

Methods and materials: 3D Cheetaflex material (bolus) was examined both in a water tank and with CIRS anthropomorphic phantom, performing an end-to-end test. In water tank, a GafChromic EBT3-V3 film was oriented perpendicular to the source axis obtaining percentage depth dose (PDD) from 7 mm to 30 mm of distance from the source, with and without a bolus 5 mm thick. Two films were oriented parallel to the source at 5 mm and 15 mm of distance and results were compared with TG-43 implemented on Oncentra® Brachy treatment planning system (TPS). A set of CT images of CIRS phantom was acquired and a bolus with 7 trajectories (1 cm inter-distance and 5mm from skin) was created. A new CT set of images with bolus and phantom was imported on TPS where a target was defined and a dose plan was created. Plan was delivered with two films positioned between two different slabs of phantom, at reciprocal distance of 2 cm, orientated perpendicularly to the source axis.

Results: PDDs show a maximum difference of 4.7% (average 2.2%). At 5 mm and at 15 mm, the gamma pass rate is 100% with tolerance 3%/2 mm DTA. Results of films placed intra-slabs show a high pass rate (>96%) with tolerances of 2% dose and 1mm DTA.

Conclusion: 3D material investigated is water equivalent at Ir-192 energies and is suitable for superficial brachytherapy.

<https://doi.org/10.1016/j.ejmp.2019.09.194>

Young Investigator Grant – 2018 Grantee 15:45 – 16:05

The development of high quality training program for real time trans rectal ultrasound low dose rate (LDR) prostate brachytherapy

Andrea J. Doyle^a, Deirdre M. King^b, Frank J. Sullivan^{c,d}, Dervil Cody^a, Jacinta E. Browne^e

^aSchool of Physics, Medical Ultrasound Physics and Technology Group, Centre for Industrial & Engineering Optics, FOCAS, Technological University Dublin, Ireland

^bBlackrock Clinic, Dublin, Ireland

^cHermitage Medical Clinic, Dublin, Ireland

^dProstate Cancer Institute, National University of Ireland, Galway, Ireland

^eDepartment of Radiology, Mayo Clinic, Rochester, MN, USA

Although ultrasound forms a critical component of transrectal ultrasound image guided brachytherapy for prostate cancer, ultrasound training is not required as part of radiation oncology training programs, nor does any objective competency measure exist to independently assess clinical performance [1]. Physical simulation training and objective clinical competency testing can provide a structured approach to training [2], but only if suitably challenging training devices are available which replicate the complex anatomy of the male pelvis and prostate. This study describes the iterative process in the development of a range of training devices which simulate both the anthropomorphic and sonographic characteristics of the different presentations of patient specific prostate cancer. The design of the clinical features involved selection of patient cases and then rapid prototyping the different anatomical features and inverse casting these features in tissue mimicking materials (TMM). Novel TMMs were developed that had the sonographic appearance of the prostate and overlying tissues, as well as having the relevant mechanical compliance to give the training devices required haptic feedback. These devices will be used in the development of a training programme and will complement the learner's development of the specific skills required for the procedure. The

use of training strategies such as gamification allows trainees to track their own performance over time as well as relative to their peers; thereby, providing a structured and competitive approach to learning. The 3D prototyped clinical features in these devices provided a more clinically-relevant representation of the procedure, thus providing a more efficacious training opportunity.

References

1. Davis BJ et al.. American Brachytherapy Society consensus guidelines for transrectal ultrasound-guided permanent prostate brachytherapy. *Brachytherapy*.
2. McGaghie WC et al.. A critical review of simulation-based medical education research: 2003–2009. *Med. Educ*.

<https://doi.org/10.1016/j.ejmp.2019.09.195>

Joint Session 16:05 – 17:00

Radiation dosimetry across a variety of CBCT devices in radiology

Emer Kenny, David Caldwell, Mandy Lewis

Mater Misericordiae University Hospital, Ireland

Cone beam technology offers fast diagnosis at the point of care and is becoming more prominent in Radiology departments. Currently in our hospital we have an extremity CT, an O-arm and a number of C-arms offering 3D capabilities. Each of these modalities use wide cone beam CT technology to image the area of interest in one single rotation. Traditional CTDI metrics for radiation dosimetry in CT depend on a narrow beam geometry. Hence, the relevance of the CTDI as a dose indicator for wide beam scanning, which can be up to 400 mm for CBCT scans, has come under question due to underestimation of dose lying outside the 100 mm chamber length and CTDI phantoms being of insufficient length to achieve scatter equilibrium. In an attempt to better quantify the dose from wide-beam scanning, alternative methodologies have been developed which attempt to counter the limitations of the CTDI methodology. For the systems in our hospital, different manufacturers have stated a dose metric as either CTDI or DAP without noting the methodology used to calculate their measurements. In this study we utilised the CBCT methodology outlined in the IAEA Report 5. This method was chosen it uses a standard CTDI dose phantom and pencil chamber, both of which are typically available to a diagnostic imaging physicist. Here we discuss our CBCT dose results together with the issues we faced in attempting to develop a common CBCT measurement protocol for our hospital. The measured results are compared to manufacturer's stated values, where available.

