The Truebeam System Varian

A complete guide to clinical oncology, covering the main treatment modalities and diagnosis and treatment strategies for specific tumour types.

This is a single, comprehensive handbook for clinical oncology trainees and consultants, covering the basic aspects of stereotactic radiotherapy systems and treatment.

This book is a comprehensive review of image guided interventions of the spine. Beginning with a chapter dedicated to the history of

image guided spinal interventions, authors set the stage for the role these procedures have and will play in the field. Chapters cover the key procedures, techniques, and considerations to maximize effectiveness and patient care. Some major topics covered include: imaging osseo-ligamentous spine anatomy, percutaneous vertebroplasty, image guided tumor ablation, and vascular spine intervention. Additional features include high-quality illustrations with concise descriptions and clinical cases discussions. This is an ideal guide for interventional neuroradiologists, radiologists, pain *management physicians, neurosurgeons, orthopedic spine surgeons, and related residents, fellows, and students wanting in depth information on image guided interventions of the spine.*

Stereotactic body radiation therapy (SBRT) has emerged as an important innovative treatment for various primary and metastatic cancers. This book provides a comprehensive and up-to-date account of the physical/technological, biological, and clinical aspects of SBRT. It will serve as a detailed resource for this rapidly developing treatment modality. The organ sites covered *include lung, liver, spine, pancreas, prostate, adrenal, head and neck, and female reproductive tract. Retrospective studies and prospective clinical trials on SBRT for various organ sites from around the world are examined, and toxicities and normal tissue constraints are discussed. This book features unique insights from world-renowned experts in SBRT from North America, Asia, and Europe. It will be necessary reading for radiation oncologists, radiation oncology residents and fellows, medical physicists, medical physics residents, medical oncologists, surgical oncologists, and cancer scientists.*

Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy

A Comparative Analysis for Verification of IMRT and VMAT Treatment Plans Using a 2-D and 3-D Diode Array

Iterative CBCT - Improving CBCT Image Quality at ProBeam

Use of ClearView Gel Dosimeter for Quality Assurance and Testing of Stereotactic Radiosurgery

Adaptive Radiation Therapy

The convolution-superposition dose calculation algorithm of the Pinnacle3 Treatment Planning System (TPS) necessitates that a model of the beam be created for every licensed energy during the TPS commissioning process. To model photon beams in Pinnacle3, the user is required to measure depth dose curves and beam profiles for a variety of geometries (combinations of various source-to-surface distances (SSD), beam modifiers, and field sizes) for each energy and then import the gathered data into the TPS. Achieving the best fit of the measured profiles is the main objective of this modeling process, with different modeling parameters derived from different profiles. Specifically, Pinnacle3 models beam spectrum and electron contamination to create curves that fit the measured depth dose curves. Although the curves produced by the auto-modeling process may closely fit the measured data, they depend on many variables and a range of acceptable solutions are possible. Due to the uncertainties inherent to the modeling process, the derived photon beam spectrum and electron contamination may not accurately represent the true physical nature of their real world counterparts. A study of the accuracy of Pinnacle3's models was performed for 6 and 10 MV flattening-filter free (FFF) beams of a Varian Edge linear accelerator using two distinct routes of investigation: first, direct comparison of the Pinnacle3 spectra with those previously published or derived with alternative models, and second, indirect comparison through the inspection of resulting percent depth dose (PDD) curves in water phantoms. For the former approach, the modeled spectra produced by Pinnacle3 were compared with phase-space file (PSF) Monte Carlo modeled spectra for TrueBeam (and Edge) linear accelerators, as well as spectra for the same energy found in models from other TPSs. As for the latter, a virtual model of the TrueBeam photon source with a water phantom set up directly beneath the accelerator head was created in the Monte Carlo N-Particle (MCNP) radiation transport package and PDD curves were collected for both Pinnacle3 and PSF-MC modeled spectra. The direct effect of beam spectra on dose calculations in realistic patient plans was evaluated as the final step. New photon beam models were created in the Pinnacle3 TPS by replacing the originally modeled spectra with spectra obtained from the Varian PSF and an alternate version of the Edge machine was commissioned using the new photon beam models. A number of previously treated lung and brain patient plans that used 6 and 10 MV FFF beams and the conformal arc modality were identified. These plans were recalculated using the newly commissioned machine and were renormalized before comparing their dose distributions to those found in the original plans. Plans were selected so that tumors were located in areas with high heterogeneities and high dose gradients, increasing the effect that a change in photon spectrum had on the dose distribution. Differences between plan sets were evaluated by comparing maximum doses to targets, dose gradient, target conformity, and maximum doses to local critical structures. The spectral distributions for the PSF MC-modeled spectra and spectra modeled by other TPSs were found to be shifted so that lower energy photons had greater intensities compared to the Pinnacle3 modeled spectrum for both 6 and 10 MV FFF beams. The average photon energies for spectra modeled outside the Pinnacle3 TPS were likewise lower: average photon energy of the 6 MV FFF PSF MC spectrum was EAVG=0.537 MV, down from the Pinnacle3 spectrum value of EAVG=1.224 MV, and for the 10 MV FFF PSF MC spectrum EAVG=0.750 MV, down from the Pinnacle3 spectrum value of EAVG=1.545 MV. The Pinnacle3 calculated PDD curve using the Pinnacle3 modeled spectrum best fit measured commissioning data, although the measured data fell in between PDD curves modeled in MCNP using Pinnacle3 and PSF MC modeled spectra. Modeled PDD curves created in both Pinnacle and MCNP for the PSF MC spectra had shallower depth of maximum dose values than PDD curves created using the Pinnacle3 spectra for both energies. After evaluating multiple treatment plans, it was found that replacing the spectra used in Pinnacle3's calculations typically resulted in minor variations in dose distribution inside target volumes, with the exception of very small targets. The latter finding is particularly clinically significant for SRS/SBRT plans, where very high doses delivered to tumors require the highest possible accuracy in dose calculations and more extensive fine-tuning of the commissioned model may be warranted.

The ProBeam proton therapy system offers CBCT imaging for patient setup with a Feldkamp-Davis-Kress (FDK) algorithm with a kernel-based scatter correction. For the TrueBeam radiotherapy system, Varian Medical Systems commercially offers for Head and Pelvis protocols additionally an advanced reconstruction technique u2013 Iterative CBCT (iCBCT), using a statistical reconstruction and in the case of pelvis protocol a deterministic Boltzmann Transport Equation solver-based scatter correction. Preliminary results from an early evaluation of ProBeam clinical head/neck and pelvis scans reconstructed with iCBCT show a significant improvement of image quality. iCBCT reconstructions show a reduction of cone-beam, streak and shading artifacts and noise, resulting in

enhancements of soft-tissue definition. iCBCT will be implemented at ProBeam and ProBeam 360u00b0 to improve visualization and facilitate more precise patient setup. The improved image quality is expected to enable new applications like usage of CBCT images for replanning and adaptive radiotherapy at ProBeam and ProBeam 360u00b0.
This textbook describes in detail the process of cancer metastasis from a single cell in the primary site through its arduous journey to the sentinel lymph node as the main gateway and beyond to distant sites. The most up-to-date knowledge on key topics in the molecular biology, diagnosis, and treatment of metastatic cancer is highlighted by a large panel of experts. The book begins with a comprehensive

