ACPSEM NZ PEM

13-14 May 2024
Palmerston North

NEW ZEALAND PHYSICS AND ENGINEERING IN MEDICINE NZPEM-2024

Palmerston North Conference & Function Centre, 354 Main St, Palmerston North

WELCOME TO PALMERSTON NORTH !

The New Zealand Medical Physics and Engineering community is once again coming together for two days to exchange ideas, share knowledge and foster collaboration.

The theme of this year's conference is *"Harnessing Diversity in New Zealand Medical Physics for Creative Clinical Solutions"*.

Thank you for joining us to celebrate the wide cultural diversity in our profession as a driving force for creativity and innovation!

Organisers contacts: Tania Groudeva | taniagr@mdhb.health.nz
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Invited Speakers

Pavlina Venkova

EMBRACING CULTURAL DIVERSITY TO OPTIMIZE TEAM PRODUCTIVITY

Pavlina Venkova is a marketing and communications professional passionate about technology, and the dynamic landscape of traditional and digital media. With over 20 years of experience, her expertise spans content creation, corporate communications, and tech solutions marketing within multinational, multicultural environments.

She holds a master's degree in English and American Studies from Sofia University St. Kliment Orchridski (Bulgaria) and an MBA from the University of Lincoln (UK).

Pavlina Venkova will share insights on the importance of cultural diversity in the context of a multinational professional environment.

Prof Joanne Hort PhD

IMAGING TASTE PERCEPTION | John Strong Memorial Lecture

Prof Hort is Fonterra Riddet Chair in Consumer & Sensory Science and Director of Feast, the Food Experience and Sensory Testing Lab at Massey University in New Zealand. Prior to moving to New Zealand, Joanne was SABMiller Chair at the University of Nottingham in the UK.

Her research focuses on a multidisciplinary approach to understanding the factors affecting flavour perception and consequent choice behaviours.

This has included collaborations with colleagues at the University of Nottingham using fMRI to better understand taste and flavour perception. She has authored 130 publications and is a Fellow of the UK Institute of Food Science and Technology (IFST), Member of the NZIFST and the Royal society of New Zealand. She is a Director of the international Pangborn Sensory Science Trust, sits on the editorial board of Food Quality and Preference and is a founder member and past Chair of the European Sensory Science Society.

***Abstract**: Taste, as opposed to flavour, is an innate mechanism that has evolved to enable humans to consume nutrients and avoid harm, although taste perception and preferences vary considerably across individuals. In this talk going beyond medical physics, Professor Hort will explore the application of functional Magnetic Resonance Imaging (fMRI) to better understand the brain's response to taste stimuli. Presenting research conducted with her colleagues at the University of Nottingham, she will take the audience through the application of fMRI to develop a gustotopic map pinpointing where different taste sensations are processed in the brain, alongside investigations into individual variation in taste response and its manifestation in the brain.*

Invited Speakers

Dr Prabhakar Ramachandran, Ph.D., DABR

OPTIMIZING CBCT IMAGES QUALITY WITH ADVANCE DEEP LEARNING ALGORITHMS

Dr. Prabhakar Ramachandran, with over 27 years of experience in the field of Medical Physics, currently serves as the Director of Medical Physics at Princess Alexandra Hospital in Brisbane, AU. Dr. Ramachandran has authored more than 86 publications, including 36 as the first author. He holds adjunct faculty positions at Queensland University of Technology and the University of Queensland, as well as an overseas professorship at Anna University. His research interests span real-time dosimetry, treatment planning, 4D imaging, radiation dosimetry, and the development of deep learning models in radiotherapy

Stephen Chadwick

A JOURNEY THROUGH THE MILKY WAY

Astrophotography at the Social Evening, Focal Point Cinema

Stephen has been involved with astrophotography for 20 years. His book, *Imaging the Southern Sky*, was the first dedicated to photographing deep-sky objects in the Southern Hemisphere.

He enjoys inspiring the public to take an interest in astronomy, through combining scientific information with aesthetically beautiful images of astronomical objects.

During the day he is a lecturer at Massey University.

