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Quality assurance of the linear accelerator device using star track and Perspex

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Abstract

Radiation therapies with linear accelerator are one of the efficient techniques cancer treatment. The aim of this study is to verify of quality assurance of the linear accelerator at the Baghdad Center for Radiation Therapy and Nuclear Medicine. In this study, a STARTRAK device and Perspex were used to ensure the quality of the linear accelerator for the period from August to December 2018. Quality assurance of the linear accelerator work using Perspex and Star Track by measuring the output dose. The results show an acceptable variation in the output X-ray dose delivered from Linear accelerator type synergy. The achieved variation was ±2% and it was within the permissible range according to the recommendations of the manufacturer of the accelerator (Elkta).

Key words

Quality assurance, perspex, STARTRAK.

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ضمان جودة جهاز المعجل الخطي باستخدام ستار تراك وبيرسبكس

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الخلاصه

تعد العلاجات الإشعاعية باستخدام المعجل الخطي واحدة من الأساليب الفعالة لعلاج السرطان. حيث كان الهدف من هذه الدراسة هو التحقق من ضمان جودة المعجل الخطي المتوفر في مركز بغداد للعلاج الإشعاعي والطب النووي باستخدام ستار تراك وبيرسبكس. اجريت الدراسة في الفترة من شهر اب إلى شهر كانون الاول 2018. أظهرت النتائج تباينًا مقبولًا في الأشعة السينية الخارجه من المعجل الخطي السنرجي. هذا الاختلاف بلغ ± 2٪ وهو ضمن النطاق المسموح به وفقًا لتوصيات الشركة المصنعة للمعجل (اليكتا).

Introduction

The principle of radiation therapy depends on using high energy ionizing radiations in the patient's treatment especially those have had malignant tumors. The cancerous cells tend to divide and grow rapidly and have the ability to leave the original tumor and seed in new sites. Main object of radiation therapy is to give a sufficiently high absorbed dose to define the target volume in order to eradicate the tumor with minimum dose as possible to the healthy tissues [1]. For this reason, it is necessary to highly conform the treatment beam to the target treatment and to minimize the radiation dose to the normal tissues surrounding the tumor [2, 3].

High energy electron and photon beams are typically produced by linear accelerators range between 4 and 25 MeV for the electron 4 and 15 MeV for photons [1, 4, 5]. The dose out from the linear accelerator is measured by the Perspex and Star Truck techniques [6]. The aim of this study is to check the quality assurance of the linear accelerator in Baghdad Center for Radiation Therapy and Nuclear Medicine using Star Track and Perspex. The verification of the dose output of the linear accelerator is done by using many methods of dosimetry one of them is stare track. The correction factor, KTP, for both pressure and temperature is calculated using the following equation [7]:

$$KTP = (273+T)/ (273+T°) ((P°)/P \quad (1)$$

where T is the temperature measured during measurement, P_0 is the reference pressure and P is the pressure measured during measurement, respectively.

Materials and method

Measurements were performed on linear accelerator at, Medical City. Photon energies used were 6MV and 10 MV. Equipment used to perform the measurements is shown in brief detail and the procedures used to measure the absorbed dose following each code of practice are explained

1. Star track method

A device used to check the beam outside of the radiator and as a measuring device for the absorbed dose and profile of radiation beam which expresses the symmetry and stability of the beam during treatment. This device consists of 453 ionic counters. The distance between the counters is equal to 5mm and the diameter of the counters is about 3mm. Counters of type plate-parallel ionization and the power that is supplied is about 100-240 V. The device is placed below the head of the linear accelerator after which is moved to SSD = 100 cm as shown in Fig.1. The device is interfaced via computer on line outside the examination room and by (Omni Pro-Advance) the device will complete the work after selecting a field size 10 cm × 10 cm. as shown in Fig.1.

The measurements are taken from an output dose from the Star Track device.

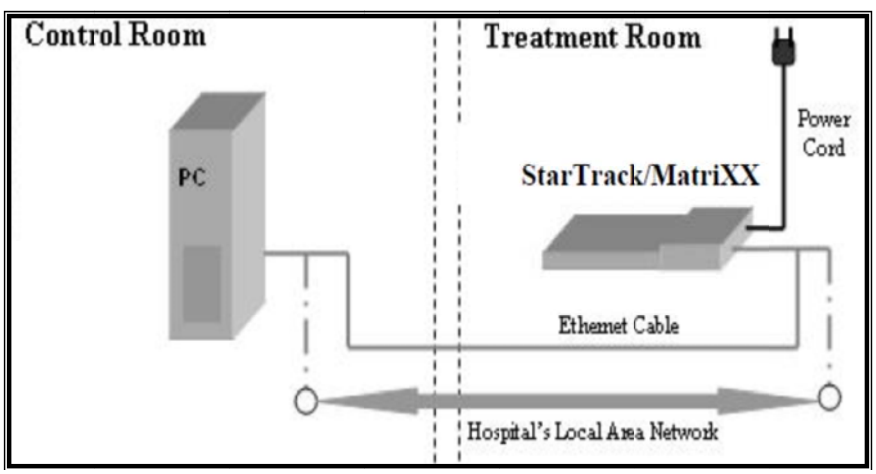

Fig.1: Star track system.