overview of the genetic and molecular mechanisms that promote or inhibit cancer metastasis through lymphatic pathways to lymph nodes or through vascular pathways to distant sites, providing the reader with an essential basic knowledge. This is followed by further details on the role of the immune system within the primary tumor and the lymph node and the importance of the microenvironment at the metastatic site. The role of the sentinel lymph node in cancer metastasis is emphasized. Special attention is also given to state-of-the-art imaging techniques for the detection of early-stage cancer and cancer metastases, as well as the use of liquid biopsies in sarcoma, prostate, gastrointestinal, and lung cancer. Clinical patterns of malignant tumors arising in different organ systems are compared, described, and discussed with the goal of determining what similarities and/or differences exist. The book concludes with a detailed discussion of surgical intervention, radiation, and systemic therapy of primary and metastatic cancer, and briefly previews several emerging topics, such as the latest findings on personalized cancer therapy, cancer stem cells, unique molecular mechanisms of virus-induced cancer, the impact of the microbiome on cancer metastasis and the application of artificial intelligence in cancer metastasis research. By providing fundamental knowledge of the biological and clinical aspects of cancer metastasis, this book will be an important reference for cancer researchers, clinical oncologists, teachers, and students.

Written by experts in the field, each chapter includes a summary of the chapter's key points and open-ended questions that address pressing issues in the field and encourage the reader to consider future directions.
This book gives a comprehensive overview on the use of image-guided radiation therapy (IGRT) in the treatment of lung cancer, covering step-by-step guidelines for clinical implementations, fundamental principles and key technical advances. It covers benefits and limitations of techniques as well as quality and safety issues related to IGRT practice. Addresses imaging simulation, treatment planning, verification, and delivery Discusses important quality assurance issues Describes current methods using specialized

machines and technologies Jing Cai, PhD, is an Associate Professor of Radiation Oncology at Duke University Medical Center. Joe Y. Chang, MD, PhD, is Professor in the Department of Radiation Oncology at The University of Texas MD Anderson Cancer Center in Houston. Fang-Fang Yin, PhD, is Chief of the Division of Radiation Physics, Professor of Radiation Oncology, and Director of the Medical Physics program at Duke University.

Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy (SBRT)

CyberKnife NeuroRadiosurgery

Cancer Metastasis Through the Lymphovascular System

Intensity-Modulated Radiation Therapy

A Practical Guide

From the essential background physics and radiobiology to the latest imaging and treatment modalities, the updated second edition of Handbook of Radiotherapy Physics: Theory & Practice covers all aspects of the subject. In Volume 1, Part A includes the Interaction of Radiation with Matter (charged particles and photons) and the Fundamentals of Dosimetry with an extensive section on small-field physics. Part B covers Radiobiology with increased emphasis on hypofractionation. Part C describes Equipment for Imaging and Therapy including MR-guided linear accelerators. Part D on Dose Measurement includes chapters on ionisation chambers, solid-state detectors, film and gels, as well as a detailed description and explanation of Codes of Practice for Reference Dose Determination including detector correction factors in small fields. Part E describes the properties of Clinical (external) Beams. The various methods (or ‘algorithms’) for Computing Doses in Patients irradiated by photon, electron and proton beams are described in Part F with increased emphasis on Monte-Carlo-based and grid-based deterministic algorithms. In Volume 2, Part G covers all aspects of Treatment Planning including CT-, MRand Radionuclide-based patient imaging, Intensity-Modulated Photon Beams, Electron and Proton Beams, Stereotactic and Total Body Irradiation and the use of the dosimetric and radiobiological metrics TCP and NTCP for plan evaluation and optimisation. Quality Assurance fundamentals with application to equipment and processes are covered in Part H. Radionuclides, equipment and methods for Brachytherapy and Targeted Molecular Therapy are covered in Parts I and J, respectively. Finally, Part K is devoted to Radiation Protection of the public, staff and patients. Extensive tables of Physical Constants, Photon, Electron and Proton Interaction data, and

typical Photon Beam and Radionuclide data are given in Part L. Edited by recognised authorities in the field, with individual chapters written by renowned specialists, this second edition of Handbook of Radiotherapy Physics provides the essential up-to-date theoretical and practical knowledge to deliver safe and effective radiotherapy. It will be of interest to clinical and research medical physicists, radiation oncologists, radiation technologists, PhD and Master's students.
Low Energy Particle Accelerator-Based Technologies and Their Applications describes types of low energy accelerators, presents some of

the main manufacturers, illustrates some of the accelerator laboratories around the globe and shows examples of successful transfers of accelerators to needed laboratories. Key Features: Presents new trends and the state of the art in a field that's growing Provides an overview of numerous applications of such accelerators in medicine, industry, earth sciences, nuclear non-proliferation and oil Fills a gap, with the author drawing on his own experiences with transporting such relatively large machines from one lab to the other that require a tremendous amount of planning, technical and engineering efforts This is an essential reference for advanced students as well as for physicists, engineers and practitioners in accelerator science. About the Author Dr. Vladivoj (Vlado) Valkovi?, a retired professor of physics, is a fellow of the American Physical Society and Institute of Physics (London). He has authored 22 books (from Trace Elements, Taylor & Francis, 1975, to Radioactivity in the Environment, Elsevier, 1st Edition 2001, 2nd Edition 2019), and more than 400 scientific and technical papers in the research areas of nuclear physics, applications of nuclear techniques to trace element analysis in biology, medicine and environmental research. He has lifelong experience in the study of nuclear reactions induced by 14 MeV neutrons. This research has been done through coordination and works on many national and international projects, including US-Croatia bilateral, NATO, IAEA, EU-FP5, FP6 and FP7 projects. Cover photo credit: 3SDH 1 MV Pelletron system with RF source and analysis endstation designed with the intended purpose of aiding in fusion research. It is capable of Ion Beam Analysis (IBA) techniques such as RBS, ERD, PIXE and NRA. Further detectors could be added to the endstation to allow for other techniques. Installed in Japan in 2014. Courtesy of National Electrostatics Corp.

"The Varian TrueBeam STx linear accelerator features a developer's mode in which treatment plans can be programmed that include patient couch motion during radiation delivery. The combination of synchronous couch/gantry trajectories with Varian volumetric modulated arc therapy (VMAT) optimizations, called RapidArc, can result in a treatment technique that has been designated Virtual Isocenter RapidArc (VIRA). Prior to its implementation, the accuracy of dose calculations in the Varian Eclipse treatment planning system, on which the RapidArc optimization depends, must be validated, as well as the positional accuracy of the

TrueBeam patient couch. The dose calculation accuracy was evaluated extrinsically through the delivery of clinical dynamic multileaf collimator (DMLC) intensity modulated radiotherapy (IMRT) treatment plans as a function of source-to-surface distance (SSD) and measurement with ionization chamber and Gafchromic EBT3 film. Parameters intrinsic to dose calculations in Eclipse, the dosimetric leaf gap (DLG) and leaf transmission (LT), were also investigated for their dependence on SSD. The positional accuracy of the treatment couch was assessed through the generation of treatment plans with static couch/gantry, static couch/rotating gantry, and synchronous couch and gantry motion, with measurement of the real-time ionization chamber current positioned in a cylindrical phantom during radiation delivery. The relative agreement of ionization chamber measurements to Eclipse dose calculations for DMLC IMRT treatment plans decreased by 1.5±0.3% over SSDs in the range of 85 cm to 135 cm (less than 1.0% deviation from standard clinical reference conditions of 100 cm SSD). Gafchromic EBT3 film measurements were consistent with ionization chamber results, though noise in the film data at low doses resulted in large uncertainties. Measurements of DLG were independent of SSD, following corrections for geometric projection. LT showed a dependence on SSD of 0.09±0.02% over the SSD range investigated. The ionization chamber current measurements for synchronous couch and gantry rotation, analogous to the proposed VIRA technique, indicated a maximum deviation of 0.2 cm relative to treatment isocenter, equal to the deviation observed for the rotating gantry/static couch treatment, analogous to conventional VMAT delivery. These results indicate that the Varian TrueBeam and Eclipse maintain the necessary positional and dosimetric accuracy required for VMAT treatments involving dynamic couch trajectories." --

