Johns Hopkins University
Department of Radiation Oncology
Clinical Medical Physics Residency

Guidelines for Clinical Rotations

The core of the medical physics residency program is a series of ten rotations designed to cover the educational objectives of the program. The training goals for each rotation are outlined below.

The resident will have a mentor for each rotation who is a faculty or staff physicist who regularly works in the clinical area for that rotation. The mentor interacts regularly with the resident, usually daily, and serves as the primary person that the resident goes to with questions relating to that rotation. At the end of each rotation the resident will be examined and evaluated on the material in that rotation. This evaluation consists of a one-hour presentation by the resident in front of senior physicists with questions. Following this presentation the mentor is responsible for providing a written evaluation of the resident.

Rotation 1: Clinic Introduction (4 weeks)

Mentor: Todd McNutt

Training Objective: Provide the resident an understanding of clinic workflow. The resident will observer and participate in CT simulation and treatment delivery. During this rotation the resident will observe cases in all of the major disease sites and all of the immobilization devices used in the clinic. Clinical disease sites include the following: head and neck, brain, craniospinal, breast, lung, pancreas, prostate. They will follow patients through from simulation to treatment and will observe treatment setup, imaging and delivery. They will gain experience with all of the external beam delivery devices available in the clinic. The resident will also observe and participate in quality assurance.

Didactic Activities:

a. Review safety policy and procedures
b. Attend orientation and understand clinical used software: Mosaiq (understand the Record and Verify system), Pinnacle (Treatment Planning Software)
c. Attend site specific chart review
d. Observe and learn how to use Elekta linacs
e. Understand and learn immobilization devices used in clinic and site specific set-ups
f. Develop an understanding of the differences between CT simulators and diagnostic CTs.
g. Develop an understanding of image guidance techniques at the machine
h. Review ICRU Report 50 to understand tumour localization and target definitions

Clinical Activities:

a. Observe and understand patient set-up (i.e. BBs, lasers, placement of isocenter) and CT simulations for the following sites:
    i. Prostate
    ii. Supine and prone breast
    iii. Brain
    iv. Head and neck
    v. Abdomen and pelvis cases
    vi. Extremity
    vii. 4DCT
b. Observe dosimetrists
    i. Understand Mosaiq and Quality Check Lists
    ii. Understand treatment schedule and machine schedules

c. Observe treatment delivery and understand concepts of patient set-up and workflow:
    i. Observe TBI set-up
    ii. Observe 10 cases on Versa machines
    iii. Observe 5 cases on Synergy
    iv. Observe cases on Tomotherapy
    v. Observe patient set-up on CyberKnife
d. Shadow physicist of the day to understand clinical workflow
e. Observe quality assurance tasks:
    i. Observe morning QA
    ii. Observe patient specific QA
    iii. Observe external beam monthly QA

Reading list

1. The Physics of Radiation Therapy, F. Kahn, Pub: Lippincott Williams & Wilkins, 4th Ed., 2009. Chapter 4 (linacs, etc)
2. Treatment Planning in Radiation Oncology, F. M. Khan, Pub: Lippincott Williams & Wilkins, 2nd Ed. 2006. Chapters 1-3.
3. Task Group 142 report: Quality assurance of medical accelerators (2009)

Evaluation

The resident should be able to discuss the workflow of the clinic, use Mosaiq, and feel comfortable working with the linacs. Resident will be evaluated to see if he/she is able to perform patient specific QA independently.

Rotation 2: Treatment planning I for EBRT (12 weeks)

Mentor(s): Todd McNutt and Dosimetry Team

Training Objective: The objective of this rotation is for the resident to gain experience with basic conformal radiotherapy planning and simple IMRT/VMAT, including a self-proficient use of the Pinnacle planning system. The resident will be mentored by a senior staff physicist along with help from the dosimetry group. The resident will observe the medical dosimetrists during the treatment planning process of multiple anatomical sites – brain, head and neck, lung and esophagus, breast, abdomen and rectum, pelvis and bladder, skin, sarcoma, whole central nervous system (CNS) and prostate – and develop a treatment plan for each site observed. Additionally, the resident will develop an understanding of the different 3-D photon beam dose algorithms, electron beam dose algorithms, non-dosimetric calculations performed by the planning system (e.g., DRRs, contouring tools, etc.) and dose evaluation tools.

