Student Conference ePosters

Dose optimisation in computed tomography of brain using Care kV and CARE Dose4D
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Background: Computed tomography scan of brain is the most widely used CT examination. CT scanners have the potential to deliver low radiation dose by utilising tube potential and tube current modulation techniques. We aim to determine the application of CARE kV (kV modulation) and CARE Dose4D (mAs modulation) in CT scan of brain. Both CARE kV and CARE Dose4D are well-established innovative technology of Siemens.

Methods: A prospective study was conducted from April to August 2015 at TUTH. Data were collected on a Siemens 128 slices CT scanner. Non-random purposive sampling was employed. Ethics approval was taken for every participant. Non-contrast CT images were acquired without using CARE kV and CARE Dose4D, whereas during contrast enhanced, both were turned on keeping scanning parameters constant for each individual.

Results: A total of 72 patients (42 male and 28 female; mean age 41 years ± 18.75, maximum 87 and minimum 16) participated in this study. Body mass index was 21.97 ± 1.90 (maximum 24.98 and minimum 18.08). The mean value of Computed Tomography Dose Index (CTDI), dose length product (DLP) and effective dose (ED) before and after switching on both CARE kV and CARE Dose4D, whereas during contrast enhanced, both were turned on keeping scanning parameters constant for each individual.

Conclusions: CARE kV and CARE Dose4D can reduce radiation dose dramatically in CT scan of brain without loss of image quality. CTDI, DLP and ED were all decreased by approximately 31% when CARE kV and CARE Dose4D were switched on.

Analysis of fractional anisotropy values and diffusion coefficient values in ischaemic stroke diseases of GE MRI 3 Tesla
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Background: Diffusion weighted imaging (DWI) and diffusion tensor imaging (DTI) are advanced techniques in MRI that show the diffusion in the brain of ischaemic stroke disease. DWI shows the lesions without gadolinium contrast agent and produces apparent diffusion coefficient (ADC) values, whereas DTI shows connectivities of the central nervous system that cannot be seen by using conventional MRI. DTI produces fractional anisotropy (FA) values.

Aim: This study aims to analyse the ADC values and FA values in ischaemic stroke disease.

Methods: 14 samples were used, consisting of seven (50%) men and seven (50%) women with ischaemic stroke disease. Each sample deals by DWI and DTI sequences. The region of interest is placed in ischaemic stroke lesions and the contralateral side of lesions.

Results: Nine samples of brain tissue lesions located in the right side and five samples in the left side. Right lesions have the average ADC stroke: 0.001748; normal ADC: 0.000954; FA stroke: 0.144522; and normal FA: 0.426111. Left lesions have the average ADC stroke: 0.000979; normal ADC: 0.000835; FA stroke: 0.2556; and normal FA: 0.4324.

Conclusion: ADC values in cases of ischaemic stroke can decrease or increase depending on the age of stroke. While the FA values will decrease without being affected by age of stroke.
The attenuation characteristics of scatter radiation protection cream using image analysis
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Background: Image analysis is considered an easy and fast method in determining the attenuation characteristics of thin and heterogeneous radiation protection for scattered radiation, such as hand-cream.
Methods: Four samples were made: hand-cream mixed with barium sulfate (BaSO4) powder and blank samples. Samples were different percentages of BaSO4 powder. The samples were irradiated to the scattered radiation produced using general X-ray and PMMA phantom at 60 kV and 80 kV. An imaging plate (IP) detected it penetrating the samples, and its DICOM images were acquired from the IP scanning device. Similarly, DICOM images of the aluminium step wedge were taken in the same conditions as the scattered radiation. The aluminium step wedge and the sample images were analysed, taking average pixel values and histogram in regions of interest. Aluminium attenuation equivalent and attenuation ratio were calculated as attenuation characteristics. These were derived using histogram bins, average pixel value of the blank sample and aluminium attenuation co-efficient.
Results: As the percentage of BaSO4 powder increased, the pixel value of histograms decreased. Attenuation ratio had scaled linearity with the percentage. 3 of 4 samples completed all these attenuation characteristics.
Discussion: It has shown that if the BaSO4 percentage of the sample is too low, the average pixel value of sample was more than that of the blank sample. The cause of that is suspected to be the scatter radiation produced from the BaSO4 in the sample itself.