Dr Dayananda Sharma, PhD, Dip R P, MCMPI

COMMISSIONING OF TREATMENT PLANNING CALCULATION ALGORITHM FOR INTENSITY MODULATED PROTON BEAM THERAPY

Dr Sharma is a Professor and Head of the Medical Physics Department at Apollo Proton cancer Centre, Chennai, India, with 25 years experience in the field. He has led the commissioning of the first Proton therapy Facility in South East Asia and Middle East and is recipient of multiple awards for his publications in international conferences.

Key dates

- **12 May, 18:00** - Unofficial meet-and-greet at the “Brew Union”, 41 Broadway Av.
- **13 May, 08:30** - NZPEM-2024 begins at the Palmerston North Conference Centre, 354 Main St.

  07:30 - On-site registration.
- **13 May, 18:00** - Social evening, Focal Point Cinema, 223 Cuba St.
- **14 May, 15:00** – NZPEM ends.

Monday, 13 May, Palmerston North Conference Centre Registration from 07:30	
Session 1	Conference room | Chair: Tim O'Brien, Tania Groudeva
08:30 – 09:00	**Conference opening** *Mandy Smith, Associate Director of Allied Health, MidCentral DHB*
09:00 – 09:20	**Embracing Cultural Diversity To Optimize Team Productivity** *Pavlina Venkova, Global Tech Content Manager, Akkodis Bulgaria*
09:20 – 10:00	John Strong Memorial Lecture: **Imaging Taste Perception** *Prof. Joanne Hort, Massey University*
10:00 – 10:30 Morning tea	
Session 2	Conference room | Chair: Iordan Kostourkov
10:30 – 10:45	**RadCalc 3D commissioning and early clinical experience** *Sophie Halliday | Wellington Blood & Cancer Centre*
10:45 – 11:00	**The development of new tools for the evaluation of treatment plans where air cavities exist in the target volume** *Karla Hayward, Alicia Moggré, Steven Marsh, Victoria Beenstock | Canterbury DHB*
11:00 – 11:15	**Electron backscatter from Al, Cu, and Pb in intraoral electron shields** *R. Hobbs, N. Schleich, A. Williams | Wellington Blood & Cancer Centre*
11:15 – 11:30	**Commissioning of PTW 60019 Microdiamond detector for relative dosimetry in 6FFF beams** *Oscar Ma | MidCentral DHB*
11:30 – 11:45	**Validation of FilmQA Pro software for patient specific QA using EPID dosimetry** *Donna Jimmy, Tania Groudeva | MidCentral DHB*
11:45 – 12:00	**Clinical Implementation of an EPID in-vivo Dosimetry Monitoring System** *Ivy Au | Auckland Radiation Oncology*
12:00 – 12:15	*Gold Sponsor presentation, AlphaXRT*
12:15 – 13:15 Lunch break	
Session 3	Conference room | Chair: Steven Muir
13:15 – 13:30	**Efficacy of Differing Surgical Lead Gowns from Small and Large Scattering Sources: Minimizing Risk Through Safe Fluoroscopic Practices** *Brett Cunningham | Roentgen Analytical*
13:30 – 13:45	**Calculating Effective Dose for CT** *Steven Muir | Canterbury DHB*
13:45 – 14:00	**The human touch: Incident response is not what your theranostic protocol expected** *Troy Smith | Southern DHB*
14:00 – 14:15	**Simulation of time varying B0 fields during MRI image acquisition using PhoenixMR** *Phillip Duncan-Gelder*, Steven Marsh, Phil Bones, Darin O'Keeffe | *Southern DHB*
14:15 – 14:30	**On the use of Optically Stimulated Luminescent Detectors (OSLDs) in a Dose Audit of Total Body Irradiation (TBI) Arrangements** *Vaibhav Sharma | Auckland DHB*
14:30 – 14:45	*Gold Sponsor presentation, Varian*
14:45 – 15:15 Afternoon tea break	
Session 4	Conference room | Chair: Tania Groudeva
15:15 – 15:30	*Gold Sponsor presentation, Elekta*
15:30 – 16:00	**Optimizing CBCT Images Quality with Advance Deep Learning Algorithms** *Dr Prabhakar Ramachandran | Princess Alexandra Hospital, Brisbane, Australia*
16:00 – 16:30	**Commissioning of Treatment Planning Calculation Algorithm for Intensity Modulated Proton Beam Therapy** Dr Dayananda Sharma / Apollo Proton Cancer Center, Chennai, India
16:30 – 16:40	*Silver Sponsor presentation, GIB*

