P080 Compliance with NICE guidelines 2014 for traumatic head injury in regard to CT (Re-audit)

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Background: Traumatic head injury is one of the most common causes of mortality and morbidity in the UK for the adult and paediatric population with a 1.4 million emergency attendance annually and 200,000 admissions (1). CT head is the key primary imaging modality for prompt detection. An audit is performed based on the revised 2014 NICE guidelines for traumatic head injury to assess local practice.

Method: Retrospective analysis of the data of the same month in two consecutive years (Sep 2019 and Sep 2020) of all A&E patients with CT head and traumatic head injury was performed at a tertiary teaching hospital. The time taken for an emergency patient to be scanned, the time taken for a provisional CT head radiology report to be completed and the details of the CT head request were collected from PACS and RIS.

Results: Data of 353 cases and 330 cases of trauma CT head scans in Sep 2019 and 2020 were collected respectively. 81% (2019) and 76% (2020) of patients had CT head scans within 1 hour or 8 hours of risk factors identified. 66% (2019) and 68% (2020) of CT head reports were authorised within 1 hour of the scan being performed.

Conclusion: The results highlighted longer request-to-scan time which could be due to staffing and Covid-19-related factors. This audit also showed that more CT heads were reported in a shorter timeframe which could be due to the implementation of registrar-to-registrar referral during out-of-hours resulting in less disruptions during reporting.

1. National Institute for Health and Clinical Excellence. (2014) CG176. Head Injury: assessment and early management. London. https://www.nice.org.uk/guidance/cg176.

2. irefer. The Royal College of Radiologists. (2017) Making the best use of clinical radiology services 8th edition. https://www.rcr.ac.uk/sso/irefer/v8.

DOSE / RADIATION PROTECTION / IMAGING TECHNOLOGIES POSTER PRESENTATIONS

P082 Paediatric unenhanced CT head dose audit: Comparing our single-photon emission computed tomography (SPECT) scanner in the 16 slice standard CT acquisition mode against our standard 64 slice CT scanner

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Background: At our tertiary referral paediatric specialist trust we use a single General Electric (GE) 64 slice scanner, the Lightspeed VCT 64, for our CT scanning. The most frequently performed CT study in our trust is an unenhanced CT head. There are occasions where due to routine maintenance, quality assurance testing or unexpected faults that the CT scanner is not available for use. On these occasions, where clinical need dictates that imaging cannot be delayed, we use the CT scanning capabilities of our single-photon emission computed tomography (SPECT) scanner in the standard CT acquisition mode - installed in 2019. Whilst standard quality assurance processes are undertaken on both the CT and SPECT scanner in accordance with the Ionising Radiation Regulations 20171, a comparison of the doses from our SPECT scanner in CT mode and our standard CT scanner has not previously been made.

Purpose: To audit the dose from the SPECT scanner against our reference standard, the doses from our standard CT scanner

Methods: A retrospective, single centre audit evaluated 94 unenhanced CT heads between May 2019 and June 2021. Only studies acquired in a single acquisition were included.

Results: A one-way analysis of covariance (ANCOVA) test showed no significant difference ($p>0.05$) in the mean dose for an unenhanced CT head on the CT scanner vs the SPECT scanner when adjusted for age at event. Subjectively there was no difference I image quality. We will continue to use the SPECT scanner as a backup to perform standard CT acquisitions when adjusted for age at event.

1. Ionising Radiations Regulations 2017. Available at https://www.legislation.gov.uk/uksi/2017/1075/pdfs/uksi_20171075_en.pdf (accessed 15/12/2021)

P084 Virtual grid software for scatter correction to improve image quality and reduce radiation dose, assessed using a TOR CDR image quality phantom

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Background: Currently, the use of virtual grid (VG) technology in diagnostic radiology is limited and has a low evidence-base. VGs are a new post-imaging processing technology, which can be implemented to reduce the effects of scatter radiation on an image. Traditionally, scatter issues have been minimised via the use of physical grid devices (PG), however, they do lead to increased radiation dose and grid cut-off. This study aims to assess the image quality of VG corrected images compared to PG.

