deliver the higher surface and superficial doses than treatment techniques based linear accelerator. It showed adequate dose (over 75% of prescribed dose) at 1 mm depth in skin region.

**EP-1398**

**Automated software analysis of multileaf collimator performance in dynamic mode**

C. Leprand¹, B. Ben Hémia¹, T. Bély¹, C. Di Bartolo¹, M. Edouard¹, J. Mesgouez¹, D. Autret¹

¹Institut de Cancérologie de l’Ouest, Medical Physics, Angers, France

**Purpose/Objective:** The aim of this study was two folds: (i) to implement a software that automatically assess multileaf collimator (MLC) performance in dynamic mode (ii) to analyse MLC performance over a long period of continuous operation.

**Materials and Methods:** This study was carried out with a Trilogy linac performing RapidArc® treatments equipped with a Millenium 120 MLC (Varian). Qualimagiq software solution was used (v5.4.1, Qualiformed, La Roche-Sur-Yon, France). Tests were as follows: (i) four sliding window at gantry 0°, 90°, 270° and 180° (CQ1); (ii) four picket fence at gantry 0°, 90°, 270° and 180° (CQ2); (iii) two picket fence with gantry rotation with and without intentional errors (CQ3 and CQ4); (iv) dose rate versus gantry speed (CQ5); (v) dose rate versus leafs velocities (CQ6). Images were acquired at 6MV with an AS1000 portal imager (EPID) and transferred to the software for data processing and analysis. All these tests were performed once a week for 9 months. Images were corrected from EPID mechanical slack. Acceptable tolerance levels and their uncertainties were taken from publications, manufacturer recommendations, repeatability and short-term reproducibility study.

**Results:** Weekly images acquisition and associated analysis take about 25 min and 5 min respectively. CQ1, CQ2, CQ4, CQ5 and CQ6 agreed with recommendations. For CQ3, leafs positions were over 0.2 mm limit. Further investigations showed that both leaf bank shifted during gantry rotation (0.74 mm ± 0.4 mm, clockwise and counter clockwise).

**Conclusions:** A simple tool to understand and to master for assessing periodically MLC performance in dynamic mode was implemented. Apart from the CQ3 test, they were all within tolerances. Thanks to this tool, we have understood why CQ3 was out of tolerance. A sag in MLC carriage due to the gravity effect happens during gantry rotation. This phenomenon would not have been detected with log files analysis and will be further investigated on other accelerators (2100C/D and True Beam, Varian).

**EP-1399**

**Radiochromic film based dose measurements during radiotherapy 4D CT-simulation**

N. Tomic¹, C. Quintero¹, F. DeBlois¹, J. Seuntjens¹, S. Devic¹

¹McGill University, Oncology, Montreal, Canada

**Purpose/Objective:** A 4D CT-simulation is becoming a widely accepted imaging modality for the management of target motion in radiotherapy. As it revolves around slow CT acquisition, it raised questions about the dose patient receives during this procedure. We measured 4D CT dose using radiochromic films on Rando phantom.

**Materials and Methods:** Pieces of XR-QA2 GafChromatic™ film were placed at the surface and between the slabs of the Rando phantom (chest and abdomen region, Fig.1.a). A Pulmonary (retrodirective) 4D CT protocol was used on Philips Big Bore CT-simulator to scan both Rando phantom (for dose) and Catphan (for image quality) using 3 different mA settings: 80, 133 (default), and 199. The dynamic Thorax Phantom (CIRS) and the Philips Bellows system were used to trigger the 4D acquisition with a period of 4 seconds. Response of radiochromic film (change in reflectance using red color channel of scanned tiff images on Epson expression 10000 XL document scanner) was calibrated in terms of air kerma in air by irradiating film pieces in the air. Dose to water at the surface of Rando phantom was obtained by multiplying air kerma in air values (derived from measured response of film pieces and strips) by the ratio of mass energy-absorption coefficients water-to-air at a given beam quality following TG-61 protocol.

**Results:** Fig.1.b shows the basic image quality parameters: image noise and low contrast detectability (LCD), at 0.5% contrast level obtained for 3 tube current settings from uniformity and low contrast sections within Catphan. As expected, with the increased mA setting the image noise decreases while the LCD increases showing the visibility of 15 mm, 6 mm and 5 mm contrast pins at 0.5% contrast level at 80, 133, and 199 mA setting respectively. Fig.1.c represents horizontal (black) and vertical (red) dose profiles through the chest area for default mA setting of 133 mA. Insets indicate the positions of film strips. Fig.1.d shows results of surface dose measurements for three different mA settings at two anatomical levels; chest (solid bars) and abdomen (slashed bars). Doses to ANT-POST aspects are slightly larger than to lateral aspects due to the smaller separation. Also, doses to pelvis region appear to be slightly higher than in the chest region (particularly in ANT-POST direction) due to smaller separation. The highest measurement uncertainty was estimated to be 6%.