Social evening, Focal Point Cinema and Café

18:00 – Refreshments | 18:30 – "A journey through the Milky Way" by Stephen Chadwick | 19:00 – Dinner

Tuesday, 14 May 2024	
Session 5	Conference room |Chair: Alicia Moggré
08:30-08:50	**ACPSEM NZ Branch meeting at NZPEM** This session will be a relatively informal meeting to provide a chance for NZ Branch members to meet any members of the Branch committee in attendance, hear about ACPSEM plans to support Branch activities, and discuss Branch priorities and processes.
08:50-09:10	**Cultural safety update,** Lisa Te Paiho, MIRO - Māori in Radiation Oncology This session will discuss the importance of being culturally safe and inform us about work going on in this area around the country to improve the cultural safety of our patients and staff including the MIRO - Māori in Radiation Oncology group.
	NZ Departments update
09:10 – 09:15	*Southern DHB*
09:15 – 09:20	*Canterbury DHB*
09:20 – 09:25	*St George's Centre, Christchurch*
09:25 – 09:30	*Icon Cancer Centre Bowen, Wellington*
09:30 – 09:35	*Wellington Blood and Cancer Centre*
09:35 – 09:40	*MidCentral DHB*
09:40 – 09:45	*Waikato DHB*
09:45 – 09:50	*Kathleen Kilgour Centre, Tauranga*
09:50 – 09:55	*Auckland Radiation Oncology*
09:55 – 10:00	*Auckland DHB*
10:00 – 10:30 Morning tea	
Session 6	**Peer review session on EPID dosimetry implementation** Conference room | Chair: Gray Lu
10:30 – 10:40	*Gray Lu, Rebecca Day | Wellington Blood and Cancer Centre*
10:40 – 10:50	*Kelvin Hiscoke | Icon Cancer Centre Bowen Wellington*
10:50 – 11:00	*Dineli Alahakone | Southern DHB*
11:00 – 11:10	*Ivy Au | Auckland Radiation Oncology*
11:10 – 11:20	*Tania Groudeva | MidCentral DHB*
11:20 – 11:30	*Fadil Rhani | Kathleen Kilgour Centre, Tauranga*
11:30 – 11:40	*Alicia Moggré | Canterbury DHB*
12:00 – 13:00 Lunch break	
Session 7	Conference room | Chair: Alicia Moggré
13:00 – 14:00	**ROMP TEAP Session** This session aims to cover a number of topics that will be of interest to ROMP TEAP supervisors and registrars along with those who have an interest in registrar training in New Zealand. Content will include: • An update from the New Zealand Clinical Training Coordinator Christine Thompson and Preceptor Alicia Moggré on progress and outcomes of the New Zealand ROMP TEAP training scheme, as well as current and upcoming initiatives to support registrars, supervisors and trainers; • Presentations from periodic progress review assessor Iordan Kostourkov and clinical and scientific reports assessor Alicia Moggré about how registrars can approach these to avoid common pitfalls and get the most benefit from these tasks; • A chance for clinics to share experiences in how registrar training is planned and scheduled within their department; • There will be a chance for the attendees to share experiences and discuss best practice in TEAP training.
14:00 – 14:15	**Medical Physics at the University of Canterbury** *Steven Marsh*
14:15 – 15:00	Prize giving and closing

RadCalc 3D commissioning and early clinical experience

Sophie Halliday | Wellington Blood & Cancer Centre

Introduction

RadCalc 3D dose calculations for 6 MV beams using a collapsed cone convolution superposition (CCC) beam model have been commissioned and released for clinical use at Wellington Blood and Cancer Centre.

Method

The 6 MV CCC beam model was commissioned and evaluated against data measured in homogenous and heterogeneous phantoms. Commissioning guidance was taken from vendor documentation and AAPM TG-219 [1].

Upon clinical release, the metrics used to assess each plan were reference point 3D dose deviation within ±5%, and a minimum 90% pass rate for a 3%/2mm local gamma criteria. The gamma pass rate was applied as a soft constraint, while the reference point dose deviation was a hard constraint. Since clinical release, 90 plans that were calculated using the Varian analytical anisotropic algorithm (AAA) in Eclipse have been assessed.

