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Research Article

An Assessment of Radiation Protection and Shielding Properties of 256 Slice Computed Tomography (CT) Facility: Intermed Nisantasi

Baris Cavli[1*], Ceren Ozturk[1], Fuat Şahintürk[1]

[1]Affidea, Istanbul, Turkey (ORCID: 0000-0002-3494-8858)

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Abstract

Background: The distance factor is one of the fundamental principles of radiation protection. In CT facilities, maximum dose consists near the CT gantry and dose rate is decreases by distance. To know the rate of reduction of the radiation dose that distance is very important for radiation protection procedure especially for apply criterias of International Commission on Radiological Protection (ICRP) on radiation protection.
Materials and Methods: This technical paper aimed to investigate the backscattered dose amount from 256 Slice CT device (Philips iCT) for verification of radiation protection measures in Intermed Nisantasi CT facility and also to evaluate the shielding properties of walls of operating room and patient waiting room during the abdominal CT scan. This technical study has been performed in Intermed Nisantasi. In this study, we measured the dose rates from the gantry until exit door and behind the door.
Results: The results showed that, backscattered dose amount has decreased by distance. We obtained only background radiation in radiographer room and patient waiting room. The results also showed that radiation protection requirements are maximized in investigated CT facility.
Conclusion: It can be concluded that, recent method can be applied for various CT facilities for optimum radiation protection studies which also in discussion with ICRP and IAEA for better radiation protection and shielding in radiology clinics.

Keywords: Radiation Protection; CT; Radiation Shielding

256 Kesitli Bilgisayarlı Tomografi (CT) Çekim Alanının Radyasyondan Korunma ve Koruyucu Özelliklerinin Değerlendirilmesi: Intermed Nişantaşı

Öz

Arka plan: Uzaklık faktörü, radyasyondan korunmanın temel ilkelerinden biridir. BT alanlarında, maksimum doz CT portalına yakındır ve saçılan doz oranı mesafeye göre azalır. Radyasyon dozunun azalma oranının bilinmesi, özellikle radyasyondan korunma üzerine Uluslararası Radyolojik Koruma Komisyonu (ICRP) kriterlerini uygulamak ve radyasyondan korunma prosedürü için oldukça önemlidir.
Gereç ve Yöntem: Bu teknik çalışma, Intermed Nişantaşı BT tesisinde radyasyondan korunma önlemlerinin doğrulanması için 256 Slice CT cihazından (Philips iCT) abdominal BT taraması sırasında geri saçılan doz miktarını araştırmayı ve ayrıca ameliyathane ve hasta bekleme odasının duvarlarının koruyucu özelliklerini değerlendirmeyi amaçlamıştır. Bu teknik çalışma Intermed Nişantaşı'nda yapıldı. Bu çalışmada, portaldan çıkış kapısına ve kapının arkasına kadar olan doz oranları ölçülmüştür.
Sonuçlar: Sonuçlar, geri saçılan doz miktarının mesafe ile azaldığını göstermiştir. Radyografide ve hasta bekleme odasında sadece arkaplan radyasyon elde edilmiştir. Sonuçlar ayrıca, araştırılan BT tesisinde radyasyondan korunma gereksinimlerinin en üst düzeye çıkarıldığını göstermiştir.
Öneriler: Radyoloji kliniklerinde daha iyi radyasyon koruması ve koruması için ICRP ve IAEA ile tartışılan optimum radyasyon koruma çalışmaları için çeşitli BT tesisleri için mevcut araştırma yöntemlerin uygulanabileceği sonucuna varılabilir.

Anahtar Kelimeler: Radyasyondan Korunma; CT; Radyasyon Zırhlaması

[*] Corresponding Author: Affidea, Istanbul, Turkey, ORCID: 0000-0002-3494-8858, baris.cavli@affidea.com

1. Introduction

Computed Tomography (CT) scams provides a group of X-ray images achieved via various angles to establish the cross-sectional images of examined patient. CT can be utilized especially for bones scans, blood vassels as well as soft tissues. As a comparison between two device, achieved anatomical data from the patient by using CT is much more higher then the normal plain X-ray device. Since CT uses different amount dose of X-rays for imaging of body, the term of radiation protection became a vital topic during the medical applications. Computed tomography (CT) is an imaging method that produces cross-sectional images by representing in each pixel the local X -ray attenuation properties of the body. Since the introduction of helical computed tomography (CT) in the early 1990's, the technology and capabilities of CT scanners have changed tremendously. By the developing technology on diagnostic devices, procedures are performing with detailed informations about patient. In CT examination, patient is placed between the source and detector and the detector is configured with its geometric center located at the x-ray source. In addition to various benefits of medical imaging by using CT, of course there is some risk groups associated with the x-ray radiation exposure. The possibility for absorbed X-rays to cause cancer or inheritable mutations leading to genetically associated diseases in offspring is thought to be very small for radiation doses of the magnitude that are associated with CT process. Under some rare circumstances of prolonged, high-dose exposure, x rays can cause other adverse health effects, such as skin erythema), skin tissue injury, and birth defects following in-utero exposure. There is some considerable absorbed dose rates from CT scan. Table 1. shows the dose a patient could receive during the procedure [1]. As it can be seen from the Table 1, radiation dose rates should be considered as which would cause biological effects. High-radiation exposure occurs during computed tomographic (CT) fluoroscopy [2]. This high rate of radiation is a condition that acceptable to the patient because of imaging procedure but we have to consider one other case that radiation dose around CT device that can be effect the CT operator or other staff. For the CT operator, exposure is primarily a function of scattered radiation and collimator or gantry leakage [3]. In past several years, some work has been done on this subject [4-7]. This technical paper aimed to investigate the backscattered dose amount from 256 Slice CT device (Philips iCT) for verification of radiation protection measures in Intermed Nisantasi CT facility and also to evaluate the shielding properties of walls of operating room and patient waiting room during the abdominal CT scan. This technical study has been performed in Intermed Nisantasi. In this study, we measured the dose rates from the gantry until exit door and behind the door.