Breast cancer, its causes, early detection and treatment have received considerable attention, since this widespread disease is one of the most important health concerns for women. This book provides a comprehensive overview of the diagnostic and therapeutic aspects of the management of early-stage breast cancer, including essential information on basic topics like pathology, and radiology, as well as the latest developments. Further, it discusses all aspects of surgical care, chemotherapy and radiation therapy, together with the controversies and current management guidelines. Helping readers acquire a deep, holistic understanding of the topic, the book is a valuable resource for practitioners and postgraduate students in the field of gynecologic oncology. Moreover, it is a useful aid to decision-making in day-to-day practice for oncologists, residents, fellows and experienced practitioners.

Dosimetric Evaluation and Verification of Respiratory Motion Management System in Radiation Oncology

A Comparative Image Quality Analysis Between Multi-slice Computed Tomography and Cone Beam Computed Tomography for Radiation Treatment

Planning Purposes
Surface Guided Radiation Therapy
Medical Electron Accelerators
Theory and Practice, Second Edition, Two Volume Set

The main result of this thesis is a software system, called PRIMO, which simulates clinical linear accelerators and the subsequent dose distributions using the Monte Carlo method. PRIMO has the following features: (i) it is self-contained, that is, it does not require additional software libraries or coding; (ii) it includes a geometry library with most Varian and Elekta linacs; (iii) it is based on the general-purpose Monte Carlo code PENELOPE; (iv) it provides a suite of variance-reduction techniques and distributed parallel computing to enhance the simulation efficiency; (v) it is graphical user interfaced; and (vi) it is freely distributed through the website http://www.primoproject.net In order to endow PRIMO with these features the following tasks were conducted: - PRIMO was conceived with a layered structure. The topmost layer, named the GLASS, was developed in this thesis. The GLASS implements the GUI, drives all the functions of the system and performs the analysis of results. Lower layers generate geometry files, provide input data and execute the Monte Carlo simulation. - The geometry of Elekta linacs from series SU and MLCi were coded in the PRIMO system. - A geometrical model of the Varian True Beam linear accelerator was developed and validated. This model was created to surmount the limitations of the Varian distributed phase-space files and the absence of released information about the actual geometry of that machine. This geometry model was incorporated into PRIMO. - Two new variance-reduction techniques, named splitting roulette and selective splitting, were developed and validated. In a test made with an Elekta linac it was found that when both techniques are used in conjunction the simulation efficiency improves by a factor of up to 45. - A method to automatically distribute the simulation among the available CPU cores of a computer was implemented. The following investigations were done using PRIMO as a research tool : - The configu ration of the condensed history transport algorithm for charged particles in PENELOPE was optimized for linac simulation. Dose distributions in the patient were found to be particularly sensitive to the values of the transport parameters in the linac target. Use of inadequate values of these parameters may lead to an incorrect determination of the initial beam configuration or to biased dose distributions. - PRIMO was used to simulate phase-space files distributed by Varian for the True Beam linac. The results were compared with experimental data provided by five

European radiotherapycenters. It was concluded thatthe latent variance and the accuracy of the phase-space files were adequate for the routine clinical practice. However, for research purposes where low statistical uncertainties are required the phase-space files are not large enough. To the best of our knowledge PRIMO is the only fully Monte Carlo-based linac and dose simulation system , addressed to research and dose verification, that does not require coding tasks from end users and is publicly available.

Clinical conformal radiotherapy is the holy grail of radiation treatment and is now becoming a reality through the combined efforts of physical scientists and engineers, who have improved the physical basis of radiotherapy, and the interest and concern of imaginative radiotherapists and radiographers. Intensity-Modulated Radiation Therapy describes in detail the physics germane to the development of a particular form of clinical conformal radiotherapy called intensity modulated radiation therapy (IMRT). IMRT has become a topic of tremendous importance in recent years and is now being seriously investigated for its potential to improve the outcome of radiation therapy. The book collates the state-of-the-art literature together with the author's personal research experience and that of colleagues in the field to produce a text suitable for new research workers, Ph.D.

students, and practicing radiation physicists that require a thorough introduction to IMRT. Fully illustrated, indexed, and referenced, the book has been prepared in a form suitable for supporting a teaching course.

This comprehensive encyclopedia, comprising a wide range of entries written by leading experts, provides detailed information on radiation oncology, including the most recent developments in the field. It will be of particular value for basic and clinical scientists in academia, practice, and industry and will also be of benefit to those in related fields, students, teachers, and interested laypersons.

Currently surgery, chemotherapy and radiation therapy are the main modalities used to treat cancer. When implementing radiation therapy into the course of treatment a common goal is applied to all types of cancer: Deliver the prescribed dose to the target while sparing as much normal tissue as possible. Delineation of the GTV (gross tumor volume) is contoured onto the treatment planning CT and a margin is applied expanding the volume in order to create the PTV (planned target volume). While this expansion does help to deliver the prescribed dose to the target it simultaneously hinders the ability to spare normal tissue. Furthermore tumors in the thoracic and abdominal cavities are subject to respiratory motion which can cause the undesired effect of moving the target out of the radiation field. A possible result from this type of motion is under-dosing the target and over-dosing the surrounding normal tissue. Respiratory-Gated Radiotherapy (RGRT) has been developed to help manage the intrafractional motion caused by respiration during treatment. Respiratory gating allows the radiation beam to be turned on and off when the tumor moves into and out of a planned position. The goal of this project is to construct a motorized phantom capable of reproducing the motion a tumor undergoes during respiration in order to commission the Varian RPM (Real-Time Position Management) System package on a TrueBeam linear accelerator. Measurements will be made to verify that the planned dose agrees with the delivered dose using both an ion chamber to measure the dose delivered to a point within the moving target and the MapCHECK2 to measure the dose distribution. Multiple breathing rates are available to be used however one breathing rate was chosen for data collection in this work. Detailed discussion on motorized phantom design and analysis of the acquired data will be presented.

Automation of the Monte Carlo Simulation of Medical Linear Accelerators

Basics and Controversies

Advances in the Treatment Planning and Delivery of Radiotherapy
Image Guided Interventions of the Spine
In this third edition of Intracranial Stereotactic Radiosurgery, Drs. Sheehan and Lunsford provide an updated assessment of the practice of stereotactic radiosurgery. Topics include benign and malignant tumors, cerebrovascular abnormalities, and functional disorders. Several new topics are now included and focus on immunotherapy, hypofractionation, and repeat radiosurgery. Each chapter contains key figures and tables

to illustrate the critical concepts of the work. Contributors to the book represent many of the most prestigious stereotactic radiosurgery centers across the world. This book is comprised of 36 chapters and represents a comprehensive update to prior editions. It is intended to be a readable, credible, and accessible reference on stereotactic radiosurgery. Editors Jason Sheehan, MD, PhD, FACS, FAANS, is the Vice Chair and Harrison Distinguished Professor of Neurological Surgery at the University of Virginia (UVA). He also serves as the Neurosciences Service Line Director at UVA.

