

ical tests were performed on patient's phantoms. Gafchromic films were placed on the table of the IR machine under PMMA plates that simulate the patient. After irradiation, the film darkening is proportional to the radiation dose received by the patient's back. After film scanning and analysis, the exact dose value can be obtained at each point of the mapping. Four experimentation were performed, constituting a total of 34 acquisition incidences including all available exposure configurations. At a second time, clinical trials were launched on real patients during real "Chronic Total Occlusion (CTO)" procedures for a total of 50 cases. Gafchromic films were placed on the back of the patients. Comparison on the dose values, distribution, and shape of the irradiation fields were performed.

Results. The comparison between the dose value shows a difference less than 15%. Moreover, our model shows a very high level of geometrical accuracy: all fields have the same shape, size and location (uncertainty < 5%).

Conclusions. This study shows that our software is a reliable tool to warn physicians when a high radiation dose is reached and then deterministic effects can be avoided.

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55 Experimental evaluation of a dose management system-integrated 3D skin dose map by comparison with XR-RV3 Gafchromic® films

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Introduction. To assess the interactive Skin Dose Map® (SDM) tool integrated to the Dose Management System DoseWatch® (GE Healthcare) with XR-RV3 Gafchromic® films for implementation in routine practice.

Methods. A post case non real time dose estimation software SDM tool was used to calculate PSD and display the patient skin dose distribution. PSD was calculated with a triangle mesh of 0.055cm² resolution on ICRP 110 anthropomorphic phantom and with a square ROI of 1cm² on flat phantom. The tool uses Radiation Dose Structured Reports (RDSR) data to model exposure events and calculate the PSD per event following recommendations defined by K. Jones et al. The PSD and SDM computed with SDM tool and displayed were evaluated in comparison with XR-RV3 Gafchromic® films positioned under the PMMA Phantom (20cm) for 13 configurations. Measurements were performed on a Philips system (Allura Xper FD10). Statistical analyses were carried out to compare PSD_{Film} and PSD_{SDM}.

Results. For the 13 configurations analyzed, the average difference between PSD_{Film} and PSD_{SDM} are 6%±6% (range from -3% to 22%) for flat phantom and 5%±7% (range from -3% to 25%) for ICRP phantom. The Lin's coefficient estimation and 95% CI are 0.979 [0.875; 0.984] for flat phantom and 0.977 [0.877; 0.985] for ICRP phantom, meaning that concordance was excellent between the measured PSD_{Film} and the computed PSD_{SDM} values. Dose map representations match for 11 out of 13 tests on PMMA Phantoms. Gaps identified are related to the table displacement during fluoroscopy events and the use of wedge filter.

Conclusions. The results found in this experimental evaluation show that SDM tool is a suitable alternative to Gafchromic® film to

calculate PSD. A clinical evaluation on patients can be started in interventional radiology and cardiology.

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56 Development and association of new metrics of dose and image quality for comparing and optimizing protocols in CT imaging

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Introduction. Nowadays, though Computed Tomography (CT) examinations only correspond to a small portion of medical imaging procedures (typically 10 % in France in 2012), they are credited with about 70 % of the total imaging collective dose. Reducing the dose due to CT examinations is therefore a major issue worldwide but cannot be achieved at the expense of the image quality (IQ) needed to ensure a correct diagnosis.

Therefore, CT imaging needs to be described simultaneously using reliable metrics for delivered dose and IQ. However, such metrics are still lacking, especially for IQ. In this study, we developed and combined new metrics of IQ and patient dose in order to compare CT protocols.

Methods. For IQ evaluation, the mathematical model observer (MO) Non Pre-Whitening Eyefilter (Burgess, 1994) was implemented to estimate a detectability index linked to clinical tasks such as lesion detection or discrimination. The index was calculated on CT images of a home-made dedicated phantom acquired for various irradiation and reconstruction conditions. It was then validated in the framework of a clinical study involving a dozen of experienced radiologists, on the large set on images presented in two Alternative Forced Choice (2-AFC) experiments for both tasks. After rescaling on their responses, the MO provided a Percentage of Correct answers (PC) depending on the acquisition parameters, the task and the insert size.

For dose estimation, a complete Monte Carlo model of the GE Discovery CT750 HD scanner was developed with the PENELOPE code. All the components of the scanner were estimated by physical measurements. The modelling was validated with measurements in CTDI and anthropomorphic phantoms using ion chambers and Optically Stimulated Luminescence dosimeters. Once validated, dose levels were calculated in the home-made torso-shaped phantom for every acquisition parameter used in the clinical study. Curves linking PC values calculated by the MO with the simulated dose in the phantom were then built for both detection and discrimination tasks. They thus enabled to represent the influence of irradiation or reconstruction parameters, such as voltage or reconstruction slice thickness.

Results. Values from several CT scanner standard abdominal protocols were placed on the curves after logarithmic regression and compared from the double point of view of dose and IQ. We could then deduce the better protocols in terms of reduced dose while keeping a close PC value. We showed for instance that, according to the clinical task, the patient dose could be reduced by a factor of two keeping a similar probability of correct answers by using a dual-energy protocol with adapted parameters.

Conclusions. This method paves the way for a standardized methodology enabling clinical physicists and radiologists to optimize protocols for defined clinical tasks while keeping the dose as low as possible.

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57 Calculation of organ dose for pediatric patients undergoing computed tomography examinations: A software comparison

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Introduction. The increased number of performed 'Computed Tomography (CT)' examinations raise public concerns regarding associated stochastic risk to patients. Pediatric patients are more susceptible to radiation-induced risks than are adults owing to their rapidly growing tissues. We developed a Dose Archiving and Communication System that gives multiple dose indexes (organ dose, effective dose, and skin-dose mapping) for patients undergoing radiological imaging exams. The aim of this study was to compare the organ dose values given by our software for pediatric patients undergoing CT exams with those of another software named VirtualDose.

Methods. Our software uses Monte Carlo method to calculate organ doses for patients undergoing computed tomography exams. The general calculation principle consists to simulate: (1) the scanner machine with all its technical specifications and associated irradiation cases (Kvp, field collimation, mAs, pitch ...) (2) detailed geometric and compositional information of dozens of well identified organs of computational phantoms that contains the necessary anatomical data. The comparison sample includes the exams of thirty patients for each of the following age groups: new born, 1–2 years, 3–7 years, 8–12 years, and 13–16 years (a total of 150

patients). The parameters of the patients are very heterogeneous (various Kvp, mAs, Pitch, DLP, collimation ...). The comparison protocol is the "Head" protocol.

Results. The percentage of dose difference between the two software does not exceed 20%. This difference may be due to the use of two different generations of hybrid phantoms by the two software.

Conclusions. This study shows that our software provides useful dosimetric information for pediatric patients undergoing CT exams.

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58 Monte Carlo modelling of photon propagation in a human head model containing an enhanced-absorbing target

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Introduction. Modelling the light propagation inside brain tissue structures is still a challenging task which requires the use of complex computational schemes often based on Monte Carlo method [1–3]. Because of strong tissue-scattering process (NIR infrared range: 600–900 nm), deep probed structures receive much less light amount than the superficial tissues. This has the effect to impede optical measurements and efficient planning treatments. In this paper, we take an interest in noninvasive tissue arrangements for which a NIR light source strikes a human head model, and thus investigate how photons penetrate and interact with an enhanced-absorbing target located close to the CSF layer. The study especially aims at displaying the effects of tissue structure, optical