Table 1. Effective dose rates due to examination

Examination	Effective Dose (mSv)
IVP	2.5
Barium Swallow	1.5
Barium Enema	7.0
CT Head	2.0
CT Chest	8.0
CT Abdomen	10.0
CT Pelvis	10.0
Angioplasty	7.5 – 57.0
Coronary Angiogram	4.6 - 15.8

2. Material and Method

In this study, we performed the measurements in CT device room, radiographer room and patient waiting room, respectively. Experimental measurements were obtained in the processes performed by Philips iCT 256 Slice CT device for the same imaging parameters of CT Abdominal examinations which often performing by 120 kV. As a first step, we performed the measurements for 8 different location from CT gantry until exit door. Figure 1 represents the measurements locations according to the position of the gantry. In figure 1. I is location of patient door, J is location of control room for radiographers. Moreover, the measurements points have been presented from A to H, respectively. The measured dose values are given in table 2 with the ID of measurement points. All the dose measurements are performed by using the Polimaster Survey Meter (PM1405) shown in figure 2. Polimaster Survey Meter is compact multifunction and capable of measuring x-ray, gamma and beta radiation. We performed the simultaneous and selective measurement of the x-ray radiation intensity by using PM1405 during Abdominal CT examinations. In this study, all the measurements were performed by using user interface of PM1405 in operating room by remote control with personal computer which comes with detector. Thus, no radiation risk has occurred during the measurements.

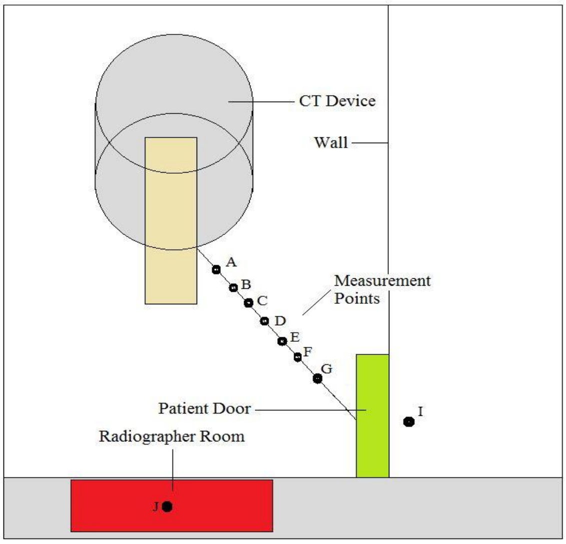

Figure 1. Schematic view of CT room

Table 1. Distance and dose rates

Examination	kV	Distance	Average Measured Dose (msV/h)	ID.
CT Abdominal	120	20	48,5	A
CT Abdominal	120	70	13,2	B
CT Abdominal	120	120	8,5	C
CT Abdominal	120	170	2,9	D
CT Abdominal	120	220	1,95	E
CT Abdominal	120	270	1,24	F
CT Abdominal	120	320	1,08	G

Figure 2. Polimaster Survey Meter PM1405

3. Results and Discussion

We performed our measurements in eight different points from the gantry by increasing 50 cm in each measurements. In addition, we measured the dose amounts in radiographer operation room (l) and patient waiting room (h), respectively. We considered the average dose rates in each distance. Table 2 gives the type of examination and kV values in different distances and the obtained dose values, respectively. Gamma radiation is the part of the electromagnetic spectrum. A gamma radiation ray not absorbed by the air, but its intensity decreases because it spreads out. Accordingly, the intensity changes with the inverse square of distance: it follows an inverse square law. As we see from the table 2, the dose rates decreased by the increased distance from CT gantry. Considering clinical parameters, we also measured the dose rates in radiographer room and behind the patient door. The measurements showed that, average dose amount was between 0.07 msV/h, in both places. This value has been obtained as a background radiation around the hospitals. Therefore, it can be said that wall shielding of the radiographer room and the patient waiting room have provided maximum radiation protection considering the optimum radiation shielding requirements.

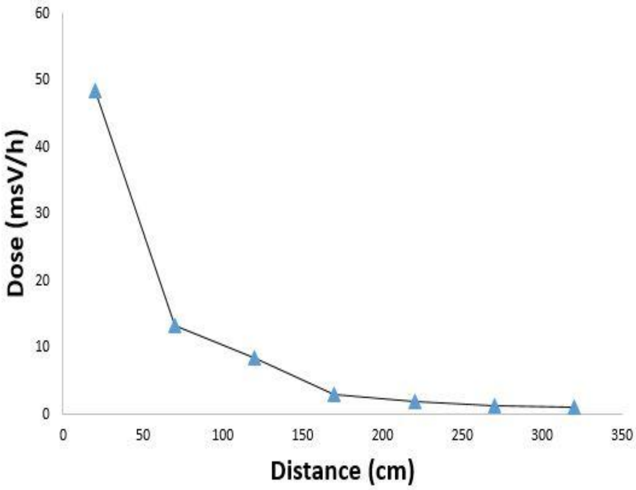

Figure 3. Comparison of distance and dose distribution

4. Conclusions

The term of radiation protection and radiation shielding for ionizing radiation have achieved great importance especially by new generation shielding materials and dose reduction techniques. This study clearly showed that, radiation protection requirements and shielding properties in investigated hospitals are significantly optimized. It can be concluded that, recent method can be applied for various CT facilities for optimum radiation protection studies which also in discussion with ICRP and IAEA for better radiation protection and shielding in radiology clinics.

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