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Original Research Article

Measures of Verification of Field Geometric for Simulator and Radiotherapy Portal Film using Image Processing

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Abstract: Radiotherapy verification is the process that enables us to be certain in treating the tumor volume as planned. to ensuring that accurate radiation dose has been given to the correct region, so measures of geometric verification were done, this study was carried out in radiation and isotopes center of Khartoum (RICK) including 57 patients were female 30 represented (52.6%) and male 27 represented (47.4%). using Interactive Data Language IDL software to measure the dimension and length of each axis for all images. The results show that the mean of simulator in X-axis 9.68±4.64 and for treatment film X-axis was 9.64±4.52, and for Y-axis for simulator 9±3.45 and for treatment film 8.96±3.25. Using paired sample t-test show there is no significant differences between simulator and treatment film for X-axis, and between simulator and treatment film for Y-axis. The association between simulator and treatment film for X-axis was 0.96 mm/mm, and for Y-axis was 0.94 mm/mm. Linear regression results showed that the rate of association for the simulator (X-Axis) and Treatment film (X-Axis) increases by 0.313 mm, and the rate of association between simulator (Y-Axis) and Treatment film (Y-Axis) increases by 0.437 mm.

Keywords: Simulator, Radiotherapy, portal film, IDL

INTRODUCTION:

Radiation therapy is the medical use of radiation and radioactive materials to treat cancer and a small number of benign diseases. In recent years, rapid development in the technology of radiation oncology has been seen, Potential errors can occur at each step. During the target definition step, sources of uncertainties include: target motion, patient set up errors, organ (tumour) motion and delineation of the target volume(s) [1].

Imaging techniques have been introduced not only at this stage but also at the treatment stage, and can control patient set up errors and (or) organ motion. RT treatment delivery using these techniques is collectively called image-guided radiation therapy (IGRT). IGRT provides an essential tool to investigate, quantify and in turn correct for geometrical uncertainties [2].

Planning target volume (PTV) margins are conventionally added to the clinical target volume (CTV) to account for uncertainties associated with organ motion and day-to-day setup variation. These margins can be uniform or asymmetric, depending on organ motion and risk of toxicity to surrounding organs. There appears to be a certain degree of variation among cancer centers regarding the prostate PTV definition [3-8].

Commonly, the margin is approximately 1 cm with a smaller posterior margin to achieve better rectal sparing. A more generic approach has been suggested by van Herk, [9] who proposed linking the PTV margin with systematic and random errors. PTV margins can be reduced if better tumor targeting is achieved, for which various methods have been suggested. Patient realignment alone is adequate if interring fraction motion is considerable while intrafraction motion is not as significant, for example, the prostate. This is in contrast to gating techniques, when intrafraction motion is significant, for example, the lung. Realigning the patient [10] allows us to reduce the PTV margin while keeping the CTV adequately covered, sparing normal tissues and potentially escalating the dose.

Record and verify systems (RVSs) were initially developed to reduce the risk of treatment errors, where the treatment parameters used for a given fraction were set manually and could differ from the 'prescribed' (or 'intended') parameters [11-15]. These parameters, which were to be applied during the whole treatment course, were obtained as a result of the treatment planning process, either from a real simulation performed with a simulator, including skin marking and image verification, or from a computer based simulation performed on a treatment planning system (TPS), including computation of the provisional dose distribution. Early RVSs were computerized

Systems attached to individual treatment machines and designed to capture, before each beam delivery, several treatment parameters accessible through encoders (i.e. collimator opening, gantry and collimator angle, and presence of accessories such as wedge filters) and to compare them to the intended parameters, either entered manually or automatically transferred from the simulator or the TPS.

The beams used for imaging could be either the actual treatment beams (single or double exposure) or additional ‘set-up beams’ or ‘verification beams’ (e.g. anterior–posterior and lateral) used exclusively to check the patient position. The dose contribution from these beams often used to be neglected. However, with the increased use of these images and functionalities like the megavoltage cone beam CT, for instance, the imaging dose cannot be ignored any longer, and it should be evaluated for each treatment protocol. Most RVSs include the possibility to record the MUs used for taking the images. Sometimes they offer options either to convert this MU into dose and account for it in the cumulative dose to the target or to subtract the corresponding number of MUs from the treatment MU setting. However, it should be recognized that there is no simple solution since the verification beams or the open field portion of double exposure images contribute to volumes that are different from the fields used to treat the target volume. Another approach would be to include these ‘verification beams’ in the TPS plan. And the main objective to this study to measure the verification of field geometric for simulator and radiotherapy portal film at Radiation and Isotope Center of Khartoum (RICK).