Dr. Sheehan is the current chair of the American Association of Neurological Surgeons (AANS) and Congress of Neurological Surgeons (CNS) Section on Tumors. He serves as the Editor-In-Chief of the Journal of Neuro-Oncology. L. Dade Lunsford, MD, serves as the Lars Leksell Professor and Distinguished Professor at the Department of Neurological Surgery at the University of Pittsburgh. He is also director of the Center for Image-Guided Neurosurgery at the University of Pittsburgh Medical Center and an internationally recognized authority on stereotactic surgery, radiosurgery, and

minimally invasive surgery. He has authored or coauthored more than 1,000 scientific reports and 16 books.
With the added complexity of current radiation treatment dose delivery modalities such as IMRT (Intensity Modulated Radiation Therapy) and VMAT (Volumetric Modulated Arc Therapy), quality assurance (QA) of these plans become multifaceted and labor intensive. To simplify the patient specific quality assurance process, 2D or 3D diode arrays are used to measure the radiation fluence for IMRT and VMAT treatments which can then be quickly and easily compared

against the planned dose distribution. Because the arrays that can be used for IMRT and VMAT patient-specific quality assurance are of different geometry (planar vs. cylindrical), the same IMRT or VMAT treatment plan measured by two different arrays could lead to different measured radiation fluences, regardless of the output and performance of linear accelerator. Thus, the purpose of this study is to compare patient specific QA results as measured by the MapCHECK 2 and ArcCHECK diode arrays for the same IMRT and VMAT treatment plans to see if one diode array consistently provides a *closer comparison to reference data. Six prostate and three thoracic spine IMRT treatment plans as well as three prostate and three thoracic spine VMAT treatment plans were produced. Radiotherapy plans for this study were generated using the Pinnacle TPS v9.6 (Philips Radiation Oncology Systems, Fitchburg, WI) using 6 MV, 6 MV FFF, and 10 MV x-ray beams from a Varian TrueBeam linear accelerator (Varian Medical Systems, Palo Alto, CA) with a 120-millenium multi-leaf collimator (MLC). Each IMRT and VMAT therapy plan was measured on Sun Nuclear's MapCHECK 2 and ArcCHECK diode arrays. IMRT measured data* *was compared with planned dose distribution using Sun Nuclear's 3DVH quality assurance software program using gamma analysis and dose-volume histograms for target volumes and critical structures comparison. VMAT arc plans measured on the MapCHECK 2 and ArcCHECK were compared using beam-by-beam analysis with the gamma evaluation method with Sun Nuclear's SNC Patient analysis software. MapCHECK 2 showed a slightly better agreement with planned data for IMRT verifications with a mean pass rate of 99.4% for clinically used acceptance criteria of 3%/3mm. MapCHECK 2's 99.4% mean pass rate for IMRT verifications* *was 1.4% higher than ArcCHECK's mean pass rate. For VMAT verifications, the MapCHECK 2 had a mean pass rate of 99.6% and 100% for each arc respectively, resulting in a 1.25% to 1.92% higher mean passing rates than those measured by the ArcCHECK using an acceptance criteria of 3%/3mm. MapCHECK 2 showed consistently higher ROI-specific mean gamma passing rates, ranging from +0.2% to +5.6%. While neither diode array showed any advantage in regards to D95 measurements within the PTV, MapCHECK 2 again showed closer comparison data in the CTV/GTV with an absolute deviation of -1.14 Gy compared to*

-3.39 Gy as measured by the ArcCHECK. Lastly, while the MapCHECK 2 and ArcCHECK both closely matched with the reference doses within the PTV and CTV/GTV, the ArcCHECK consistently overestimated the maximum absolute dose to all ROI, from 0.026 Gy to 2.243 Gy. In conclusion, the MapCHECK 2 diode array measured data more closely matched with planned data compared to the ArcCHECK diode array for IMRT verifications. While MapCHECK 2 showed a marginally better gamma passing rates over the ArcCHECK diode array, the ArcCHECK's ability to simultaneously measure flatness, symmetry, output, and MLC

positional accuracy as a function of gantry angle make it a more realistic and efficient measurement device for VMAT verifications.
Usability Testing of Medical Devices covers the nitty-gritty of usability test planning, conducting, and results reporting. The book also discusses the government regulations and industry standards that motivate many medical device manufacturers to conduct usability tests.Since publication of the first edition, the FDA and other regulatory groups h
From diagnosis to treatment and continuous monitoring, imaging is one of the most important steps of cancer treatment.

Diagnostic imaging is a useful tool that allows healthcare professionals to obtain anatomical and physiological information from patients' in a non-invasive way. In Radiation Oncology, x-ray imaging is used to calculate the anatomical radiation dose as well as it can be a tool for assessing correct positioning of a patient through a treatment course. Image quality is a key factor in the process of cancer patient care for all the treatment team. Radiation Oncologists use Computed Tomography (CT) images to identify a tumor and delineate a target for radiation therapy planning. Medical Physicists fuse CT *images with images from other modalities such as MRI to help physicians in tumor anatomy contouring. The physicists also use the CT images for radiation treatment planning. Radiation Therapists use CT images to accurately position patients prior to radiation therapy sessions. Due to its importance in Radiation Oncology, the quality control of imaging systems is commonly incorporated into the quality assurance program in Radiation Oncology. This research has characterized the differences in image quality between two imaging modalities, Fan Beam CT (FBCT) and Cone Beam CT (CBCT). For* *the three scanners that we have in the University of Toledo Dana cancer center, two CBCT, Varian True Beam OBI CBCT and Varian Edge OBI CBCT, and one FBCT, Philips Gemini TF Big Bore PET/CT, were used for this study. We analyzed image quality using several routine scanning protocols on the three imaging systems. Seven parameters of image quality have been evaluated; slice thickness, spatial linearity, CT number accuracy, spatial resolution, low contrast detectability, contrast-to-noise ratio (CNR) and image uniformity. All tests were conducted using the Catphan-504 phantom.*

Image analysis was done using two methods, automated software and manual analysis. The automated software was RIT software (version 6.6) while the manual analysis was done using a software called MIM software (version 5.6). The comparison showed a similarity in all parameters except of the low contrast detectability, where the FBCT was superior to the CBCT. The latter finding may be attributed to the excess scattered radiation at the detector in CBCT, which in turn increases the noise and degrades the low contrast detectability.

Characterization of Image Quality Between

Multi-slice Computed Tomography and Cone Beam Computed Tomography for Clinical Used Protocols in Radiation Therapy Treatment Planning
Central Nervous System Metastases
Usability Testing of Medical Devices
Beam's Eye View Imaging in Radiation Oncology
Stereotactic Body Radiotherapy
Imaging is a critical component of the management of patients having radiotherapy. This book covers the basic principles of the main imaging modalities; site specific chapters give

best practice for individual tumour sites, and it also contains information on radioprotection and regulatory issues.