Method: A TOR-CDR image quality phantom with a 10mm thick piece of Perspex placed upon it was imaged, both with a PG and without a grid, from which VG images were generated. Exposure factors were identical for all techniques: 70 kVp, mAs: 5, 10, 16, 20, 25, 32, 36, and 40, Source-to-Object distance 110cm. Mean and standard deviations of selected ROIs were measured and (CNR, SNR) calculated with paired samples T-Test undertaken to compare differences between VG and PG across all mAs values.

Results: VG improved the image quality of non-grid with a significant difference ($p < 0.001$) in terms of CNR, from 3.804.23 to 10.284.61 and SNR from 40.1433.8 to 77.3413.47, and provided a nearly comparable level of image quality compared to PG ($p > 0.05$). However, VG achieved optimal SNR/CNR at lower exposer factors (<16 mAs) whereas PG needed (> 25 mAs).

Conclusion: Image quality was not adversely impacted by the use of the VG versus the PG; VG can be performed at a lower radiation exposure.

P085 X-ray scatter correction software studies for diagnostic X-ray imaging: Scoping review

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Background: The anti-scatter grid has been used in X-ray radiography to reduce the scattered X-rays generated by the patient. However, the presence of a grid means the patient dose subsequently increases as more X-ray photons are required to compensate for those primary X-rays absorbed by the grid. Recently, several manufacturers have developed software that can correct the scattered X-ray and enhance the image contrast. This scoping review aims to systematically map the research carried out in the field and to identify any existing knowledge gaps.

Methods: This scoping review was conducted through a systematic search using different electronic databases to reveal studies that are relevant to the research questions. Published articles about X-ray scatter correction software for X-ray imaging from 1.1.2000-31.12.2021 were included. A part of the PRISMA model and the PICO framework were utilised to establish eligibility criteria.

Results: A total of 12 articles were included in the data synthesis. The study population of the included studies was varied: patients, image quality phantoms, and anatomical phantoms. The clinical application that used X-ray scatter correction was found to be limited in some body parts, including the cervical spine, chest, shoulder, lumbar spine, hip, and pelvis. The scatter correction software seems to be effective in terms of image quality and radiation dose. However, the conventional grid still provides higher image quality, but with a high radiation dose.

Conclusions: X-ray scatter correction software could be effective, and it seems that there are potential benefits of this software for some circumstances or clinical.

P086 Verification experience of SRS and SABR using the Suncheck Dosecheck and Per Fraction systems

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Method: The Dosecheck and Per Fraction systems were installed and commissioned in 2021 as an additional verification method alongside our current Patient Specific QA measurements and software. The system calibration and training was straightforward with easy to follow process taking less than 3hrs. A 6MV FFF model was produced by Sun Nuclear that is used for both systems. At our centre all lung SABR is delivered using 6MV FFF and SRS will be in the near future. Single isocentre SRS plans are generally more difficult to verify as they involve small field sizes and off axis dose points. Standard phantom geometry and a set of past single Isocentre SRS cases were used to test the implementation of the Dosecheck system. The Per fraction system was intended to look at anatomical changes to lung SABR treatments eg breathing rate, amplitude and baseline shift. The system was evaluated using a Quasar respiratory phantom, allowing dose measurements including breathing motion. The results were quantified by looking at the gamma passing rate for different treatment planning strategies for lung SABR (Average Intensity projection and Mid Ventilation Projection).

Results: The initial beam model provided showed poor verification results for small MLC fields with dose point agreement over 5% for fields less than 2x2cm in simple phantom geometry. However, for larger fields the agreement was within 1%. A subsequent model was then obtained which resulted in agreement within 2% for the smallest fields and acceptable verification for a set of small fields, single isocentre SRS cases. This provided confidence in the use of the system. The per fraction system proved to be a sensitive and reliable tool for verifying lung SABR cases and could distinguish between different planning strategies, with increased gamma passing rates for the mid ventilation planning approach.

P087 Effect of simulating body habitus on image quality metrics when using low-dose CT parameters

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Background: Image quality affects decision making and confidence when reporting. The importance of simulating body habitus when measuring image quality is often underestimated. A range of image quality metrics (IQMs) were investigated for low-dose CT acquisition parameters and a larger body habitus in a phantom model.