Results

There was good agreement between the 3D CCC dose calculation and the measured commissioning data. Water phantom PDDs agreed within ±0.3% at depths >1 cm. Profiles were within ±0.7% over the central 80% for jaw defined square fields 5-40 cm. Profiles for MLC defined square fields 2-5 cm were optimized such that the central 80% matched within ±1.2% in the cross plane direction (i.e. across the leaf tips). RadCalc MLC modeling only applies in the leaf tip direction. Profiles in the in plane (leaf edge) direction could not be optimized.

For the first 90 clinical plans, the mean reference point 3D dose deviation was -0.2% S.D. 1.3%, with no 3D reference dose point deviations exceeding the ±5% tolerance. Only 56 plans had a local gamma pass rate >90%. Patterns of failure in the gamma analysis tended to be in the periphery of the body contour and in low dose regions of the dose distribution. It is suspected that the lack of modelling of the MLC leaf edge contributes to the poor local gamma results.

Conclusion

RadCalc 3D dose calculations using a CCC model have proven to be useful for verifying the dose calculated using the local treatment planning system for 6 MV beams. Early experience with 3D RadCalc suggests that further investigation into the gamma analysis tolerance and settings are needed in order to improve the quantity of plans meeting the gamma pass rate criteria and to understand the reason for the failure.

References

[1] Zhu TC, Stathakis S, Clark JR, Feng W, Georg D, Holmes SM, Kry SF, Ma CM, Miften M, Mihailidis D, Moran JM. (2021) Report of AAPM Task Group 219 on independent calculation-based dose/MU verification for IMRT. Medical physics. Oct;48(10):e808-29. https://doi.org/10.1002/mp.15069

The development of new tools for the evaluation of treatment plans where air cavities exist in the target volume

Karla Hayward, Alicia Moggré, Steven Marsh, Victoria Beenstock | Canterbury DHB

Introduction

Evaluation and validation of radiation therapy treatment plans rely on assessing dose distributions in planning target volumes (PTVs) and organs at risk (OARs) against dose/volume metrics. While well-established tools for assessment do exist, some have limitations, especially in considering dose variations in clinically relevant sub-regions. The effect of these limitations become more evident in the presence of heterogeneities such as air cavities. Information from these new tools could be crucial for informed planner decision-making under certain conditions. This study aims to introduce these new tools used to better understand the localization of dose and its uncertainties.

Method

A novel metric, the mean dose to rinds surrounding an air cavity within the PTV, was developed to compare plan quality between different planning methods in the context of variations in cavity size during treatment. A custom algorithm was developed to localise film regions against corresponding plan structures, quantifying uncertainty in dose deposition in relevant PTV or OARs. These methods were tested using head and neck plans using three different planning methods for four patients with air cavities in the PTV. Variations in cavity size were simulated for planning studies and phantom-based film validation measurements.

Results

The mean dose to rinds metric allowed for direct comparison of the effects of different planning methods on dose calculations in tissue surrounding an air cavity as the cavity size changed. Film-based measurements confirmed mean doses in these structures against planning system outputs. The ability to localise the dose to structures gives more insight into how the dose distribution is affected in given regions by planning method as the cavity size changed.

Conclusion

The developed dose metrics and film assessment tools hold promise for future plan quality assessments in clinical settings with transient air cavities, or for phantom-based plan validation of treatments with high requirements on geometric accuracy such as spine SRT.

Electron backscatter from Al, Cu, and Pb in intraoral electron shields

R. Hobbs, N. Schleich, A. Williams | Wellington Blood and Cancer Centre

Introduction

Dose enhancement from electron backscatter is an important factor to consider when designing intraoral electron shields. Dose enhancement at a lead-tissue interface can be as high as 60% and must be minimised by using additional lower atomic number material upstream from the lead. Materials such as aluminium, copper, and wax, are used to minimise shield thickness, but backscatter contributions from the aluminium and copper are often neglected.

At Wellington Blood and Cancer Centre (WBCC) the dose enhancement from lead backscatter is taken into account, 5% of which is permitted to reach the patient. We present an update to our procedure that includes the dose enhancement from aluminum and copper backscatter in our calculation and permits a larger tolerance on the backscatter dose enhancement of 10%. This will allow the construction of thinner intraoral multi-material shields.