This book is a practical guide on image-guided robotic (CyberKnife®) radiosurgery of the brain and the spine. The volume introduces the radiosurgical community to the potential of image-guidance in the treatment of neurosurgical diseases including neuro-oncological, vascular and functional disorders. Principles of image-guided radiosurgery, including physics and radiobiology are considered. Each chapter provides a critical review of the literature and analyses of several aspects to offer an assessment of single and hypofractionated treatments. Based on the authors’ experience, tables or summaries presenting the treatment approaches and associated risks are included as well. Providing a practical guide to define the selection of dose, fractionation schemes, isodose line, margins, imaging, constraints to the structures at risk will support safe practice of neuroradiosurgery. This book aims to shed new light on the treatment of neoplastic and non-neoplastic diseases of the central nervous system using the CyberKnife® image-guided robotic radiosurgery system. It will be adopted by neurosurgery residents and neurosurgery consultants as well as residents in radiation oncology and radiation oncologists; medical physicists involved in radiosurgery procedures may also benefit from this book.

This first dedicated overview for beam's eye view (BEV) covers instrumentation, methods, and clinical use of this exciting technology, which enables real-time anatomical imaging. It highlights how the information collected (e.g., the shape and size of the beam aperture and intensity of the beam) is used in the clinic for treatment verification, adaptive radiotherapy, and in-treatment interventions. The chapters cover detector construction and components, common imaging procedures, and state of the art applications. The reader will also be presented with emerging innovations, including target modifications, real-time tracking, reconstructing delivered dose, and in vivo portal dosimetry. Ross I. Berbeco, PhD, is a board-certified medical physicist and Associate Professor of Radiation Oncology at the Dana-Farber Cancer Institute, Brigham and Women's Hospital and Harvard Medical School. Surface Guided Radiation Therapy provides a comprehensive overview of optical surface image guidance systems for radiation therapy. It serves as an introductory teaching resource for students and trainees, and a valuable reference for medical physicists, physicians, radiation therapists, and administrators who wish to incorporate surface guided radiation therapy (SGRT) into their clinical practice. This is the first book dedicated to the principles and practice of SGRT, featuring: Chapters authored by an internationally represented list of physicists, radiation oncologists and therapists, edited by pioneers and experts in SGRT Covering the evolution of localization systems and their role in quality and safety, current SGRT systems, practical guides to commissioning and quality assurance, clinical applications by anatomic site, and emerging topics including skin markless setups. Several dedicated chapters on SGRT for intracranial radiosurgery and breast, covering technical aspects, risk assessment and outcomes. Jeremy Hoisak, PhD, DABR is an Assistant Professor in the Department of

Radiation Medicine and Applied Sciences at the University of California, San Diego. Dr. Hoisak’s clinical expertise includes radiosurgery and respiratory motion management. Adam Paxton, PhD, DABR is an Assistant Professor in the Department of Radiation Oncology at the University of Utah. Dr. Paxton’s clinical expertise includes patient safety, motion management, radiosurgery, and proton therapy. Benjamin Waghorn, PhD, DABR is the

Director of Clinical Physics at Vision RT. Dr. Waghorn’s research interests include intensity modulated radiation therapy, motion management, and surface image guidance systems. Todd Pawlicki, PhD, DABR, FAAPM, FASTRO, is Professor and Vice-Chair for Medical Physics in the Department of Radiation Medicine and Applied Sciences at the University of California, San Diego. Dr. Pawlicki has published extensively on quality and safety in radiation therapy. He has served on the Board of Directors for the American Society for Radiology Oncology (ASTRO) and the American Association of Physicists in Medicine (AAPM).

Intracranial Stereotactic Radiosurgery

A Companion to Gunderson & Tepper's Clinical Radiation Oncology

IMRT, IGRT, SBRT

A practical Guide

Comparison of Different Imaging Strategies in IGRT for the Thoracic

Region Regarding Dose, Workflow and Image Quality

Respiratory caused intra-fraction motion is an important factor that can affect radiation treatment accuracy. Although the major effect of respiratory motion is in lung tumors, other tumor sites in thoracic and abdomen such as esophagus and liver cancer can also move significantly depending on patient's geometry. This thesis explains dosimetric discrepancy caused by respiratory motion during radiotherapy, describes different types of respiratory management system, and specifically discusses the clinical implementation of respiratory gating system including Varian RPM system commissioning, machine quality assurance, patient specific quality assurance, and dosimetric evaluation of gating Intensity Modulated Radiation Therapy (IMRT) treatment. In order to verify gated treatment plan, dynamic quality assurance phantoms have been developed to simulate patient's specific respiratory motion modifying traditional quality assurance devices. A Quasar respiratory motion phantom has been used to commission the Varian RPM system on CT simulator, Edge linear accelerator, and TrueBeam linear accelerator.

There exists a lack of accurate, reproducible three-dimensional dosimetry techniques for stereotactic radiosurgery (SRS) commissioning and quality assurance. This experiment evaluates the use of ClearView gel dosimeters as an alternative to current methods for small field dosimetry in SRS testing. ClearView differs from other gel dosimeters in that it uses tetrazolium salt in its chemical make-up in place of traditional Fricke-type compounds. Using a Varian TrueBeam radiotherapy system to deliver the radiation, three vials of ClearView gel dosimeter were tested in three different dose delivery scenarios. The first test examined the dosimeter’s response to a static beam with the dose isocenter targeted to the centroid of the vial. The second evaluation consisted of a full rotational SRS delivery about the center of the dosimeter. Lastly, a complete end-to-end treatment plan was performed to evaluate the accuracy of the dosimeter in a full SRS procedure. The three dosimeters were then scanned to measure the dose distribution throughout the gel. Finally, the resulting data was compared to the initial treatment plan to determine the accuracy of the gel. According to the comparisons performed, the ClearView gel showed capability of sub-millimeter spatial accuracy across the three evaluations, with a maximum geometric uncertainty of 1.2 mm. Based on these results, ClearView gel shows promise for possible use in SRS dosimetry applications in clinical settings.