Didactic Training:

1. Complete a didactic session with Todd McNutt and develop an understanding of the different 3-D photon beam dose algorithms, electron beam dose algorithms, non-dosimetric calculations performed by the planning system, and inhomogeneity correction algorithms.
2. Learn how to use Pinnacle
3. Understand DICOM and DICOM RT interfaces between CT, PACS and Treatment Planning
4. Interface between treatment planning and treatment management system (MOSAIQ)
5. MOSAIQ treatment and image guidance scheduling
6. Develop an understanding of beam properties for photons and electrons
7. Develop an understanding of beam modifiers (i.e. bolus, compensators, and wedges)
8. Understand plan evaluation (i.e. dose volume histogram, homogeneity index)
9. Understand dose limits to sensitive structures
10. Attend site specific peer review once a week
11. Complete 10 hand calculations.

Clinical Training:

The specific objectives of this rotation include the following:

1. Observe patient setup and imaging, including the following:
    i. Immobilization techniques, CT sim, BBs and shifts, MRI data, Cone-beam CT guidance, 4D-CT and ABC breath-hold
2. Perform simple calculations including the following:
    i. SSD Hand Calculation, SAD Hand Calculation, Electron Beam hand calculation
3. Perform simple plans and complete documentation including the following:
    i. AP/PA plan, Brain - 3 field, Lats + Vertex, 4 field whole pelvis or abdomen
4. Perform 3D conformal plans including the following:
    i. Breast with nodes, Electron/photon mixed beam plan, Brain (multiple non-coplanar fields), extremity, forward plan with segments
5. Perform basic IMRT/VMAT plans
    i. Prostate, brain, GYN etc.

Reading List

1. The Physics of Radiation Therapy, F. Khan, Pub: Lippincott Williams & Wilkins, 4th Ed., 2009. Chapters 9-14.
2. Treatment Planning in Radiation Oncology, F. M. Khan, Pub: Lippincott Williams & Wilkins, 2nd Ed. 2006. Chapters 4, 6, 17, 20, 23
3. Oelfke, U and Scholz, C. Dose Calculation Algorithms. 2006.

4. Verification of monitor unit calculations for non-IMRT clinical radiotherapy: Report of AAPM Task Group 114

Evaluation

The resident's performance will be evaluated based on his/her understanding and confidence of treatment planning 3D conformal sites. An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Rotation 3: Treatment planning II for EBRT with Special Procedures (12 weeks)

Mentor(s): Todd McNutt and Dosimetry Team

Training Objective: This rotation builds on and extends treatment planning #1. During this rotation the resident will perform more complex plans including: IMRT and VMAT plans for a variety of sites, craniospinal plans, ABC/Breath-hold plans, and plans performed under cone-beam CT guidance.

Didactic Training:

1. Complete a didactic session with Todd McNutt and develop an understanding of step-and-shoot and sliding window IMRT, IMRT/VMAT optimization and QA
2. Attend site specific peer review once a week
3. Better understand normal tissue contouring – observe medical resident

Clinical Training:

1. It is expected that the resident will manage a workload of approximately 1 plan per day.
2. The resident will complete at least the following number of plans outlined below:

Plan Type	No.
Cone-beam Guided IMRT (including observation of delivery)	3
Head and Neck IMRT	3
Partial Breast IMRT	3
Craniospinal	1
Sarcoma (any site)	3
ABC Case (Lung)	1
Tomotherapy Prostate and/or Head and Neck	4
Total Body Irradiation (TBI)	2

Reading List

1. Treatment Planning in Radiation Oncology, F. M. Khan, Pub: Lippincott Williams & Wilkins, 2nd Ed. 2006
2. Principles and Practice of Radiation Therapy, C.M. Washington & D.T. Leaver, Pub: Mosby, 3rd Ed. 2009

Evaluation

The resident's performance will be evaluated based on his/her understanding and confidence of treatment planning IMRT and VMAT sites. An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Rotation 4: Stereotactic radiosurgery (SRS) and fractionated radiosurgery (FSR) (12 weeks, optional to 16 weeks)

Mentor(s): Stereotactic physicist and stereotactic and CyberKnife dosimetry team

Training objective: Understand the all major aspects of SRS, FSR, and SBRT. The resident will observe and participate in planning and treatment with the CyberKnife and with cone-beam CT-guided stereotactic brain, spine, lung and pancreas etc. The resident will observe and then participate in all aspects of planning and treatment. The resident will participate in each step of the cone-beam CT (CBCT)-guided LINAC based stereotactic spine and brain radiosurgery (SRS), fractionated radiosurgery and radiotherapy (FSR and SRT).