Method

Dose enhancement predictions for electron backscatter from aluminium, copper, and lead were made using the atomic number specific formulae of Klevenhagen *et al.* (henceforth the Z-specific technique) and verified using Monte Carlo (MC) simulations [1-3]. The agreement of both methods was determined for hypothetical single-material shields and for clinically relevant multi-material combinations and compared to our present lead-only technique.

Results

For single material shields, the Z-specific technique agrees with the MC dose enhancement within 7% for 6 MeV beams and 5% for 9 and 12 MeV beams.

Initial results for multi-material shields for 6 MeV beams show that the Z-specific technique overestimates the dose enhancement by up to 3%. Conversely, the lead-only technique underestimates the backscatter at the tissue-shield interface by up to 10%.

Conclusion

The proposed Z-specific technique is superior to the lead-only technique. The revised technique will be implemented for clinical use.

References

[1] Klevenhagen SC, Lambert GD, Arababi A (1982) Back-scattering in electron beam therapy for energies between 3 and 35 MeV. Phys Med Biol 27:363-73. https://doi.org/10.1088/0031-9155/27/3/003
[2] Lambert GD, Klevenhagen SC (1982) Penetration of backscattered electrons in polystyrene for energies between 1 and 25 MeV. Phys Med Biol 27(5):721-725. https://doi.org/10.1088/0031-9155/27/5/007
[3] Rodrigues A, Sawkey D, Yin F, Wu Q (2015) A Monte Carlo simulation framework for electron beam dose calculations using Varian phase space files for TrueBeam Linacs. Med Phys 42(5):2389-2403. https://doi.org/10.1118/1.4916896

Commissioning of PTW 60019 Microdiamond detector for relative dosimetry in 6FFF beams

Oscar Ma | MidCentral DHB

Introduction

Currently at MDHB, the PTW 60019 microdiamond detector is commissioned for relative dosimetry in 6 and 15 MV photon beams as well as various electron beams. This project was done in order to confirm detector suitability for relative dosimetry purposes in a 6 MV FFF photon beam.

Method

Commissioning was done through comparative measurements of the microdiamond detector with IBA CC 13, IBA FC 65G ion chambers and IBA PFD 3G diode detector. The measurement were taken in an IBA Blue Phantom 2 water phantom with IBA OmniPro Accept v7.4 software for the following conditions:

- PDDs using 4x4, 10x10 and 40 x 40 cm square fields
- Inplane profiles at depths of dmax and 10 cm for 4x4, 10x10 and 40x40 cm square fields

Results

PDD Measurements

PDDs measured in the 6 FFF beam between the microdiamond, FC 65G and CC showed good agreement. Where differences between chambers are within 0.3% for 4x4 cm and 10x10 cm field sizes, with the difference extending to within 0.7% for the 40x40 field.

Inplane Profile Measurements

For inplane profiles the microdiamond and CC-13 detectors were compared at two regions. In the high dose region of the profile at ¼ the FWHM, differences were within 0.6% for all field sizes. In the low dose, out of field region, 4x4 cm and 10x10 cm fields showed differences within 0.3%, while 40x40 cm field showed increased differences within 0.9%.

Conclusion

Overall the microdiamond detector is accurate and suitable for relative dosimetry in field sizes 4x4 cm – 10x10 cm. Further investigation is warranted to confirm up to what field size the microdiamond is able to accurately measure with respect to the large differences seen in the 40x40 cm field. This increase in differences for large (40x40 cm) field sizes has also been noted in other similar studies with differences as high as 1.2% [1, 2]

References

1. Reggiori G, Stravato A, Pimpinella M, Lobefalo F, De Coste V, Fogliata A, et al. Use of PTW-microdiamond for relative dosimetry of unflattened photon beams. Physica Medica. 2017 Jun;38:45–53. doi:10.1016/j.ejmp.2017.05.046

2. Akino Y, Mizuno H, Isono M, Tanaka Y, Masai N, Yamamoto T. Small-field dosimetry of TrueBeamtm flattened and flattening filter-free beams: A multi-institutional analysis. Journal of Applied Clinical Medical Physics. 2019 Dec 9;21(1):78–87. doi:10.1002/acm2.12791

Validation of FilmQA Pro software for patient specific QA using EPID dosimetry

Donna Jimmy, Tania Groudeva | MidCentral DHB

Introduction

FilmQA Pro software is mainly used for analysis of radiochromic films. The aim of this work is to check the suitability of FilmQA Pro for pre-treatment delivery checks using EPID by investigating its ability to detect introduced intentional errors.