2. Perspex

These plates are made from the material equivalent to human tissues in density to verify the accuracy of the beam outside of the linear accelerator. The thickness of this single chip is 1cm the material made of it is PMMA Perspex containing the cavity to put the counter inside and then the counter is of the type CC13 in the Perspex which contains the cavity to put the counter inside. After ordering the pieces of plastic in the form it is important that the distance from the source to the surface of Perspex equals 100 cm and the size of the filed 10 cm ×10 cm, as shown in Fig.2.

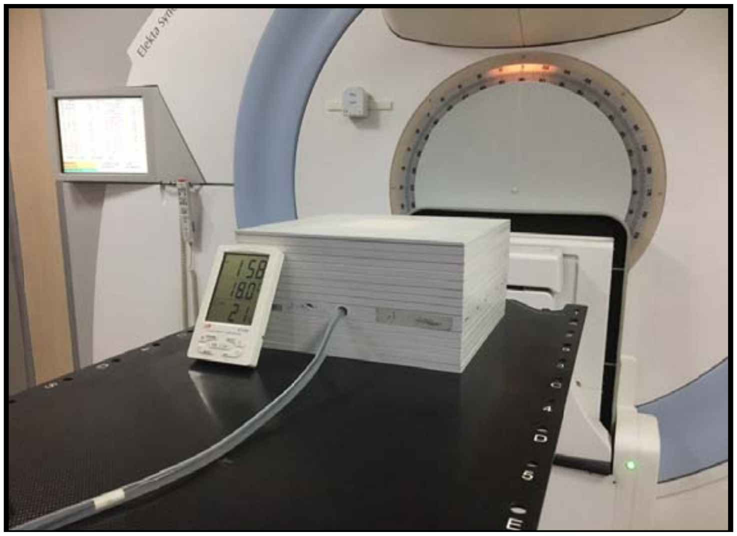

Fig.2: Perspex solid.

3. Ionization chamber

The type of ionic counter used in this work was CC13 standard chamber for clinical use in water phantoms for dose measurements and measurement profile, this type of meter is characterized by the following specifications cavity length 5.8 mm, cavity radius 3.0mm wall and thickness 0.070g/cm^2, as shown in Fig.3.

Fig. 3: The CC13 farmer ionization counter from IBA Company.

Results and discussion

In this study, a field of size used is 10cm×10cm, 6MV and 10MV for photon beam energy at D_{max} using star track device. In the first step, the external dose was measured from the linear accelerator for 6MV and 10MV. After that, the results were compared with the Perspex.

Table 1 shows the extra dose measured by star truck where measurements have shown that the measured dose is within the allowable range, range surveys is ± 2 reference value and the reference value is 100.04 for 6MV energy and 100.11 for energy 10MV and these results underlines the consistency and stability of the device for measuring during short time.

Table 1: Dose output measurements by star track

Dose output measurement 6 MV	Dose output measurement 10 MV
98.28	99.55
100.8	99
101.87	102
101.9	102
101	101.35
100.38	101.83
98.71	101.11
101	101.72
100.13	100.17
101.18	101.16

Table 2 shows the comparison between dose output measurements by star truck and Perspex. The results shows that the dose measured by star Track and Perspex is agree between the device, where we note that the dose out of the Star Track real and effective and stable readings rate change within the range of ±2 [8]. The device is stable and there is no significant change between reading and reading and when taking a second device which is Perspex when the measuring the degree of change in the readings within the range of ±2. The radiation dose is measured in this study in a way that Perspex and star truck results very good approach and in some instances identical to study number [9].

Table 2: Compare between dose output measurements by star truck and Perspex.

Dose output measurement by star truck		**Dose output measurement by Perspex**	
Dose output (cG) 6 Mv	Dose output (cG) 10 Mv	Dose output (cG) 6 Mv	Dose output (cG) 10 Mv
98.28	99.55	100	100
100.8	99	99.6	99.8
101.87	102	100	100
101.9	102	100.44	100.2
101	101.35	99.7	99.92
100.38	101.83	101.1	101.1
98.71	101.11	99.9	99.8
101	101.72	99.4	100.2
100.13	100.17	100.3	100.4
101.18	101.16	100.4	99.9

Conclusions

From this study we can verify the quality Assurance of the linear accelerator located at the Baghdad Center for Radiation Therapy and Nuclear Medicine using Star Track and Perspex. This study presented different details and main in the quality of the linear accelerator work using Perspex and Star Track by measuring the output dose. Overall, measurements obtained are in very good agreement with each other. The very little tolerances in the value of the outpatient dose ±2. It is within the permissible tolerances of this type of accelerator in radiation therapy.

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