Didactic Activities:

1. Meet with mentor once a week to go over reading list
2. Understand small field planning, optimization and QA
3. Understand organ motion and organ-motion corrected methods
4. Understand image guided radiotherapy equipment and techniques (i.e. planar MV, CBCT)
5. Attend CNS chart rounds every week

Clinical Actitivies:

1. Understand CyberKnife workflow:
    a. Observe immobilization and orthogonal KV image guidace and understand the considerations involved.
    b. Oberve MRI, CT and angiography images and understand the considerations involved.
    c. Observe, practice and then perform treatment planning and treatment for the full variety of disease indications treated with the CyberKnife.
    d. Participate in daily and monthly QA
2. Complete the following CyberKnife plans:
    a. Multiple metastasis
    b. Post-op FSR boost
    c. SRT plan for benign tumor (pituitary, optical meninigioma etc.)
    d. Spine SRS plan
    e. SRS plan for benign tumor/symptom (Acoustic Neuroma, AVM etc.)
3. Perform both conformal and IMRT based stereotactic plans on different types of brain and spine tumor. The objective is to understand the specific consideration and planning techniques in stereotactic planning including margin setup, non-coplanar beam arrangement and different isodose normalization. The following plans need to be completed:
    a. Spine SRS plan
    b. Pancreas SBRT plan
    c. Lung SBRT plan
    d. Other SBRT plans if cases show up
    e. Single or Multi isocenter brain metastasis
4. The resident will participate stereotactic treatments and understand various specifics of stereotactic treatment including: CBCT guidance, inter- and intra-fraction motion monitoring and management, using of 6-degree freedom couch to correct patient setup uncertainty, etc.
5. The resident will perform patient specific treatment QA and stereotactic treatment devices QA routinely during this rotation.

Reading List:

1. AAPM TG 42 report: Stereotactic Radiosurgery
2. AAPM TG 101: Stereotactic body radiation therapy
3. AAPM TG 76: Motion Management
4. AAPM TG 135: Quality assurance for robotic radiosurgery

Evaluation

The resident's performance will be evaluated based on his/her understanding and confidence of treatment planning SRS and SBRT sites. An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Rotation 5: Quality Assurance for EBRT

Mentor: Assigned Machine Physicist

Training objective: Become self-proficient in all aspects of EBRT quality assurance. In this rotation the resident learn how to perform and evaluate quality assurance (QA) tests of patient-specific IMRT plans, regular monthly and annual QA of linacs, and QA of simulators.

Didactic Training:

1. Observe assigned machine physicist during monthly and annual QA
2. One on one session with machine physicist to understand basics of linacs
3. Develop an understanding of beam scanning systems and dose measuring systems

Clinical Training:

The specific rotation expectations:

1. Perform patient-specific IMRT QA routinely through out the entire residency. The QA includes patient-specific measurement, result analysis and report generation.
2. Perform regular monthly QA of Linac through out the whole residency. The QA will rotate through different LINACs at JHH including Elekta and TOMO machines.
3. The resident will perform regular monthly QA of Simulators through out the whole residency.
4. Perform regular annual QA of Linac through out the whole residency. The QA will rotate through different LINACs at JHH including Elekta and TOMO machines.
5. The resident is expected to fully understand the EBRT dosimetric calibration protocols for photon and electron beams.

Reading List:

1. AAPM TG 142: The QA of linear accelerators
2. AAPM TG 106: Accelerator beam data commissioning equipment and procedures.
3. AAPM TG 51 report: AAPM's TG-51 protocol for clinical reference dosimetry of high energy photon and electron beams
4. AAPM TG 21 report: A protocol for the determination of absorbed dose from high energy photon and electron beams
5. AAPM TG 39 report: The Calibraton and Use of Plane-Parallel Ionization Chambers for Dosimetry of Electron Beams
6. AAPM TG 40 report: Comprehensive QA for Radiation Oncology
7. AAPM TG 45 report: AAPM Code of Practice for Radiotherapy Accelerators

Evaluation

The resident's performance will be evaluated based on his/her understanding and confidence on using the linacs. The resident will be observed to see if he/she can complete patient specific and monthly QA independently.

Rotation 6: Linear accelerator acceptance testing and commissioning (12 weeks)

Mentor: Machine Physicist

Training objective: The resident will commission a new linear accelerator for treatment. Working with a staff physicist they will be responsible for all aspects of the acceptance testing and commissioning measurements. The resident may complete this rotation at the proton therapy center.