Method

Gamma analysis using FilmQA Pro was performed for 20 VMAT plans from four different sites. The results were compared with the existing in-house developed software as per our current practice.

A VMAT head and neck clinical plan was chosen, and test plans were created, with errors introduced to have an impact on the clinical goals. These errors included change in collimator angle, MLC leaves position and loss of segments. All plans were delivered with Varian TrueBeam linear accelerator. EPID measurements were acquired at isocentre with gantry and collimator rotation, as per the treatment plan. Gamma analysis was done using 3%/2 mm, 2%/2 mm, 10% dose threshold criteria and the measured results were compared against the expected results from RayStation TPS plans.

The EPID dosimetry departmental protocol was used for image acquisition and QA plans calculation.

Results

The results show that FilmQA Pro can be utilized for EPID pre-treatment delivery checks.
Mean gamma passing rate of all beams for head, head and neck, thorax and pelvis were 94.91%±2.5%, 97.96%±1.2%, 97.56%±1.1% and 97.05%±1.9% respectively with 2%/2 mm, 10% dose threshold gamma criteria.

The agreement between measured and predicted gamma pass results, dose profiles and gamma maps show the software is sensitive and accurate enough to capture the introduced errors.

Conclusion

FilmQA pro is a reliable tool for EPID based VMAT patient specific QA and we can implement it in our clinical practice using the existing gamma criteria (>90% gamma pass, 2%/2 mm, 10% dose threshold). However, further investigation is required to check the capability of the software for smaller error detection.

Clinical Implementation of an EPID in-vivo Dosimetry Monitoring System

Ivy Au | Auckland Radiation Oncology

Introduction

Routine in-vivo dosimetry plays a crucial role in ensuring patient safety and accurate dose delivery in radiation therapy. *Fraction N* (part of the SunCHECK QA platform developed by Sun Nuclear Corporation) supports the use of transit EPID images for independent 2D planar dose verification of each treated fraction.

This work highlights the validation and clinical implementation procedure of *Fraction N* in streamlining Auckland Radiation Oncology's departmental workflow for breast treatments in replacing resource-intensive diode measurements with highly automated EPID-based dosimetry.

Method

The performance of *Fraction N* was tested and verified using phantoms by introducing various intentional errors to plan deliveries. These errors included machine errors such as changes in beam energy and linac output, and setup errors such as phantom shifts and contour changes. The dosimetric impact of these intentional errors was assessed using the SunCHECK platform's inherent gamma assessment.

Fraction N was clinically implemented on all breast treatments, including free-breathing and breath-hold deliveries. A comparison of these results were made with the concurrent diode measurements acquired during treatment delivery.

Results

Fraction N was able to detect changes in radiation beam output and energies as well as phantom setup discrepancies.
Results collected in the first month since the implementation of *Fraction N* yielded a mean 3%/3 mm global gamma passing rate of 98.6±1.5% (with 30% low dose threshold).

Conclusion

This study demonstrated the ability of *Fraction N* in detecting introduced errors during plan delivery. One month since its clinical implementation, *Fraction N* was found to be an efficient and reliable in-vivo dosimetry system for replacing diode measurements.

Efficacy of Differing Surgical Lead Gowns from Small and Large Scattering Sources: Minimizing Risk Through Safe Fluoroscopic Practices

Brett Cunningham | Roentgen Analytical, Christchurch

Introduction

Fluoroscopy is a valuable imaging technique widely used in surgical procedures to guide surgeon's actions in real-time. The variability in surgical fluoroscopic procedures, including the type of procedure, anatomical site, and imaging parameters, contributes to a wide array of patient doses and scatter radiation exposure. Understanding this variability is crucial for optimizing radiation safety practices and minimizing radiation exposure.