Method: An anthropomorphic chest phantom, fitted with and without attenuation jackets, had simulated lesions ranging in density (-800HU, -630HU, 100HU) and size (5mm, 8mm, 10mm) that were placed in the upper, middle and lower regions of the lung. CT image series were acquired using incremental amperage settings (10mA to 100mA) at 120kV. A variety of IQMs were then applied to the image data, including mean squared error (MSE), peak signal-to-noise ratio (PSNR), structural similarity index (SSIM), non-shift-edge ratio (NSER) and texture analysis IQMs looking at Energy, Homogeneity and Entropy.

Results: The effect of using attenuation jackets was seen in graphed data with changes in gradient averaging 34% (range 7%-80%), and y-intercept averaging 38% (range 4%--77%), when looking at the IQMs as a whole. Within the IQMs, T-tests compared averaged datasets of image series obtained both with and without attenuation jackets, proving statistical significance ($p<0.01$) in most instances.

Conclusion: These findings are specific to the inherent high-contrast region of the thorax, but have wider implications for image quality measurement. Results of most IQMs demonstrated a significant difference when attenuation jackets were used, highlighting the importance of considering body habitus when performing image quality assessment.

P088 Optimising CT dose in Radiotherapy

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Background: National guidance (IR(ME)R 2017) recommends that CT imaging in Radiotherapy is optimised. The first UK survey of dose indices from radiotherapy planning CT scans was conducted by the Institute of Physics and

Engineering in Medicine (IPEM) in 2018. Breast, brain, head and neck, 3D and 4D lung, prostate and gynae scans were audited. Local imaging doses were found to be higher than national standards for prostate, gynae and 4D lung. With the reduction of scan lengths where appropriate and the introduction of a reconstruction algorithm such as iDose, which allows image quality to be personalised by preventing artifacts and increasing spatial resolution at low dose, it should be possible to reduce local imaging doses to within recommended levels.

Method: Scan lengths for 59 prostate patients were audited. We measured the vertical distances between mid SI joint level and (i) extrema of marked planning volumes (ii)L3 (iii) superior border of scan.

Results: Superior scan border for prostate scans approx. 13cm (median) too high relative to required anatomy for planning radiotherapy. Identified mismatch between Doctor's protocol and Radiographers work instruction for prostates -- aligned documentation and gave guidance to staff. Started to weigh all patients at CT, to enable best use of iDose in future.

Conclusion: We have now implemented a departmental change to shorten the scanning parameters for prostate only patients. We met our aim to bring prostate imaging doses to within national recommended levels, further work is being done for gynae and 4D lung.

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P089 The dosimetric evaluation of the consequences of CTV displacement for patients enrolled in the SBRT arm of the PACE trial

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Background: In radiotherapy the magnitude of PTV margins is calculated from geometrical considerations (1) so any information on CTV dose as a result of displacement during treatment would be valuable in verifying that used margins are appropriate. The PACE trial (2) including prostate radiotherapy requires acquisition of post treatment CBCT images which can be used to estimate the displacement of the CTV from the reference scan position during treatment. The displacement can be introduced in a treatment planning system and the planned dose recalculated to verify that prescribed clinical goals are maintained.

Method: For each of the 5 fractions for 10 patients enrolled on the PACE trial displacements of patients from a reference CT scan position were taken from post treatment CBCT images and the plan dose recalculated in the TPS (RayStation v9.2) with these displacements. The resultant CTV dose volume statistics were then analyzed.

Results: The mean CTV volume receiving 36.25Gy was greater than 95% for 9 out of 10 patients with one particularly low value for 1 fraction (75.85%) for a patient bringing the average below 95%. A relatively large displacement was associated with this fraction. In general, the CTV clinical goal was maintained despite displacement from the plan reference position.

Conclusion: The study gives some confidence that clinical goals for the CTV are maintained with PTV margins in use for these patients. The study has the limitation of assuming there is a translation of the CTV and intrafractional motion isn't fully taken into account.

