Working on MRI Simulator for MP who are **NOT** trained in MRI

Oana Craciunescu, PhD, DABR

Department of Radiation Oncology, Duke University Medical Center, Durham, NC 27710

SAM Session: Technical and Professional Preparations for Medical Physicists in the Upcoming MRgRT Era

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Background | What does "trained in MRI" mean?

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Background | What does "trained in MRI" mean?

Officially

- 1. US – ABR Certification in Diagnostic Medical Physics
- 2. Canada – CCPM Certification

- Both these certifications now require CAMPEP graduate and residency programs

- https://www.theabr.org/medical-physics/initial-certification
- http://www.comp-ocpm.ca/english/career-education/career-resources/certification.html

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CAMPEP | 2012/2014 → ABR Requirement

- Graduate Programs
- Residencies

EDUCATION

WILEY

Navigating the medical physics education and training landscape

Brian Loughery[1] | George Starkschall[2] | Kristi Hendrickson[3] | Joann Prisciandaro[4] | Brenda Clark[5] | Gary Fullerton[6] | Geoffrey Ibbott[7] | Edward Jackson[1] | Jay Burmeister[1]

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Grad. Prog. (TG 197) | RT Track

- 2.1 Core Topics, 2.2 Imaging Science

2.2.5 Magnetic Resonance Imaging

The basic principles of magnetic resonance imaging (MRI) physics are discussed in this section. The emphasis is not on the more advanced MRI techniques, but on the development of a solid understanding of the basics of image formation and spatial accuracy, image contrast (for the most commonly utilized clinical pulse sequences), primary clinical applications, and safety. The common uses and limitations of MRI as a tool for diagnosis and image-guided therapy should be discussed. Measurements of image quality, quality assurance, accreditation, and regulations should be addressed. Brief introductory material is provided on more advanced techniques.

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Grad. Prog. (TG 197) | DI Track

- 2.1 Core Topics, 2.2 Imaging Science + 3.2 Imaging Science 3.2.5 MRI) + Lab requirements
  - Basic Principles
  - Hardware
  - Basic Image Quality Issues
  - Basic Pulse Sequences
  - Artifacts and Methods of Reduction
  - Safety and Bioeffects
  - Quality Control

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Residency (TG 249) | RT Track – Duke MP Example

- 6 mo. imaging rotation that covers CT, US, PET-CT, **MRI**, simulator

MR Specific

- Operate and QA, participate in different scans for different patients, co-registrations
- More MRI SRS-specific under SRS/SBRT and Brachy rotations

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Residency (TG 249) | DI Track – Duke MP Example

- 3 months MRI rotation
- 1 Quality Improvement Project (40 hours)
- Didactic, mathematical and practical competences including:
  - NMR Physics, Magnetic Resonance Imaging, Artifacts
  - Clinical Safety, Equipment
  - Acceptance, Annual Quality Assurance,
  - Weekly Quality Control Evaluations

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Parenthesis|

- Majority of practicing clinical RT Physicist were trained in pre ABR/CAMPEP requirements ERA
- Many from CAMPEP accredited Graduate Programs, but not residencies
- Many from non-CAMPEP Graduate or residencies
- So the level of MRI training of an RT Physicist varies widely

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Question | So?

- Is a DI-trained MP needed for clinical implementation of MRI guided radiotherapy?
  - In-house
  - From a Radiology department or specialized imaging consulting group?

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Background | Questions

- What is MRI Simulation?
- Why is MRI Simulation needed or preferred?
- What are the challenges at implementation and in daily clinical use

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Background | What is an MRI Simulator?

- MRI simulation = acquiring high fidelity, high contrast resolution MR images to identify true disease extent and proximity to OAR for the purposes of RT Planning
- With
  - dedicated MRI scanners in RT departments
  - MRI scanners in other departments as shared resources.

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Background | Why an MRI Simulator?

June 22 – Sep 16, 2018, Frist Art Museum, Nashville TN

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Background | Why an MRI Simulator?

- Other known advantages:
  - "Simulator" → image in treatment position
  - If MR-planning, eliminate uncertainties CT/MRI co-registration
    - partial target miss → additional planning margins
    - OAR overdose (especially in pelvic targets); cranial *
  - Possibility for functional and physiological imaging
    - Help further with target delineation
    - Assessment of treatment response and adaptive planning
  - Real-time dynamic imaging for motion management (with no imaging dose) -> pediatric patients

* Ulin et al,

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Background | Challenges of working on MRI Simulator


Radiotherapy planning using MRI

- MR in treatment position
- Geometric accuracy of MR images (image distortion):
  - System-related
  - Patient related
- Image artifacts and their reduction
- Estimation of electron density
  - Bulk density assignment
  - Atlas based segmentation, Synthetic CT
- Treatment setup references (DRRs)
- Motion (from long data acquisitions)
- MR compatible tissue markers
- MR safety issues
- Unique challenges for MRI-based brachy

Need DI trained MP for MRgRT implementation?

PARALLEL OPPOSED EDITORIAL

WILEY

Are in-house diagnostic MR physicists necessary for clinical implementation of MRI guided radiotherapy?

Minsong Cao[1,2] | Kyle R Padgett[1,2] | Yi Rong[1]

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Need DI Trained MPs | PRO

- "Integrating MRI in RT flow is not so straightforward due to a number of **challenges** which call for strong cross-disciplinary collaboration between therapeutic and diagnostic medical physicists".
  - Equipment selection an site planning
  - Acceptance
  - QA
  - MR Safety
  - Training and education

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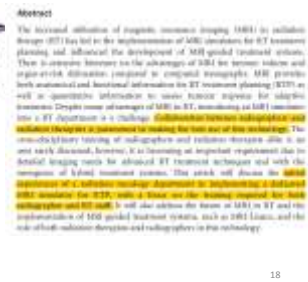
Collaboration | RT + DI

Journal of Medical Radiation Sciences

The integration of MRI in radiation therapy: collaboration of radiographers and radiation therapists

Conclusion



Abstract

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Conclusion

- For implementing MRgRT, if you are not ABR or CCMP certified in diagnostic imaging, the most prudent action is to:
  - Understand the challenges of using MRI in RT planning
  - Enlist the help of a highly trained MRI DI MP
  - Work with and get trained by MR manufacturer
- For daily support of a MRgRT program, non-MRI trained RT MP can be very effective if well trained and clear and detailed SOPs were setup at implementation:
  - AAPM TGs: upcoming TG 117, TG 303, TG 310
  - Attend educational sessions (AAPM, RSNA, MR in RT Symposium), courses offered by early adopters

Conclusion

- Apply the "Socratic Paradox": *"Nobody actually knows anything, but I actually know this thing, so I know something"* → ***So know when you need help!!!***

Acknowledgements

- Anna Rodrigues, Duke Rad Onc
- Zheng Chang, Duke Rad Onc
- Yang Sheng, Duke Rad Onc
- Justin Solomon, Duke CIPG
- Joshua Wilson, Duke CIPG
- Scott Robertson, Duke CIPG
- Ehsan Samei, Duke CIPG

oana.craciunescu@duke.edu