Method

Radiation scatter doses were assessed from two simulated orthopedic procedures, distal radius repair and proximal femur fixation, using a Siemens Cios Flow c-arm and relevant anatomical scattering medium. Shielding efficacy of three lead gown styles was measured for each procedure at predefined locations on the surgeon, as well as notable staff locations around the room.

Results

Distal radius repair resulted in low levels of scatter radiation, and as anticipated, all styles of gowns provided shielding that reduced scatter to levels comparable to background radiation doses. Conversely, proximal femur fixation yielded higher scatter radiation levels, leading to varying degrees of shielding efficacy among gown styles. This variability was influenced by the precise fitment of gowns, and staff orientation and proximity to exposed anatomical structures. Additionally, unavoidable positioning of surgical staff and their proximity to anatomy during fluoroscopy exposure contributed to high scatter doses rates.

Conclusion

The results highlight the importance of not only correct selection and fitment of lead gown, but also increased vigilance of potential avoidable exposure scenarios. Although risk is low for these procedures, there is scope for it to be minimised through staff training and adhering to radiation safety protocols.

Calculating Effective Dose for CT

Steven Muir | Canterbury DHB

Introduction

There are several software methods for calculating effective dose for CT exams including applying a k-factor, IMPACT spreadsheet, Siemens Teamplay, and Virtual Phantoms software. This presentation examines some of the issues with each method.

Method

Effective dose from a selection of CT exams was calculated using four software techniques and the results compared.

Results

There was a factor of 2 difference between lowest and highest effective dose in head scans, and a factor of 3 difference between abdomen scans. For Torso scans Siemens Teamplay appeared to give twice the expected dose compared to the k-factor (which their calculation is based on). In some cases, it was not always clear what values should be used for mAs and scan length.

Conclusion

Effective dose calculations vary significantly depending on what software method is used. Care must be taken to input correct data, as input fields and units can be confusing.

The Human Touch: Incident response is not what your theranostic protocol expected

Troy Smith | Southern DHB

Introduction

Incidents and accidents are inevitable in any venture. Medical physicists prioritize implementing mitigations to reduce their likelihood and impact. Yet, some incidents are unforeseeable and challenging to prepare for, especially when the human element is involved. Understanding human behaviour and unpredictability is essential, which becomes even more complex with patients with ingested radioisotopes. This presentation seeks to build upon the recent I^{131} theranostic peer-review by exploring Dunedin's incident response measures, and by reviewing unique incidents from the southern region.

Methods

This review compares current Dunedin incident procedures with both national and international standards. Unique incident case studies that occurred in the southern region are discussed. These incidents are reviewed by the setting in which they occur, contributing factors, response strategies, and lessons learned. Additionally, the emergency protocols and case studies will be compared with the literature.

Results

Dunedin's incident protocols are compliant with New Zealand law and international standards. However, incidents stem from various reasons, making it impossible to anticipate every possibility. While frameworks like failure modes and effect analysis exist, they can be time-consuming and resource-intensive for most departments. Effective incident management in the south often relies on strong regional contacts due to incidents occurring outside of Dunedin, and basic scientific common sense. Reviewed incidents discussed include:

- Near misses.
- Car crash with a radioactive patient.
- Cardiac arrest during managed isolation.

These incidents have helped to improve the response of future left field events. The recurring themes of these case studies is a lack of communication to the right people, and staff/responders not following established protocols whether that be radiation response or even own professional standards.

Conclusion

Medical physicists demonstrate a strong commitment to theranostic safety nationwide. Unexpected incidents often require an ad hoc approach for resolution. Building a repository of experiences through reviews is vital for future planning response.

Simulation of time varying B0 fields during MRI image acquisition using PhoenixMR

Phillip Duncan-Gelder*, Dr. Steven Marsh, Prof. Phil Bones, Dr. Darin O'Keeffe
* Southern DHB