<https://doi.org/10.1016/j.ejmp.2019.09.196>

EPA funded radon research in Ireland and its impact on the National Radon Control Strategy

Mark Foley^a, Stephanie Long^b, David Fenton^b, Le Chi Hung^c, Jamie Goggins^c, Marta Fuente^c

^aNational University of Ireland, Galway, Ireland

^bOffice of Radiological Protection, EPA, Ireland

^cNational University of Ireland, Galway, Ireland

Radon is a radioactive gas formed in the ground by the radioactive decay of uranium which is present in all rocks and soils. It is

the greatest source of exposure to ionising radiation for people living in Ireland and the leading cause of lung cancer after smoking. It is estimated that exposure to radon accounts for approximately 14% of all lung cancers in Ireland, which equates to around 300 lung cancer cases annually. In November 2011 the then Minister for the Environment, Community and Local Government, announced the Government decision to establish an Inter-Agency (IA) group to develop a national radon control strategy (NRCS) for Ireland. The purpose of the strategy is to reduce the number of lung cancers in Ireland that are caused by radon. The IA group comprises experts from the key Government Departments and State Agencies relevant to tackling the radon problem in Ireland. A Research Working Group (RWG) was established by the IA group to identify knowledge gaps and to point to areas where further targeted research could support and improve the effectiveness of the NRCS. The RWG reviewed the research ideas collected during the development of the NRCS including those raised in the stakeholder and public consultations. The research ideas were divided into four thematic areas, this paper will present an overview of the EPA funded radon research that falls under the theme that focuses on radon preventive measures and also outline the impact of this work at a national and international level.

<https://doi.org/10.1016/j.ejmp.2019.09.197>

History of Medical Physics and Physics in Medicine in Ireland

Jim Malone^a, Barry McMahon^b

^a Trinity College Dublin, Ireland

^b Tallaght Hospital/Trinity College Dublin, Ireland

Medical Physics and contributions from physics to medicine are relatively well developed in Ireland, although no comprehensive account of both is available. This paper will endeavour to address both, emphasising the former, but not overlooking the latter. The methods employed include documentary research and interviews with some of those that made significant contributions from time to time. Documentary evidence for historical aspects of the development of medical physics is relatively sparse. However, several good sources have been identified and accessed covering periods C, D, and E below. Good sources for Irish contributions/contributors from physics to medicine have been identified and are available over a longer period since the seventeenth century British enlightenment, and especially for the nineteenth and early twentieth centuries. Sources for G and H, education/training and international contributions, are limited but archival material is available. Professional bodies will be treated, where relevant, under each heading. This paper will present a summary of findings from these sources under headings including: A. The Enlightenment (17th century) period (Multiple sources) B. Nineteenth and early twentieth centuries (Multiple sources) C. Twentieth century up to late 60's/early 70's (>5 sources) D. Twentieth century from 70's to 90's (>3 sources) E. Period since the 90's (>3 sources) F. Statutory developments and National Benchmarks (Multiple sources) G. Education and training initiatives (>3 Sources and archival material) H. Contributions to the international community (Archival material) The findings from this investigation provide a rich context and heritage for medical physics in Ireland.

<https://doi.org/10.1016/j.ejmp.2019.09.198>

Poster Session : P1

Yttrium-90 selective internal radiation therapy: Are patient radiation protection contact restrictions necessary?

Seán Cournane, Jackie McCavana, Michael Manley, Linda Gray, Ronan Ryan, Jeff McCann

St Vincent's University Hospital, Ireland

Yttrium-90 (90Y) microspheres are used for selective internal radiation therapies (SIRTs) to treat patients with hepatocellular carcinoma (HCC) or metastatic colon cancer to the liver, with doses of up to 150 Gy delivered per treatment. 90Y is a pure beta emitter with a decay energy of 0.94 MeV and half-life of 64.2 h. While external beta exposure from the patient is negligible, there can be a considerable associated Bremsstrahlung radiation exposure component. Previous studies in the US, towards establishing radiation dose rates from patients, have deemed radiation protection precautions post-therapy to be unnecessary in most cases; however, the question remains as to whether precautions are necessary within the EU, where more conservative dose constraints are employed. Accordingly, dose rates from 28 patients, treated over a three year period (2016–2018) were measured post therapy at distances of 0.3 m and 1 m, and in contact with the patients' upper abdomen. Dose rates were compared with theoretical predictions and used as model inputs for calculating radiation doses received by family members and carers based on interaction patterns previously described in the literature. The work demonstrated restrictions to be advisable considering the dose constraints employed within the EU. Indeed, while this study examined dose rates for 90Y Therasphere patients, another 90Y therapeutic pharmaceutical, namely SIRSphere, require reportedly similar treatment activities, leading to similar Bremsstrahlung radiation dose rates. Thus, in accordance with EU dose constraints, radiation protection precautions are necessary for those individuals in regular contact with patients having undergone SIRT procedures.

<https://doi.org/10.1016/j.ejmp.2019.09.199>

Poster Session : P2

Quantifying tumor heterogeneity from multi parameter magnetic resonance images for prostate using texture analysis

Saleh Alanezi^{a,b}, Frank Sullivan^{c,d}, Christoph Kleefeld^a, Johan Greally^e, Declan Sheppard^f, Niall Colgan^a

^a School of Physics, Faculty of Science, National University of Ireland Galway, Ireland

^b Physics Department, Faculty of Science, Northern Border University, Saudi Arabia

^c Department of Radiation Oncology, Galway Clinic, Ireland

^d Faculty of Medicine, National University of Ireland, Galway, Ireland

^e Department of Pathology, Galway Clinic, Ireland

^f Department of Radiology, University Hospital Galway, Department of Radiology, Galway Clinic, Ireland

Tumor spatial heterogeneity is a key prognostic indicator, which is reflected in medical images. Heterogeneity in tumor images can be