking (visible light, infra-red, radio-frequency, radioactive)
Reference Acquisition

- Patient Position Acquisition Geometry IOD
- Patient Position Acquisition Instruction IOD

Result:
- image objects (CT, US, ...)
- Surface Segmentation IOD
- Optical Surface Scanner IOD
- Fiducials IOD
Registration

• Registration Instruction IOD

Result:
• Registration IOD
Position Modification

• Patient Position Correction Instruction IOD
• Patient Position Modification Instruction IOD

Result:
• Patient Position Modification Result IOD
Monitoring

• Patient Position Monitoring Instruction IOD

Result:
• Patient Position Monitoring Result IOD
• Waveform IOD
Cooperation

Joint Enterprise by:

- DICOM Working Group 07 „Radiotherapy“ – Sub-Group „Positioning and Workflow“
- IHE Radiation Oncology Technical Committee – Sub-Group „Discrete Positioning and Delivery Workflow“
References

http://dicom.nema.org/

http://www.IHE.net/

• DICOM Supplement 96 “Unified Worklist and Procedure Step”
• DICOM Supplement 147 “2\textsuperscript{nd} Generation Radiation Therapy”
• DICOM Supplement 160 “Positioning & Workflow”
• IHE-RO Supplement “Discrete Positioning and Delivery Workflow”
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Thank you for your attention!