1. On target: ensuring geometric accuracy in radiotherapy RCR, IPEM, SCR 2. The PACE Trial (Prostate Advances in Comparative Evidence) International randomised study of prostatectomy vs stereotactic body radiotherapy (SBRT) and conventional radiotherapy vs SBRT for early stage organ-confined prostate cancer

P090 Radiation protection for student nurses in IR

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Within our busy IR department, we have a number of student nurses at varying stages of their training. They often spend between a week and 6-week blocks playing an integral role within our team. It is, however, apparent that they

have very little training in regard to radiation safety which poses a particular problem when working in the IR theatre. This poster was aimed at those students and other new members of staff to give them a basic understanding of radiation protection and how to protect themselves when working within this environment.

1. Ball, J., Moore, A.D. and Turner, S. (2008) Ball and Moore's Essential Physics for Radiographers. 4th edn. United Kingdom: Blackwell Science. 2. British Medical Association. (2007) The British Medical Association Illustrated Medical Dictionary. 2nd Edn. London. A penguin Company. 3. Carter, C. (2006) Imaging Science. Oxford: Blackwell Science 4. Hiles, P., Hughes, H., Arthur, D. and Martin, C. (2016) Personal Protective Equipment for Diagnostic X-ray use. United Kingdom. The British Institute of Radiology. 5. International Commission on Radiological Protection (ICRP). (2000) "Avoidance of Radiation Injuries from Medical Interventional Procedures" Annals of the IRCP. 30, No 2 2000. [Online] Available at: https://www.researchgate.net/publication/11881638_Avoidance_of_radiation_injuries_from_medical_interventional_procedures_ICRP_Publication_85 Accessed: 30.10.2021). 6.Santos, J., Simola, J., Kaasalainen, T., Aho, P and Venermo, M. (2020) "Radiation Doses to Staff in a Hybrid Operating Room: An Anthropomorphic Phantom Study with Active Electronic Dosimeters" European Journal of Vascular and Endovascular Surgery. 59, 4, April [Online]. Available at: https://www.sciencedirect.com/science/article/pii/S1078588420300642 (Accessed: 01.11.2021) 7. Sloane, C., Holmes, K., Anderson, C. and Whitley, A,S. (2010) Pocket Handbook for Radiographers. Great Britain: Hodder Arnold 8. The Department of Health and Social Care (2018) Guidance to the Ionisng Radiation (Medical Exposure) Regulations 2017 [Online] Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/720282/guidance-to-the-ionising-radiation-medical-exposure-regulations-2017.pdf (Accessed: 02.11.2021) 9. United States Environmental Protection Agency (2021). Protecting yourself from Radiation. Available at: https://www.epa.gov/radiation/protecting-yourself-radiation (Accessed: 30.10.2021)

AI / IMAGING TECHNOLOGIES POSTER PRESENTATIONS

P091 An efficient way of collaborating on multicenter reader studies with your peers

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Collective Minds Radiology

Background: Collaboration in healthcare is crucial to improve patient outcomes and keep up with the continuous rapid technical developments that lean towards larger datasets and multiple imaging modalities. There is a need for a common infrastructure to collaborate between centers, institutions, countries and to conduct streamlined multicenter reader studies. This also has to be carried out in a regulatory sound way. The purpose of this study is to develop a cloud-based medical imaging platform to facilitate collaborative multicenter studies.

Method: A cloud-based medical imaging collaboration platform was developed to conduct streamlined multicenter reader studies. It facilitates collaboration options for multiple centers and enables reproducible imaging studies. Healthcare professionals can manage and invite collaborators to build local, national and international expert groups. The imaging platform was developed with a multi-modal data repository, embedded zero-footprint DICOM viewer, pseudonymization support, customisable case report forms (CRF) and annotation/segmentation tools.

Results: We have developed a scalable and secure cloud-based infrastructure that follows GCP and data handling according to GDPR. The platform includes work distribution of data management, structured reporting (*Figure1*) and result delivery together with image analysis.

Conclusion: A multi-site reader study collaboration platform for multi-modal medical images, has been developed following a privacy and compliance by design concept. The platform allows for easy collaboration following GCP and GDPR. We believe that this infrastructure will facilitate both academic single- and multi-institution reader studies as well as large clinical trials, especially where interdisciplinary work is required.