Didactic Training:

1. Meet one-on-one with physicist to understand linac acceptance test and commissioning project.
2. Develop an understanding of beam data acquisition and management
3. Develop an understanding of beam modelling

Clinical Training:

1. Perform mechanical tests
4. Conduct system calibration, performance evaluations and quality control, safety and compliance tests, including vendor specifications, under supervision of a qualified physicist
    a. Megavoltage photons
    b. Megavoltage electrons
    c. Small field systems (SRS,SBRT)
    d. Beam scanning systems
    e. External beam dose measuring systems
    f. 3D external beam treatment planning workstations
    g. Total body irradiation (TBI)
    h. In-vivo dosimetry (e.g. diodes, thermoluminescent dosimeters (TLDs), optically stimulated luminescence dosimeters (OSLDs)
2. Image quality tests of the imaging system
3. Beam output determination with TG51
4. Leakage determination and surveying
5. Beam data acquisition
    a. Photon Beam Data within acceptance parameters
    b. Electron Beam Data within acceptance parameters
    c. Dose Repeatability Test
    d. Output, flatness, symmetry with gantry angle
    e. Output and dose rate linearity
6. Treatment Planning System Commissioning
    a. Modeling of Beam data in TPS (Pinnacle, RayStation, or other)
    b. Verification measurements for a variety of clinically relevant fields.
7. Setup accelerator for future QA and use
    a. Establish a daily and monthly QA program
    b. Develop hand calculation tables for use with second check programs or hand calculations.

Reading Materials:

1. AAPM TG 142: The QA of linear accelerators
2. AAPM TG106: Accelerator beam data commissioning equipment and procedures.
3. AAPM TG10: Code of Practice for radiotherapy accelerators
4. AAPM TG 51 report: AAPM's TG-51 protocol for clinical reference dosimetry of high energy photon and electron beams
5. AAPM TG 21 report: A protocol for the determination of absorbed dose from high energy photon and electron beams

6. AAPM TG 39 report : The Calibraton and Use of Plane-Parallel Ionization Chambers for Dosimetry of Electron Beams
7. AAPM TG 40 report: Comprehensive QA for Radiation Oncology
8. AAPM TG 45 report: AAPM Code of Practice for Radiotherapy Accelerators
9. AAPM TG53 report: QA for clinical radiation therapy treatment planning
10. A Primer on Theory and Operation of Linear Accelerators in Radiation Therapy, C.J. Karzmark, R.J. Morton, Pub: Medical Physics Publishing Corporation, 2nd Ed. 1997
11. The Physics of Radiotherapy X-Rays from Linear Accelerators, P. Metcalfe, T. Kron, P. Hoban, Pub: Medical Physics Publishing Corporation, 1st Ed., 1997
12. The Q Book: The Physics of Radiotherapy X-Rays Problems and Solutions, P. Metcalfe, T. Kron, P. Hoban, Pub: Medical Physics Publishing Corporation, Workbook Edition, 1998

Evaluation:

An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Rotation 7: Brachytherapy (12 weeks, optional to 16 weeks)

Mentor: Brachytherapy team

Training Objective: The objective of the brachytherapy rotation is to educate and train physicists to a competency level sufficient to practice brachytherapy physics independently. To accomplish this goal, the residents will be exposed to a multitude of tasks, related to both clinical needs and quality assurance. The objective of this facet is to learn the steps involved in preparation of materials and equipment for procedures using LDR sources, LDR sources and HDR sources. This aspect of the clinical throughput involves planning by dosimetrists and/or physicists, and hands-on assistance to the physicians in the administration of the treatments.

Didactic Training:

1. Meet one-on-one with Marc Morcos once a week
2. Attend brachytherapy specific chart rounds
3. Develop an understanding of the different types of brachytherapy implants (temporary vs. permanent) and applicators used
4. Develop an understanding of dose constraints specific to different HDR and LDR procedures

Clinical Training:

1. Observe and perform the following procedures:
    a. Prostate LDR cases
    b. Gynecological procedures including treatment planning:
        i. Cylinder
        ii. Syed
        iii. Venezia
        iv. Tandem and ring
        v. Tandem and ovoid
    c. Eye plaques
    d. Brain seed
    e. IORT cases
    f. Xofigo
2. Perform quality assurance:
    a. Remote afterloader periodic QA
    b. Source QA
    c. Daily QA