This study containing 57 patients, 35 patients with brain cancer which represented 61.4% percent, 18 patients with nasopharyngeal cancer represented 31.58% percent and 4 patients have a maxillary antrum tumor represented 7.012% percent. most of the patient were female 30 represented (52.6%) and male 27 represented (47.4%)., the data it’s taken from the patient’s records, simulation process and treatment images by using master data sheet and simulator images in addition to treatment portal images.

Material used x-ray Film with size: 24×30 & 18×24. the simulator Model: THALES, radiotherapy machine Cobalt-60 Model: EQ A 100, MDS Nordion, with activity 319.9 TBq/8647ci, the second machine Model: EQ B 80, Best The ratronics with activity 244.3TBq/6603 ci, by using Interactive Data Language IDL software version 6.1 to measure the dimension and length of each axis for all images.

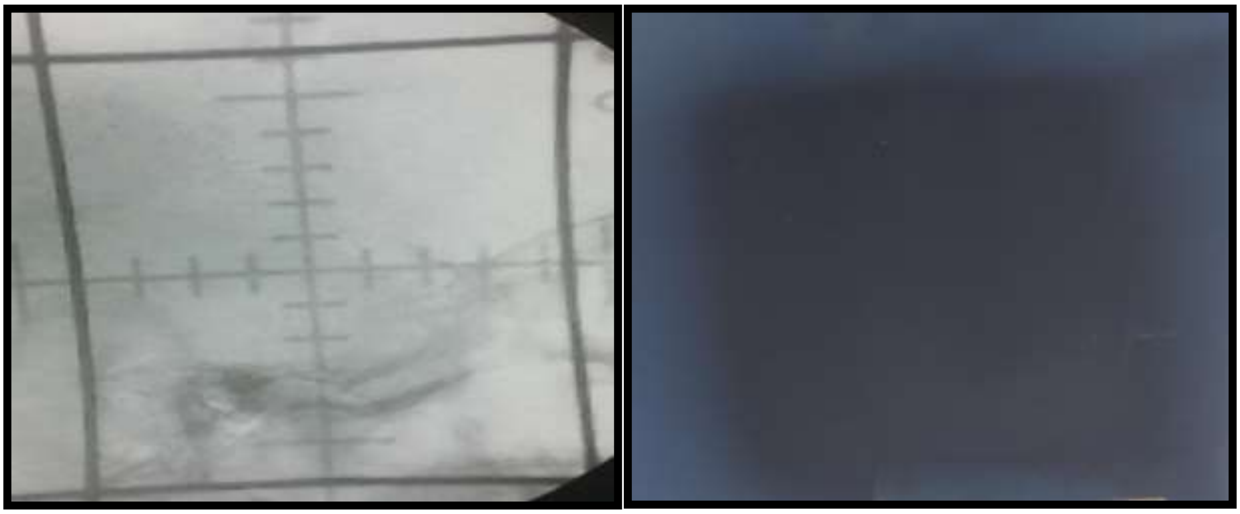

Fig-1: Simulator field size (8×12) & Treatment field size (7×12)

Fig 2: Simulator field size (7× 8) & Treatment field size (7×8).

RESULTS AND DISCUSSIONS:

This study was focus of verification of matching the axis dimension of the planning treatment (simulator) and radiotherapy film links between recovery of symptoms and treatment efficiency, present pathologic staging and grade, relation between BMI and symptoms, which is presented in tables and figures.

Table 1: paired samples statistics between simulator and treatments images:

		Mean	**N**	**Std. Deviation**	**Std. Error Mean**
Pair 1	Sim X	9.68	25	4.643	.929
	Treat X	9.64	25	4.527	.905
Pair 2	Sim Y	9.00	25	3.452	.690
	Treat Y	8.96	25	3.259	.652

Using paired sample t-test show that the mean of simulator in X-axis 9.68±4.64 and for treatment film X-axis was 9.64±4.52, and for Y-axis for simulator 9±3.45 and for treatment film 8.96±3.25.

Table 2: paired sample correlations between simulator and treatment image:

		N	Correlation	Sig.
Pair 1	Sim X & Treat X	25	.982	.000
Pair 2	Sim Y & Treat Y	25	.989	.000

Using paired sample t-test show that the correlation to x-axis for simulator and treatment film 0.982 and to y-axis for the simulator and treatment film 0.989.