Purpose: To determine the limit of detectability and resolution of the ArcCheck QA Phantom (Sun Nuclear, Inc.) for quality assurance of volumetric-modulated arc therapy and stereotactic radiosurgery procedures when used in small field sizes. Methods: Eight different square field sizes (0.6x0.6, 1x1, 2x2, 3x3, 5x5, 7x7, 10x10, 15x15 cm2) were measured on the ArcCheck QA phantom at three different gantry angles: 0, 90, and 270 degrees, using a 6 MV beam at its maximum dose rate of 600 MU/min and a dose computed from a 200 MU beam from the Varian Edge linear accelerator (Varian Medical Systems, Palo Alto, CA) at the University of Toledo Dana Cancer Center. Four different types of errors were introduced into quality-assurance analysis procedures. Measured square field sizes were compared against the same measured square field sizes with induced collimator and MLC errors. Induced collimator errors were defined by an expansion of the jaw-defined field size by 1 mm on all axes, a collimator shift of 1 mm on the X2 and Y2 axes, a table shift by 1 mm vertically and longitudinally at 270 and 90 degrees and a table shift of 1mm laterally and longitudinally for angles of 0 and 180 degrees. MLC induced errors included the addition of one and subsequently two opposing MLC leaves in the center of each square field. Dose distributions for the normal square fields and square fields with induced errors were imported into SNC patient software (Sun Nuclear Corporation, Melbourne, FL) in the form of DICOM RT dose files and measured dose distributions were compared between the normally measured square fields and fields containing induced errors. Percent pass rates were computed using gamma analysis criteria of 2 mm/2% with a threshold value of 20%. Point dose ratios were also analyzed for fields with induced MLC errors and output factors were calculated in order to determine the magnitude of the effect that these induced errors had on output measurements as compared with the ability of gamma criteria analysis in SNC to catch errors. A point dose calibration pertaining to each field size at each photon energy of the TrueBeam and Edge linear accelerators (Varian Medical Systems, Palo Alto, CA) was calculated by measuring a point dose at a range of field sizes at each energy (6 MV, 6 FFF and 10FFF for the Edge and 6 MV, 6FFF, 10 MV, and 18 MV for the TrueBeam) and dividing this number by the treatment planning system calculated point dose (calculated in Pinnacle) to obtain a cGy/MU dose calibration. An Extradin A16 Micropoint chamber (Extradin A1SL, Standard Imaging, Inc., Middleton WI) was placed in the center of the plug insert in the center of the ArcCheck phantom and a CNMC 206 electrometer (CNMC Instruments, Nashville, Tn) reading pertaining to a beam of 200 MU at different field sizes for each energy. The dose calibration factor for each energy was calculated and applied to six different patient-specific point dose QA analyses in order to determine the field size dependence of the dose calibration and to determine if the calibration improved the overall QA pass rate as well as the pass rate for individual fields for SRS QA. Finally, MLC errors were induced into three different patient-specific QA procedures performed on the Edge and TrueBeam linear accelerators. Two opposing MLC leaves were extended into the middle of the field (leaf position 30) at each control point of the first 180-180 degree clockwise field in each of the two patient QAs on the Edge and TrueBeam linear accelerators. The effect of extending the MLC leaves was analyzed using gamma analysis in SNC patient software. A point dose analysis of each QA was also taken into account and compared with the result measured using gamma criteria. Results: Examination of results in SNC patient software between measured normal fields and those with induced jaw field size errors indicate that the gamma criteria percent pass rates decrease significantly when errors are induced in the quality assurance analysis. Pass rates for a table shift and increase in field sizes by 1 mm on all axes of the square field indicate the greatest average errors for all gantry angles measured. Evidence of normal error detection was seen at a field size of 3x3 cm2 for a table shift at a 0-degree gantry angle. The field size at which normal error detection was seen by the ArcCheck was indicated at 2x2 cm2 for the 1mm margin errors induced at 90 degree and 270 degree gantry angles. The field size at which normal error detection was seen by the ArcCheck with MLC error induction into square field sizes was indicated at a field size of 2x2 cm2. Two QA procedures that did not improve by applying the field-size specific calibration factor decreased by an average of 0.44%. Three patient-specific quality assurance procedure dose distributions measured with an induced MLC error indicate that errors in MLC leaf position when applied to all control points of a full 360-degree arc are indicated with a lower percent gamma/DTA criteria pass rate. These pass rates were 77.4% and 96.1% on the Edge and 96.5% on the TrueBeam accelerator, respectively, when a measured normal dose distribution and a dose distribution with an induced MLC error were compared in SNC patient software. Of the six patient-specific quality assurance procedures for which a field-size specific point dose calibration factor was applied, four were improved significantly by an average of 87.6% with the application of a field-size specific calibration factor. Discussion and

Conclusion: This work indicates the potential for having the ability to detect potential errors in VMAT quality assurance for small field sizes using the ArcCheck QA phantom. The ability of the ArcCheck to detect uncertainties in quality assurance procedures is based on the size of the field and the position and spacing of the diode detectors. Gamma analysis and point dose measurements indicate a 3x3 cm2 field size as the smallest field size at which accurate quality assurance is analyzed. Pass rates resulting in an induction of

MLC errors in square field sizes can be utilized to predict pass rates resulting from the induction of MLC errors in patient-specific quality assurance procedures. It is suggested that a field-size specific CGy/MU calibration factor is utilized in order to more accurately predict patient-specific point dose measurements.

Exploring RayStation Treatment Planning SystemCommissioning Varian TrueBeam Photon and Electron Energies, and the Feasibility of Using FFF Photon Beam to Deliver

Conventional Flat Beam
Practical Clinical Oncology
Practical Radiation Oncology Physics
Evaluation of Dose Calculations and Couch Positional Accuracy in the Context of Dynamic Couch Trajectories
Handbook of Radiotherapy Physics
Low Energy Particle Accelerator-Based Technologies and Their Applications

Organized to serve as a ready reference, this book covers the design & principles of operation of microwave electron linear accelerators for the radiation treatment of cancer. Designed for use by persons without extensive knowledge & experience of accelerator technology, the book assumes a knowledge of elementary physics & mathematics & places its emphasis on how accelerators actually function & how they are used in cancer treatment. Coverage includes the history of development & application, general theory of acceleration, accelerator systems, radiation beam systems & associated equipment, performance characteristics, testing & use. The major modules of a representative medical accelerator are described, including principles of operation & how these models function collectively to produce electron & X-ray beams for radiotherapy.

The ability of an imaging system to accurately identify patient anatomy and provide reliable tumor information is critical in the radiation treatment planning process. As image guided radiation therapy and adaptive radiation therapy become more prevalent in treatment procedures, the image quality of these systems could perhaps be a limiting factor in their effectiveness. This research is intended to explore the differences in image quality between two separate imaging modalities commonly used in radiation therapy. A Philips Gemini TF Big Bore PET/CT and Varian True Beam On-Board kV cone beam CT imager were both assessed using the Catphan 504 image quality phantom. Ten different tests were evaluated with the phantom using several routine imaging protocols from both systems. Overall, the image quality between the cone beam and CT system was fairly consistent with one another with the exception of the low contrast detectability measurements. The effects of scatter radiation and image noise significantly reduced the cone beams ability to detect low contrast objects which ultimately degraded its image quality compared to CT.

This book provides a comprehensive overview of brain metastases, from the molecular biology aspects to therapeutic management and perspectives. Due to the increasing incidence of these tumors and the urgent need to effectively control brain metastatic diseases in these patients, new therapeutic strategies have emerged in recent years. The volume discusses all these innovative approaches combined with new surgical techniques (fluorescence, functional mapping, integrated navigation), novel radiation therapy techniques (stereotactic radiosurgery) and new systemic treatment approaches such as targeted- and immunotherapy. These combination strategies represent a new therapeutic model in brain metastatic patients in which each medical practitioner (neurosurgeon, neurologist, medical oncologist, radiation oncologist) plays a pivotal role in defining the optimal treatment in a multidisciplinary approach. Written by recognized experts in the field, this book is a valuable tool for neurosurgeons, neuro-oncologists, neuroradiologists, medical oncologists, radiation oncologists, cognitive therapists, basic scientists and students working in the

area of brain tumors.
Modern radiation therapy has heavily evolved over the past decade: the introduction of technologies such as multi-leaf collimators (MLCs) and enhancement dynamic edges (EDWs) have allowed one to maximize dose to the target volume while minimizing dose to organs-at-risk. Along with these, new treatment techniques have also evolved in order to increase the efficiently of treatment planning. The introduction of intensity-modulated radiation therapy (IMRT) and volumetric-modulated arc therapy (VMAT) have maximized the ability to create optimal treatment plans. Within the past few years, there has been a focus on studying the clinical impact of the treatment couch in treatment planning. With the heavy

use of arc therapy, there are portions of the beam that will pass through the treatment couch on the posterior sides of the patient. It was originally thought that the couch did not have any significant dosimetric effects, due to the light density of the carbon fiber shell and interior foam that makes up the treatment couch. However, new studies have disproved this, and heavy research has gone into modeling the treatment couch in the treatment planning system in order to study the dosimetric impact. The goal of this research was to study this effect using the RayStation v.8A treatment planning system. For this study, a kVue Calypso 6D couch support by guard rails for an Edge linear accelerator, and a TrueBeam utilizing a Varian IGRT couch was analyzed.