What causes out-of-range deviation index values with appropriate exposures?
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Background: The deviation index (DI) is an indicator of the difference between acquired exposure and target exposure. Numerous factors can impact the DI value. This research explores the effects of wet and dry plaster on DI values, as well as the effects of including metal within the collimation of the radiograph.
Methods: This was investigated in two parts: one with an ankle phantom, the other with a self-constructed wrist phantom using lamb shanks as the radius and ulna. A metal plate was additionally drilled into the wrist phantom to replicate an ORIF to test the impact of metal. The effects upon DI were compared quantitatively, with qualitative assessment of image quality of radiographs obtained.
Results: There was no significant difference in DI values when changing orientation of the detector from landscape to portrait. In the wrist phantom, higher exposure indices were obtained for dry plaster compared to wet plaster for the wrist phantom, though results were mixed for the ankle phantom.
Discussion and Conclusion: Further investigation is needed to confirm this study.
Reference
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Comparison of surface guided radiation therapy and tattooing techniques for breast radiotherapy
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Background: Radiotherapy practice relies on the ability to accurately set-up, reproduce and monitor the treatment position to ensure that the delivered dose is consistent with the planned treatment. Techniques are constantly evolving in order to enhance set-up reproducibility, including tattooing and, more recently, surface guided radiotherapy (SGRT).

Tattoos are used as a reference point for treatment set-up, usually placed close to the isocentre or field margins. SGRT utilises non-ionising stereo-vision technology to track the patient’s surface in 3D. Studies have shown that SGRT produces smaller set-up error in comparison to sub-cutaneous tattoos. These findings are based on the ability of SGRT to monitor both inter-fraction and intra-fraction motion and perform respiratory gating.

Method: A literature search was conducted, with exclusion of studies relating to sites other than the breast and/or more than 10 years old. The information obtained was collated, summarised and presented in poster format. The poster aimed to describe the procedure, rationale, technical aspects, patient perspective, advantages and disadvantages and future developments in SGRT in comparison with tattooing techniques for breast radiotherapy.

Conclusion: In comparison to traditional tattooing techniques, the emergence of SGRT in breast radiotherapy can potentially provide improved accuracy, faster patient positioning, additional safety precautions and continuous intra-fraction motion and perform respiratory gating.

References
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In radiotherapy of superficial tumours and irregular contours, is 3D printed bolus more effective than commercial bolus?
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Introduction: Conventional bolus products increase superficial skin dose and reduce the effect of skin sparing in photon beam radiotherapy. Challenging irregular patient contours may result in air cavities between the patient’s skin surface and the bolus material, which may impact the patient’s quality of treatment. Fabrication and placement of conventional bolus can be time-consuming and resource intensive with bolus contour conformity at the discretion of the practitioner.

Objective: An exploration of the literature to ascertain whether bolus conformity and quality of the dose distribution can be improved with 3D printing technologies by eliminating the presence of air cavities and user discretion.

Methods: A literature review was conducted across Ovid and PubMed with the use of Boolean terminology and truncation. The key papers were identified based on inclusion criteria and relevance of title and abstract.

Results: Seven papers were identified for primary outcome measure analysis of conformity and dosimetry. Five articles were further identified for secondary aim analysis of expenses. Based on these studies, comparable or favourable conformal and dosimetric parameters were recorded for 3D-printed bolus application over conventional techniques. Nevertheless, 3D-printed bolus resulted in a significant increase in expenses when compared to historical fabrication methods.