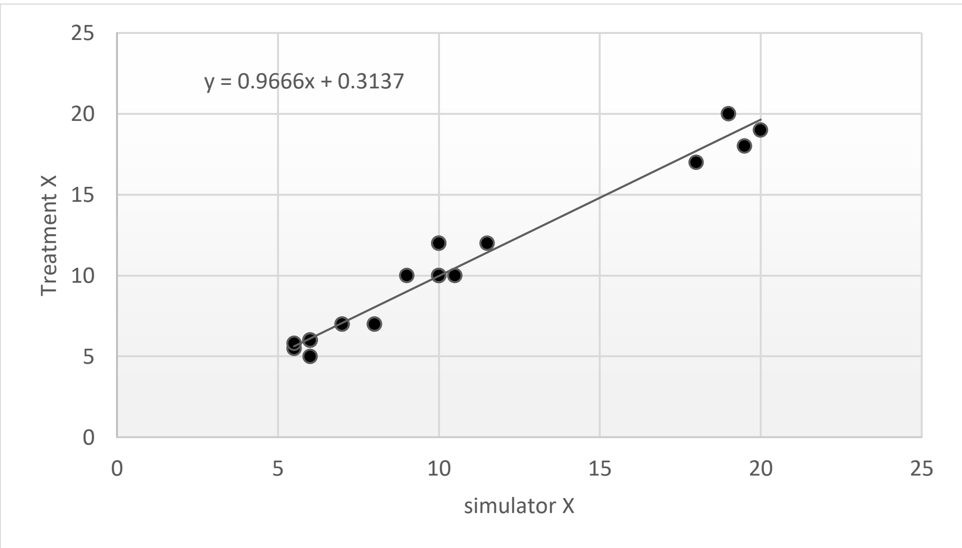

Fig 3: Show correlation for x-axis between simulator and treatment film

Linear regression results showed that the association between simulator and treatment film for X-axis was 0.96 per mm for each mm, and the linear regression results showed that the rate of association for the simulator (X-Axis) and Treatment film (X-Axis) increases by 0.313 mm fig 3.

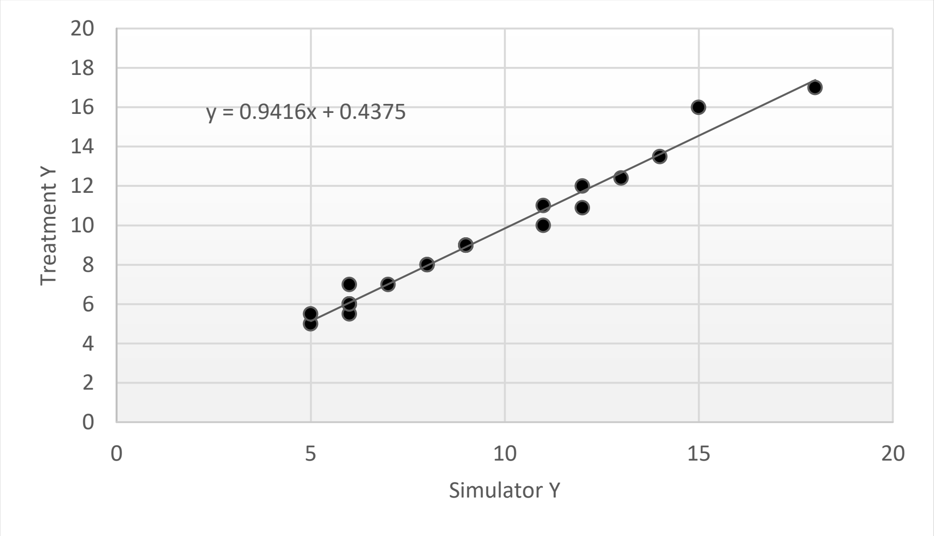

Fig 4: Show correlation for Y-axis between simulator and treatment film

Linear regression results showed that the association between simulator and treatment film for Y-axis was 0.94 per mm for each mm, and the linear regression showed that the rate of association for the simulator (Y-Axis) and Treatment film (Y-Axis) increases by 0.437 mm.

CONCLUSION:

Radiotherapy verification is the process that enables us to be certain we are treating the tumor volume as planned. In ensuring that the accurate radiation dose has been given to the correct region, measures are done for geometric verification in simulator and treatment machine using portal film.

The results show that the mean of simulator in X-axis 9.68±4.64 and for treatment film X-axis was 9.64±4.52, and for Y-axis for simulator 9±3.45 and for treatment film 8.96±3.25. Using t-test show there is no significant differences between simulator and treatment film for X-axis and between simulator and treatment film for Y-axis. The association between simulator and treatment film for X-axis was 0.96 mm/mm, and for Y-axis was 0.94 per mm for each mm.

Linear regression results showed that the rate of association for the simulator (X-Axis) and Treatment film (X-Axis) increases by 0.313 mm, and the rate of association for the simulator (Y-Axis) and Treatment film (Y-Axis) increases by 0.437 mm.

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