Both couch tops involve a carbon fiber shell that contains a low-density foam interiorly. A paper written by Alessandro Savini et al presents two methods to couch modeling: the use of CT scans and the use of geometric modeling. Since the modeling approach is both easier to implement and agrees closely to the use of CT scans, this method was used. The geometric models of the couches were made using the MIM_64 contouring software, and the appropriate densities of the materials were assigned in RayStation 8A. With the couch models in Raystation, treatment plans for the following sites were created using VMAT: brain, breast, lung, liver, and prostate. For each site, 5 patients were selected, and plans were created on both the Edge and TrueBeam linear accelerators. With these plans made on both machines, the quality assurance (QA) plans were generated in RayStation and compared with and without the treatment couch. These plans were measured using an ArcCheck, as well as using a special insert for an A16 micro ion chamber to compare the dose per fraction with and without the treatment couch model.

Principles and Clinical Applications

Radiotherapy in Practice - Imaging

Commissioning Varian TrueBeam Photon and Electron Energies, and the Feasibility of Using FFF Photon Beam to Deliver Conventional Flat Beam

Principles and Practice of Image-Guided Radiation Therapy of Lung Cancer

Encyclopedia of Radiation Oncology

Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy (SBRT) is a comprehensive guide for the practicing physician and medical physicist in the management of complex intracranial and extracranial disease. It is a state-of-the-science book presenting the scientific principles, clinical background and procedures, treatment planning, and treatment delivery of SRS and SBRT for the treatment of tumors throughout the body. This unique textbook is enhanced with supplemental video tutorials inclusive to the resource. Beginning with an overview of SRS and SBRT, Part I contains insightful coverage on topics such as the evolving radiobiological principles that govern treatment, imaging, the treatment

planning process, technologies and equipment used, as well as focused chapters on quality assurance, quality management, and patient safety. Part II contains the clinical application of SRS and SBRT for tumors throughout the body including those in the brain, head and neck, lung, pancreas, adrenal glands, liver, prostate, cervix, spine, and in oligometastatic disease. Each clinical chapter includes an introduction to the disease site, followed by a thorough review of all indications and exclusion criteria, in addition to the important considerations for patient selection, treatment planning and delivery, and outcome evaluation. These chapters conclude with a detailed and site-specific dose constraints table for critical structures and their

suggested dose limits. International experts on the science and clinical applications of these treatments have joined together to assemble this must-have book for clinicians, physicists, and other radiation therapy practitioners. It provides a team-based approach to SRS and SBRT coupled with case-based video tutorials in disease management, making this a unique companion for the busy radiosurgical team. Key Features: Highlights the principles of radiobiology and radiation physics underlying SRS and SBRT Presents and discusses the expected patient outcomes for each indicated disease site and condition including a detailed analysis of Quality of Life (QOL) and Survival Includes information about technologies used for the treatment of SRS and SBRT

Richly illustrated with over 110 color images of the equipment, process flow diagrams and procedures, treatment planning techniques and dose distributions 7 high-quality videos reviewing anatomy, staging, treatment simulation and planning, contouring, and management pearls Dose constraint tables at the end of each clinical chapter listing critical structures and their appropriate dose limits Includes access to the fully-searchable downloadable eBook

Over the last 4 years, IMRT, IGRT, SBRT: Advances in the Treatment Planning and Delivery of Radiotherapy has become a standard reference in the field. During this time, however, significant progress in high-precision technologies for the planning and delivery of radiotherapy in cancer treatment has called for a second edition to include these new developments. Thoroughly updated and extended, this new edition offers a comprehensive guide and overview of these new technologies and the many clinical treatment programs that bring them into practical use. Advances in intensity-modulated radiotherapy (IMRT), and 4D and adaptive treatment planning are clearly presented. Target localization and image-guided radiotherapy (IGRT) systems are comprehensively reviewed as well. Clinical tutorials illustrate target definitions for the major cancer sites, and useful techniques for organ motion management are described and compared. There are also several chapters that explore the technical basis and latest clinical experience with stereotactic body radiotherapy (SBRT) and summarize practical treatment recommendations. Furthermore, the significant and increasing contributions of proton therapy to cancer care are also highlighted, alongside the practical allocation of all these new technologies from an economic perspective. As a highlight of this volume, a number of images can be viewed online in time-elapse videos for greater clarity and more dynamic visualizationWritten by leading authorities in the field, this comprehensive volume brings clinical and technical practitioners of radiotherapy fully up to date with the key developments in equipment, technologies and treatment guidelines. RayStation, a new treatment planning system (TPS), was

purchased and recently commissioned for clinical use by the institution. As part of the commissioning process, an accurate model of the TrueBeam linear accelerator was made prior to clinical acceptances. Data collection, importing measurements, beam modeling, point dose verifications and clinical plan comparisons are procedures that must be done in order to complete the commissioning of photon and electron energies. During the beam modeling process, various parameters were modified to achieve close matches between the computed and measured PDD curves, as well as measured and computed beam profiles. The tolerance objectives were to have computed data deviating from the measured data within the 2% in fall-off regions, 3%

tolerance within in-field and out-of-field regions, and 10% tolerance in build-up regions and penumbra regions [1] . The dosimetric validation procedure followed. Point dose measurements were completed using both the ArcCHECK phantom and the water tank. The majority of the results met the set criteria except for some measurements blocked by MLC leaves or jaws when taken adjacent to the edge of fields. To further confirm the goodness of modeled beams, clinical treatment plans developed with the previously clinically commissioned Pinnacle TPS and imported into the RayStation TPS to generate new plans with same beam arrangements and control points and used as comparisons. After clinical commissioning was completed for RayStation software, a

feasibility of using FFF beams to deliver identical or superior beam profile provided by conventional flattened beams of the same energy was investigated. The objective of this research was to show that through sliding window treatment planning, one can create optimized plans and hence no longer the technology of flattening filter is required in modern linear accelerators. To explore this topic, a two stage analysis was carried out. First, delivering doses in a water cube with 10 × 10 to 30 × 30 cm2 open-field 6 MV flattened beams and also create 0.1cm thick square plane structures to be used when undergo the optimization process with 6 FFF beams. Then scaling doses to prescribe 100 cGy at the center of the plane for comparison purpose. The overall

uniformity of line profile for FFF beams across the CAX at 10 cm depth showed 1% to 2% superior to flattened beams. For the clinical treatment plans comparison, ten patients were selected with five head and neck cancer plans as well as five lung and mediastinum cancer plans. Original plans were all completed with 6 MV flattened beams and approved by radiation oncologists. New plans were accomplished with 6 FFF beams and same coverages of PTVs were achieved. Most of average mean doses to critical structures and normal tissue volumes receiving 5%, 10%, 20% and 30% of the prescription dose were reduced with FFF plans with slightly increased average max doses.

