cal setting, whether Hp(3), Hp(0.07) or Hp(10), has received little attention in the literature; however, the effect has been identified as the dominant source of uncertainty in current eye dosimetry methods. Accordingly, this study aims firstly to measure scattered x-ray energy spectra to staff in Interventional Radiology procedures under varied conditions and system settings. Consequently, the dosimetry accuracy of a series of currently available eye dosimeters, including TLDs (100s, 100Hs), OSLD and Electronic Personal dosimeters (EPDs), and a variety of real-time trunk dosimeters will be presented, with energy dependent correction factors established for each dosimeter type, leading to more precise dose measurement.

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A review of Slope Intercept GFR patient data to validate and optimize the introduction of Single Sample GFR technique

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The Glomerular filtration rate (GFR) is a quantitative measure of kidney function determined from the plasma clearance of a radiopharmaceutical such as 51Cr EDTA or 99mTc DTPA. The British Nuclear Medicine Society 2018 guidelines recommend a single sample GFR (SS-GFR) analysis method replacing the slope intercept method (SI-GFR) of the previous 2004 guidelines. This research explores the feasibility and implications of making the transition from SI to SS GFR, by retrospectively determining the SS GFR on a patient population whose GFR was previously evaluated using SI-GFR. One shortcoming of the SS-GFR method is that a prior approximation of the GFR is necessary for choosing a sampling time for an accurate result. The objectives of this study are to, firstly, assess the agreement and associated errors of the SS-GFR when compared to SI GFR and, further, to optimise the single sample approach. The study examines the reliability of using previous GFR measurement or a biochemically determined eGFR documented in the patient healthcare record as a guide to optimum blood sampling time. The use of other GFR predictors is also investigated for patients undergoing DTPA imaging, functional indicators gained from renogram curves such as body surface area (BSA) and sensitivity corrected summed functional phase slopes. Regression analysis will be carried out on renogram parameters to identify the statistically significant predicators ($p<0.05$) which will be entered into a multivariate model. Statistical agreement between the SI-GFR and SS-GFR is tested using Bland-Altman plots and the associated errors quantified.

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Verification of manufacturer supplied source paths for Elekta ring applicators at Cork University Hospital

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Ring applicators are routinely used in gynaecological brachytherapy to direct a radioactive source through a number of predetermined dwell positions close to the tumour. Literature has shown that the dwell positions of radioactive sources in ring applicators can deviate from their expected positions by several millimetres. Since high dose rate 192Ir sources are used, even small deviations can have a large impact on the distribution of dose received by the patient. AAPM Report 59 deems positional accuracy of within 2 mm to be clinically acceptable. This study investigates the level of agreement between the measured source path and manufacturer supplied source path for Elekta ring applicators of diameters 26 mm, 30 mm and 34 mm. Dwell positions were measured using both the "gold standard" approach of GAFchromic film and a MatriXX ionisation chamber array. We developed processing algorithms using ImageJ. Use of an ionisation chamber array with free, open source software for this application is novel. Our results found insufficient evidence to verify that the actual source path matches the manufacturer supplied source path for any of the applicators. Most source paths were found to be clinically acceptable, however, deviations of the source from the expected path of up to 3.8 mm (MatriXX) and 4.0 mm (film) were recorded. Inter-applicator deviances of up to 1.7 mm (MatriXX) and 2.1 mm (film) were observed. Measurements using the MatriXX were found to be comparable to the standard film-based approaches for source path measurement, offering improvement in speed, ease of use and cost.

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A study on the comparison of the dose distribution of low kV X-ray radiation in generically modulated bone and CT scanned bone

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The INTRABEAM system is a device that uses low kV X-ray radiation in the treatment of cancers. During Kypho-IORT the INTRABEAM delivers a single high dose of radiation to a metastasis in a spinal vertebra, sterilising the metastasis, before the vertebra is stabilised with PMMA. However, much remains uncertain about the dose distribution of low kV X-ray radiation in heterogeneous tissue, such as bone. Current generation planning CTs do not have sufficient resolution to resolve the trabecular architecture. Voxel averaging therefore affects the calculation of bone density values which are typically underestimated. This subsequently affects dose calculations. In this study the GEometry ANd Tracking 4 (GEANT4) code was used to develop a generic model of a spinal vertebra that includes trabecular architecture. The dose distribution of low kV X-ray radiation within this architecture was modelled using a Virtual Source Model (VSM) of the INTRABEAM and compared to the dose distribution of the same radiation in simulated CT scanned bone. The results show that the dose distribution of low kV X-ray radiation in trabecular bone is more complex than previously suggested. A spherical dose distribution is modulated by the trabecular architecture such that the energy deposition in the trabecular walls can reach five times higher than expected, while the energy deposition in the trabecular openings is reduced by upwards of 50%. With further development, this code may be incorporated into future treatment planning software resulting in improvements in the dose distribution calculations for low kV treatments such as Kypho-IORT.

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Dosimetry assessment of patient-specific 3D printable material for HDR surface brachytherapy

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Purpose: 3D printable material water equivalence was investigated within the range of Iridium-192 source energies. The aim is to validate it for superficial brachytherapy treatments.