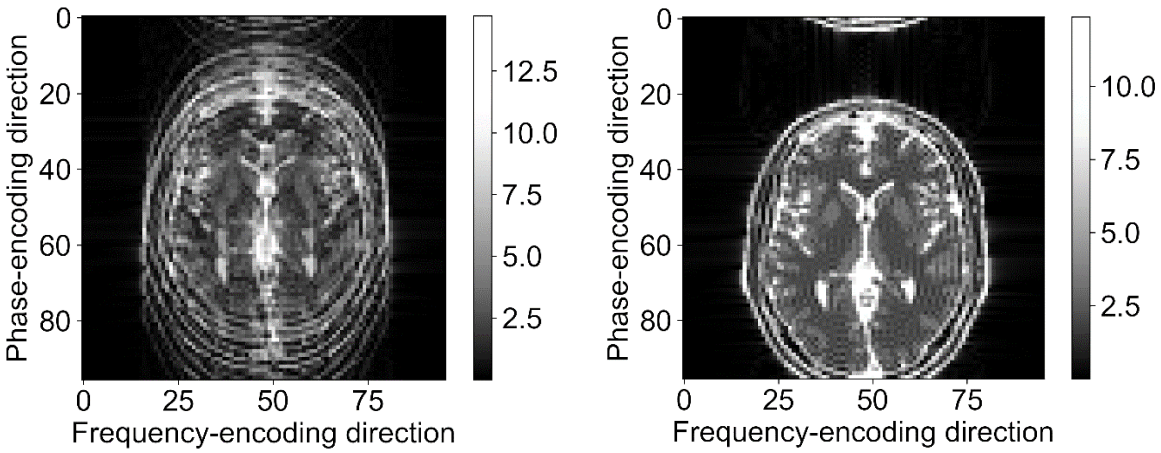
Introduction

PhoenixMR has been previously introduced as a fast, accurate, and flexible MRI simulation framework. The framework has several unique features including the ability to simulate additional processes in real time. One of these processes that we have investigated is the impact of time varying B0 inhomogeneity fields on EPI imaging sequences during MRI acquisition.

Method

Two models using the McGill brain phantom and a single shot inversion-recovery echo-planar sequence (TE = 100 ms, TI = 50 ms), with differing B0 inhomogeneity fields were compared. The first model features a temporal variation of B0 inhomogeneity where the field was switched using a rectangular function between -1, 0, and 1 ppm with a frequency of 50 Hz. The second model uses a static B0 field for comparison.

Results



A single reconstructed slice from the temporally varying B0 inhomogeneity (left) and the static B0 inhomogeneity (right) are shown. Of note is the significant difference in Nyquist ghosting observed, with the time-varying field demonstrating a significantly increased number of ghosts. Simulations were performed using a single RTX3080 in ~3 seconds.

Conclusion

PhoenixMR can model complex phenomena (like the temporally varying B0 inhomogeneity simulated here) and execute on fast GPUs without direct user modification of the simulator. Existing simulators have yet to achieve this capability, making performing simulations of advanced MRI techniques possible. PhoenixMR will be made freely available upon request to non-commercial researchers in medical physics soon. It is expected to increase and improve MRI simulation-related research.

On the use of Optically Stimulated Luminescent Detectors (OSLDs) in a Dose Audit of Total Body Irradiation (TBI) Arrangements

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Introduction

It is of clinical importance to perform a dose audit of the technique of TBI because of the extended treatment distances, large field sizes, and low dose rates involved. In our department, reference dosimetry for this technique is based on ion chamber measurements. A dosimetric verification of the manual dose calculations performed for TBI could help guide Physicists in providing a better treatment for their patients. OSLDs were chosen due to their ideal dosimetric properties and small size [1, 2].

Method

NanoDot^{TM} (*Landauer*) OSLDs (Al_2O_3:C) were placed in a custom-made phantom in which the OSLDs were embedded in a bolus material that was sandwiched between two solid water sheets. This phantom was then placed at an extended SAD with varying amount of solid water and Perspex placed either side to imitate the depth of various organs irradiated under TBI conditions, such as the thorax, sacrum, and head. A manual dose calculation was performed for each arrangement and was compared with the measured dose by the OSLDs post irradiation. The departmental TBI conditions were with a 6 MV photon beam at a low dose rate of 200 MU/min, SAD of 400 cm, the linear accelerator rotated to 270^o, and a field size of 40×28 cm^2.

Results

The measured dose in each investigated arrangement agreed with the manual dose calculation within the inherent uncertainty of the OSLDs of $\pm$ 5.5% as quoted by the manufacturer.

Conclusion

The dosimetry in a TBI setting was verified using OSLDs placed in a custom-made phantom with various amounts of solid water and Perspex placed either side to imitate the depth of various organs.

References

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