D. Reading List:

1. AAPM TG 32: Specification of Brachytherapy Source strength
2. AAPM TG 43: Dosimetry of Interstitial Brachytherapy Sources
3. AAPM TG 43U: Revised Protocol for Brachytherapy Dose Calculations.
4. AAPM TG 59: HDR Treatment Delivery
5. AAPM TG 64: Physics Aspects of Permanent Prostate Implants
6. AAPM TG 41: Remote Afterloading Technology
7. ABS Guidelines: Consensus for locally advanced carcinoma of the cervix: Part 1 General Principles
8. ABS Guidelines: Consensus for locally advanced carcinoma of the cervix: Part 2 High Dose Rate Brachytherapy
9. ABS Guidelines: Consensus for Guidelines for Interstitial Brachytherapy for Vaginal Cancers
10. ABS Guidelines: Consensus Guidelines for High-Dose-Rate Prostate Brachytherapy

Evaluation:

An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Rotation 8: Radiation Safety

Mentor: Radiation Safety Officer and Radiation Safety Office

Training objective: Gain experience with aspects of radiation safety including exposure risk evaluation and monitoring, surveying and shielding. This rotation will also include training in the patient safety improvement efforts of the department. The resident will also spend a week in the Radiation Safety department.

Didactic Training:

1. Complete radiation safety orientation with Rob Hobbs and go over personnel dosimetry
2. Complete one-on-one lecture with Carl in Radiation Safety to understand different detectors and policies of the hospital
3. Understand the material in NCRP report 151 and 103
4. Understand national and state regulations
5. Understand radiation exposure to the public
6. Understand failure mode effects analysis (FMEA) principles and applications
7. Understand reporting requirements for medical events
8. Understand sealed source storage, safety and protection
9. Understand patient release criteria following radionuclide therapy
10. Understand neutron shielding

Clinical Training:

1. Perform at least one shielding calculation for a new linear accelerator facility and for a diagnostic room. If none are under construction at the time of the training, example plans will be used.
2. Perform package acceptance, shipping, and source disposal at the Radiation Safety Department
3. Perform sealed source packaging and transportation
4. Perform sealed source inventory
5. Perform exposure, contamination, and facility radiation surveys
6. Perform root cause analysis (RCA)

Reading list:

1. The Physics of Radiation Therapy, F. Khan, Pub: Lippincott Williams & Wilkins, 4th Ed., 2009
2. Shielding Techniques for Radiation Oncology Facilities, P.H. McGinley, Pub: Medical Physics Publishing Corporation, 2nd Ed., 2002
3. NCRP Report Number 151
4. ICRP Report Number 103
5. NUREG 10 CFR Part 20: Standards for protection against radiation
6. NUREG 10 CFR Part 35: Medical use of byproduct material

Evaluation

The resident's performance will be evaluated based on the shielding calculations. An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Rotation 9: Imaging (4 weeks)

Mentor: Imaging Physicist

Training objective: Understand the basic aspects of medical physic imaging including: CT, cone-beam CT, ultrasound, MR, PET/CT. This two-month rotation will focus on the practical aspects of medical physics imaging as related to the practice of radiation oncology. This is meant as an addition to the standard didactic background in medical physics imaging as outlined above.

Didactic Training:

1. Spend one-on-one with physicist to understand DICOM standards, DICOM RT and data management
2. Develop an understanding of image registration, fusion, and segmentation
3. Develop an understanding of validation of imported images
4. Develop an understanding of the information acquired from PACS

Clinical Training:

1. Perform quality assurance of the department MR simulator, CT simulator, cone-beam CT devices, and brachytherapy ultrasound devices.
2. Spend at least one week in a rotation with radiology which will include physics aspects of MRI and PET/CT. Our physics contacts in radiology will act as laisons for this rotation.
3. Observe PET or PET CT scanner QC procedure in radiology department. This procedure may include rod source normalization, 20 cm phantom measurement for transmission and emission test. Make sure understand the basic principles of PET imaging, including image resolution, etc.
4. Perform daily imaging physicist tasks such as image and plan fusions:
    a. Multi-modality image fusion for contouring and target definition.
    b. Treatment plan fusion with deformation for dose compositing and replanning

Reading List:

1. TG 132: Use of Image Registration and Data Fusion Algorithms and Techniques in Radiotherapy Treatment Planning
2. The Essentials of Physics of Medical Imaging, J.T. Bushberg, J.A. Seibert, E.M. Leidholdt, J.M. Boone, Pub: Lippincott Williams & Wilkins, 3rd Ed., 2012
    a. Image Quality: Chapter 4
    b. Tubes and X-ray Production: Chapter 6
    c. Radiography (CR Plates, CCD, flat panel imagers): Chapter 7
    d. Mammography: Chapter 8
    e. Fluoroscopy: Chapter 9
    f. Computed Tomography: Chapter 10
    g. MRI: Chapters 12-13
    h. Ultrasound: Chapter 14
    i. PET: Chapter 19

Evaluation

An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Rotation 10: Physicist of the Day Rotation

Mentor: Physicist of the day

Training Objective: Provide the resident with the fundamental knowledge and practical training for proficiency with day-to-day clinical operations as the floor physicist. Resident will perform all tasks under the supervision of a senior physicist.

Didactic Activities:

a. Review ROTA, Oncobrowser white board.
b. Review functionality of clinical software programs: Mosaiq, RadCalc, and Sun Nuclear's Daily QA3.
c. Review in-vivo dosimetry (i.e. diodes, thermoluminscent dosimeters [TLDs], optically stimulated luminescence dosimeters [OSLDs])

Clinical Activities:

The resident will work with the designated physicist of the day on the activities listed below:
Under the supervision of the senior physicist, assist with clinical issues that arise during the treatment day, as needed.

1. Daily Quality Assurance: Review morning machine quality assurance data for all treatment units and identify any parameters outside of specification.
2. Complete 25 initial treatment plan/chart checks
    a. Check patient prescription in Mosaiq compared to the physician approved treatment plan
    b. Check second MU calculations (generated in RadCalc)
    c. Provide treatment day physics assistance
    d. Perform final physics chart checks
3. Complete 50 weekly treatment plan/chart checks
    a. Overall check of chart for completeness & signatures
    b. Check fractions treated & dose site summary
    c. Check the tolerance table values in Mosaiq compared those found in the treatment chart.
    d. For applicable plans, review diode measurements to ensure readings are within the expected range and transcribed into Mosaiq.
4. Complete 25 final treatment plan/chart checks
    a. Work through Final Physics Checks assessment
    b. Become familiar with process of billing (senior physicist is responsible for billing)

Reading list

1. AAPM TG 275 Report: Strategies for Effective Physics Plan and Chart Review in Radiation Therapy.
2. AAPM TG 100 Report: The report of Task Group 100 of the AAPM: Application of risk analysis methods to radiation therapy quality management.
3. AAPM TG 203 (TG 34) Report: Management of radiotherapy patients with implanted cardiac pacemakers and defibrillators.
4. C. Hurkmans, J. Knegjens, et al. Management of radiation oncology patients with a pacemaker or ICD: A new comprehensive practical guideline in The Netherlands. Radiation Oncology 2012, 7:198.

Evaluation:

The resident's performance will be evaluated based on his/her understanding and confidence of handling clinical situations, behavior and relationship with other clinical staff and patient. An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.

Rotation 11: Proton Therapy (Optional)

Mentor: Proton Therapy Physics Team

Training Objective: Provide the resident resident an overview of the proton therapy physics and treatment techniques. The resident will learn through observation and direct participation in the clinical physics activities. The resident will participate in technical aspects of patient care under the supervision of staff proton physicists. These activities include quality assurance (daily, monthly, annual and patient-specific), patient treatment simulation, treatment planning, review of patient positioning and immobilization.

Didactic Activities:

a. Attend proton specific chart rounds/peer review
b. Attend proton physics meetings for plan pre-check
c. Review functionality of clinical software programs: RayStation, Mosaiq

Clinical Activities:

The resident will work with staff proton physicists and dosimetrists on the activities listed below:

1. Shadow the physicist of the day
    a. Observe simulation
    b. Observe chart check
2. Complete 10 treatment plans
    a. Under the supervision of a dosimetrist and physicist,
3. Complete proton specific QA
    a. Complete monthly QA
    b. Complete patient specific QA

Reading list:

1. AAPM TG 224 Report: Comprehensive proton therapy machine quality assurance
2. Chapter 10: IAEA TRS-398 Absorbed Dose Determination in External Beam Radiotherapy: An International Code of Practice for Dosimetry based on Standards of Absorbed Dose to Water
3. ICRU 78 Prescribing, Recording, and Reporting Proton-Beam Therapy

Evaluation

The resident's performance will be evaluated based on his/her understanding and confidence of handling clinical situations, behavior and relationship with other clinical staff and patient. An oral examination will be taken by the mentor and/or other staff physicist worked with the resident in this rotation.