Conclusion: The literature advocates for the use of 3D-printed bolus fabrication showing significant promise in air cavity reduction, PTV coverage and sparing of critical structures. Future randomised clinical trials are required to improve the quality of the data across human studies allowing comparison to a wider population level and to further reduce demographic bias.
**MRI-guided adaptive brachytherapy**  
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Intracavitary brachytherapy plays an important role in the treatment of cancer of the uterine cervix. The insertion of radioactive sources close to the tumour give a highly localised radiation dose internally to the tumour volume, resulting in higher local control rate and better organ sparing. The traditional approach requires the planning of brachytherapy to define point dose based on the bony structures provided by 2D images. The drawback is soft tissue, such as the tumour, and organs at risk (OAR) cannot be visualised in 2D images and result in suboptimal dose distribution and high grade of toxicity. In recent years, 3D planning for brachytherapy is achievable with the help of volumetric images (CT/MRI), which can provide superior soft tissue contrast. MRI-guided adaptive intracavitary brachytherapy for cervical cancer is an emerging trend. Different from the standard Manchester system, this technique can optimise the dose for every patient whose dose is now prescribed in terms of the tumour volume. MRI benefits treatment planning in providing exquisite details of the soft tissues, more accurate delineation to both target tumour volumes and surrounding OAR. Moreover, adaptive brachytherapy allows the adaptation of dose according to the anatomy of each patient, the position of OAR, the bladder volume and also the tumour regression or its movement between fractions. In addition, it allows the incorporation of interstitial needles to cover the parametrial extent or the underdosed part of a bulky tumour that cannot be covered by the dose of the applicator.

**Fiducial tracking of stereotactic body radiotherapy for non-small cell lung cancer patients in CyberKnife: from preparation to treatment**  
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Stereotactic body radiotherapy (SBRT) for non-small cell lung cancer (NSCLC) is a high-dose precision technique requiring accurate target tracking. Fiducials as surrogates of tumour position can be used for tracking in Cyberknife (Accuray, Inc.) but fiducial migration may affect the feasibility of the treatment. Low dose CT is done three days before fiducial implantation. The oncologist delineates the target in the CT as reference for the respiratory experts to implant the fiducials. Gold fiducials measured 0.8mm x 5mm are implanted bronchoscopically with fluoroscopic guidance on Day 1. CT scanning at exhale breathing status is done the next day after implantation of fiducials. This set of CT is used as reference location of the fiducials. 4DCT and CT scanning at exhale breathing status are done for radiotherapy planning purpose on Day 5. Fiducial checking session is arranged on Day 7 to ensure the fiducials are in place and can be tracked in CyberKnife. If the checking is successful, SBRT in CyberKnife can proceed. If the checking fails, another set of planning CT are done for re-planning purpose on that day. Fiducial checking session is then arranged on Day 9. If that fails again, the treatment cannot be done in CyberKnife. The CyberKnife uses periodic X-ray imaging for fiducial tracking in combination with continuous optical imaging of light-emitting diodes placed on the body surface. Eighty-five percent of NSCLC patients implanted with fiducials successfully completed SBRT with fiducial tracking in CyberKnife using this workflow.
Exploring cultural competency related to Hauora Māori in radiation therapy
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Introduction: It is crucial that Māori patients undergoing radiation therapy have positive treatment experiences to reduce disparities in cancer outcomes. Cultural competency and Hauora Māori teaching improves outcomes of Māori patients and adherence to treatment. There is however little research surrounding this subject within the profession of radiation therapy.

Aim: To explore the importance of cultural competency, related to Hauora Māori, in radiation therapy and to make recommendations for improvements within the profession to improve experiences and outcomes for Māori patients.

Methods: Key informants with expertise in cultural competency, Hauora Māori, radiation therapy and cancer care were interviewed and discussed cultural competency, current standards, personal experiences and ideas for the future of radiation therapy. Interviews were recorded, transcribed and qualitatively analysed.

Results: Cultural competency interpretations, tikanga and the importance of the Treaty of Waitangi were important aspects of Hauora Māori. Positive and negative examples of cultural competency were conveyed with ideas of improvement and changes in the profession, including current practice standards. Racism was explicitly discussed and affected outcomes for Māori cancer patients. Recommendations from informants were the normalisation of te reo, increasing the Māori radiation workforce, consistency between DHBs, health professions and governing boards in their standards and definitions along with improvements to professional development for radiation therapists and increased Hauora Māori content in the training curriculum.

Conclusion: Consistency of standards, opportunities for professional development and undergraduate learning, and implementation of tikanga in practice will improve the experience of Māori radiation therapy patients and produce better health outcomes.