Validation of a radiotherapy sector with an END-TO-END test in an anthropomorphic phantom for radiosurgery from a 3D printer

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Introduction

The present work aims to study the quality control in radiosurgery and to present the results of a phantom created in a 3D printer for END-TO-END testing (end-to-end verification test for the whole process of image acquisition, design, planning and dose delivery).

Methods

An END-TO-END test was carried out at the Hospital Regional de Juazeiro (HRJ) – Bahia, for the inauguration of the Radiotherapy Service. The test was carried out using a SIEMENS SOMATON tomograph and a VARIAN CLINAC CX linear accelerator, a dose of 10Gy and a dosimetric set consisting of: FC65-P - IBA ionization chamber and Dose 1 IBA electrometer.

The planning carried out used three radiation fields (angles of 0º, 270º and 180º), isocenter in the lesion and with the target being the sensitive volume of the FC65-P ionization chamber.

Results

Table 1 presents the collected dose (cGy) corrected by polarization factors K_{pol}, temperature, pressure and humidity K_{pt}, chamber response K_s and the difference defined (%) at the end of the test. It is part of a document delivered to the hospital that proves the validation of the END-TO-END test at the institution, so that the service can start its services.

Table 1. Result of the END-TO-END test performed at Hospital Regional de Juazeiro (HRJ)

Dosimetry	TPS[1] (cGy)	Reading (C)	Kpt	Kpol	Ks	Chamber Factor (nC/Gy)	Dose (cGy)	Difference (%)
Phantom	10.197	2.034E-7	1.010	1	1.003	20.91	9.724	4.63
		2.095E-7					10.015	
		1.952E-7					9.335	

[1]TPS - Treatment Planning System

Conclusions

The END-TO-END test is of fundamental importance to verify all possible errors during the patient flow in a radiotherapy service. The phantom presented results of extreme interest, a dose delivery below 5% difference between the planned and the collected doses, taking into account that the positioning at the time of the treatment presented a small deviation and this may have interfered in the result for a greater difference.

Repeated pediatric computed tomography examinations: Assessment of cumulative radiation dose and radiogenic risks

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Introduction

Computed tomography (CT) is the primary source of medical exposure to the general public for medical purposes representing 70% of the collective dose. Cumulative doses from CT procedures raised concerns about the biological effect of ionizing radiation due to the high dose per procedure. Pediatrics and children are more sensitive to ionizing radiation than adults due to their rapidly devising cells and long life expectancy. This study aims to calculate the cumulative dose, recurring radiation exposure, and potential radiogenic risks for pediatric patients during CT exams.

Methods

Data on pediatric cases from 2018 to 2023 were obtained from the radiology archives of King Abdulaziz university hospital Jeddah, Saudi Arabia. All investigations were conducted using two CT machines (SOMATOM Definition Flash & AS). CTDIvol and DLP of each CT study were extracted from radiology archives.Pediatric ages ranged from 0 to ≤15 years and were included in this study. The cumulative CT radiation exposure was estimated by summing typical CT effective doses per procedure. The effective and organ doses were estimated using CT-Expo software.

Results

The data showed that 2660 of the repeated exams for the age group 0-5, 1431 were females, and 1327 were males . . 485 (249 female and 332 males) of repeated exams for the age group 6-10 years. The number of repeated exams for the age group 11-15 years was 744 procedures (350 females and 394 males). The number of repeated CT procedures ranged from 2 to 12 for all groups. The mean and range of the DLP (mGy.cm) per procedure are 378(310-3986), 516 (129-4572), and 572 (160- 6474) for age groups 0-5, 6-10, and 11-15, respectively. The cumulative effective dose range from 65 mSv to 260 mSv. The average cancer risk per procedure is one cancer incidence per 1000 CT procedures.

Conclusions

The study showed that many repeated CT procedures were carried out frequently. The number of repeated exams is high and challenges clinicians and medical specialists. Pediatric doses varied up to 30 times for the same CT procedures, suggesting that the imaging protocol was not optimized. Implementing appropriateness criteria and establishing radiation protection guidelines ensures that CT scans are performed without unnecessary radiation exposure.