**Conclusions:** For a default 4D CT-simulation mA setting of 133 mA, surface dose ranges from 11 cGy (lateral aspect) to 13 cGy for AP/PA aspect. The highest dose observed was 17 cGy at the anterior aspect of the abdomen region for the 199 mA setting. Doses during the 4D CT-simulation appear elevated, particularly in comparison to diagnostic CT image protocols within the same anatomical regions (2 - 6 cGy). Such dose increase has to be weighted against the benefit of reduced target margins and more accurate dose delivery in the course of radiotherapy of moving targets.
EP-1400
Fast neutrons for therapy. Tract formation of fluencies about 10^7 n/cm^2/c.
A. Shvedov 1, I. Borzakovskij 1, D. Zabrovec 1, V. Kuc 1, V. Riološko 1, O. Kozak 2, I. Vishnevskij 1, O. Butrim 3
1Institute of Nuclear Research, Department of Cyclotron U-120, Kiev, Ukraine
2Region Oncology Hospital, Radiotherapy Dept, Kiev, Ukraine
3Central Military Clinical Hospital, Radiotherapy Dept, Kiev, Ukraine

Purpose/Objective: The mechanism of interaction of fast neutrons with biological systems is still unclear. High LET value of neutrons makes this type of irradiation attractive for local influence on tumors insensitive to other types of irradiation. Nevertheless the chain of transmission of the neutron energy about 7 MeV to molecular bound consisted 5-10 MeV has not been described yet. Recoil protons influence is not the only one and may not be the decisive in so high radiobiological effectiveness of neutrons. Resonance phenomenon are of great significance in neutron-tissue interactions. Similar projects all over the world were stopped or not completed except few centers. In Institute of Nuclear Research in Kiev the Project of fast neutron influence at biological objects was started. This can help in understanding nature of lesions in biological tissue after fast neutron irradiation.

Materials and Methods: Cyclotron U-120 in Institute of Nuclear Research in Kiev is used for creating neutron beams. Fast neutrons are created in reaction ^9Be(d,n)^10Be under E_n = 13.6 MeV.

Results: Maximum value of neutron torrent amounted to ~10^7 n/cm^2/c. n-y combined field is created with wide neutron spectrum E_n ~ 1-14.6 MeV. The main contribution to neutron spectrum is constituted by E_n ~ 2.0-6.0 MeV (~90%). Contribution of gamma-quantum is equal ~ 1.5%. Neutrons with the energy 13.8-14.2 keV compose ~1.5 % of neutron field. Measured data are coincide with calculated ones with great veracity.

Conclusions: The next step of the Project after description of neutron fields and providing the correct dosimetry will be investigations in changing of cell morphology after neutron irradiation, Polyamine state, determination of methylation level of DNA, chromatin fragmentation, etc.

The Project aimed at creation of therapeutic complex for irradiation tumors with fast neutrons.

EP-1401
Preliminary assessment of the dosimetric characteristics of OSLDs in Co-60
S. Han 1, S. Choi 2, S. Park 1, H. Jung 3, H. Yoo 2, M. Kim 2, Y. Ji 2, K. Kim 2
1University of Science and Technology, Radiological Cancer Medicine, Daejeon, Korea Republic of
2Korea Institute of Radiological and Medical Sciences, Research Center for Radiotherapy, Seoul, Korea Republic of

Purpose/Objective: Optical Stimulated Luminescent dosimeters (OSLDs) have been used extensively for radiation monitoring and have more recently been studied for dosimetric application in medical radiation. OSLDs have wide operating energy (5 keV - 20 MeV). The useful dose range is from 10 μGy to 100 Gy for general applications. But in medical application, OSLDs have linear response with dose up to 3 Gy. The purpose of this study is to provide dosimetric characteristics of OSLDs for radiotherapy and we carried out dosimetric characteristics of OSLDs in the 60Co unit.

Materials and Methods: This study was used commercial OSLDs (nanoDot™ Dosimeter, Landauer Inc, Glenwood, USA) and we read out with micro star system (Landauer Inc, Glenwood, USA). OSLDs were evaluated dosimetric characteristics in the 60Co unit (Theratron 780, AECL, and Kanta, Canada) for high Energy. We divided dosimeters into two groups according to energy, and each groups consisted of dosimeters with variation of radiation sensitivity within ± 1.5% among them by sampling.

Results: In the 60Co unit, the reproducibility was 0.76% of the coefficient of variation, the batch homogeneity was within 1.5% of the coefficient of variation and the depletion by repeat reading was 0.04% per reading. The half time of count decay curve after irradiation according to reading time was 0.68 min. (1 Gy), 1.04 min. (5 Gy), and 1.10 min. (10 Gy), respectively and the count decay was stable after 11 min., After stability, coefficient of variation was within 0.4%. The correlation of between dose delivered from 60Co and count was fitted by quadratic function (R^2 =0.99).

Conclusions: On the basis of the dosimetric characteristics of OSLDs, it is feasible to use them for dose evaluation in 60-Co.

EP-1402
An empirical model for portal dose prediction by a CCD camera-based EPID
A. Amvari 1, S.M.R. Aghamiri 1, S. Mahdavi 2, P. Alaei 3
1Shahid Beheshti University, Radiation Medicine Engineering, Tehran, Iran Islamic Republic of
2Iran University of Medical Sciences, Department of Medical Physics, Tehran, Iran Islamic Republic of
3University of Minnesota, Department of Radiation Oncology, Minneapolis, USA

Purpose/Objective: Electronic portal imaging devices (EPIDs) are not only used for patient setup verification but are also...