Written by internationally known experts in the field,

Stereotactic Radiosurgery and Stereotactic Body Radiation Therapy examines one of the fastest-developing subspecialties within radiation oncology. These procedures deliver large doses of radiation in one to five sessions to a precisely determined target. Often these techniques have proven to be as or more effective than traditional radiation therapy techniques, while at the same time being cost-efficient and convenient for the patient. These techniques, however, require careful planning, specialized equipment, and well-trained staff. This volume provides a cutting-edge look at the biological and technical underpinnings of SRS and SBRT techniques. It includes a history of the development of SRS and SBRT; clinical applications of the techniques;

dedicated devices for delivering precisely shaped, high doses of radiation; use of in-room imaging for treatment planning and treatment guidance; immobilization techniques for accurate targeting; and future developments that will continue to evolve and refine existing techniques. A valuable introduction to those just learning about these specialized techniques, and an ideal reference for those who are already implementing them, this book covers a wide variety of topics, with clear discussions of each aspect of the technology employed.

Stereotactic Body Radiation Therapy

Exploring RayStation Treatment Planning System

Management of Early Stage Breast Cancer

An Investigation Into the Accuracy of the Photon Beam

Energy Spectrum Modeled by the Pinnacle Treatment Planning System and Its Effects on Treatment Planning

Evaluating the Dosimetric Impact of Treatment Couch Modeling in the RayStation TPS

Image-guided radiation therapy (IGRT) is one of the most sophisticated application of modern radiation oncology. During an IGRT procedure, an online image is taken of the patient, lying on the treatment couch. After registration of the online and topometric images, the patient is moved with the couch to the treatment position. Using IGRT it is possible to increase the precision and accuracy of radiotherapy, and therefore to reduce safety margins during treatment planning. Different imaging procedures are available on Varian

TrueBeam machine these are planar images with kilovoltage (kV) or megavoltage (MV) energies and kilovoltage Cone-Beam Computed Tomography (kV-CBCT). In the case of MV planar imaging we measured 6 MV energy with 1.5 and 3 Monitor Units. In the case of planar kV imaging we used with 3 different kV values and 4 different mAs values. In case of kV-CBCT we used the same 3 kV parameters as for planar kV images, but we set only 270 mAs.There are many opportunities to measure the dose which come from IGRT. In our study, we used thermoluminescent dosimeters (TLDs), the RTI Barracuda system and CTDI phantom. The image quality is also an important factor, which was evaluated by the IBA Primus L phantom and Catphan 504 phantom. We measured the necessary time for all the three modalities. We collected the dose results, the line pair resolution, the low and high contrast resolution and the summary of points which originate from the human observers' ratings. The lowest dose was measured in the planar kV imaging. The following is the kV-CBCT. The highest dose can be attributed to the MV imaging.140 kV with 10 mAs had the worst low and high contrast resolution, because the saturation of the detector. In some case the low and the high contrast test items are getting undetectable, because too much photon are incident to the detector.In planar MV imaging and kV-CBCT imaging, the machine's default setting is acceptable to be used in the daily routine. In kV images, it is possible to reduce mAs, because it reduces the dose of the phantom surface while the image quality remains acceptable.*****Image-guided radiation therapy (IGRT) is one of the most sophisticated application of modern radiation oncology. During an IGRT procedure, an online image is taken of the patient, lying on the treatment couch. After registration of the online and topometric images, the patient is moved with the couch to the treatment position. Using IGRT it is possible to increase the precision and accuracy of radiotherapy, and therefore to reduce safety margins during treatment planning. Different imaging procedures are available on Varian TrueBeam machine these are planar images with kilovoltage (kV) or megavoltage (MV) energies and kilovoltage Cone-Beam Computed Tomography (kV-CBCT). In the case of MV planar imaging we measured 6 MV energy with 1.5 and 3 Monitor Units. In the case of planar kV imaging we used with 3 different kV values and 4 different mAs values. In case of kV-CBCT we used the same 3 kV parameters as for planar kV images, but we set only 270 mAs.There are many opportunities to measure the dose which come from IGRT. In our study, we used thermoluminescent dosimeters (TLDs), the RTI Barracuda system and CTDI phantom. The image quality is also an important factor, which was evaluated by the IBA Primus L phantom and Catphan 504 phantom. We measured the necessary time for all the three modalities. We collected the dose results, the line pair resolution, the low and high contrast resolution and the summary of points which originate from the human observers' ratings. The lowest dose was measured in the planar kV imaging. The following is the kV- CBCT. The highest dose can be attributed to the MV imaging.140 kV with 10 mAs had the worst low and high contrast resolution, because the saturation of the detector. In some case the low and the high contrast test items are getting undetectable, because too much photon are incident to the detector.In planar MV imaging and kV-CBCT imaging, the machine's default setting is acceptable to be used in the daily routine. In kV images, it is possible to reduce mAs, because it reduces the dose of the phantom surface while the image quality remains acceptable.

Modern medical imaging and radiation therapy technologies are so complex and computer driven that it is difficult for physicians and technologists to know exactly what is happening at the point-of-care. Medical physicists responsible for filling this gap in knowledge must stay abreast of the latest advances at the intersection of medical imaging and radiation therapy. This book provides medical physicists and radiation oncologists current and relevant information on Adaptive Radiation Therapy (ART), a state-of-the-art approach that uses a feedback process to account for patient-specific anatomic and/or biological changes, thus delivering highly individualized radiation therapy for cancer patients. The book should also benefit medical dosimetrists and radiation therapists. Adaptive Radiation Therapy describes technological and methodological advances in the field of ART, as well as initial clinical experiences using ART for selected anatomic sites. Divided into three sections (radiobiological basis, current technologies, and clinical applications), the book covers: Morphological and biological biomarkers for patient-specific planning Design and optimization of treatment plans Delivery of IMRT and IGRT intervention methodologies of ART Management of intrafraction variations, particularly with respiratory motion Quality assurance needed to ensure the safe delivery of ART ART applications in several common cancer types / anatomic sites The technology and methodology for ART have advanced significantly in the last few years and accumulated clinical data have demonstrated the need for ART in clinical settings, assisted by the wide application of intensity modulated radiation therapy (IMRT) and image-guided radiation therapy (IGRT). This book shows the real potential for supplying every patient with individualized radiation therapy that is maximally accurate and precise.

Perfect for radiation oncologists, medical physicists, and residents in both fields, Practical Radiation Oncology Physics provides a concise and practical summary of the current practice standards in therapeutic medical physics. A companion to the fourth edition of Clinical Radiation Oncology, by Drs. Leonard Gunderson and Joel Tepper, this indispensable guide helps you ensure a current, state-of-the art clinical practice. Covers key topics such as relative and in-vivo dosimetry, imaging and clinical imaging, stereotactic body radiation therapy, and brachytherapy. Describes technical aspects a.

Dosimetric Verification of Respiratory-gated Radiation Therapy Using a Dynamic Phantom for Commissioning the Varian Real-time Position Management System

The Limit of Resolution and Detectability of the ArcCHECK QA Phantom in Small Field Volumetric Modulated Arc Therapy and Stereotactic Radiosurgery Quality Assurance