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Analysis of 6 MV Energy Quality File Index using Percentage Depth Dose (PDD) and Tissue Phantom Ratio (TPR) Methods on Linac Siemens and Electa

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Abstract

Patient dose in the Linac Electa and Siemens determined with Source Surface Distance (SSD) technique using Precentage Depth Dose (PDD) method and Source Axis Distance (SAD) technique using Tissue Phantom Ratio (TPR) method. The study was conducted by measuring the PDD and calculating the TPR to compare the calculation of the beam quality index on the Linear plane of photon energy at a measurement of 6 MV. PDD is done with a 100 cm SSD technique at a depth of 0 cm to 25 cm. The calculation of TPR is done at SAD position of 100 cm at depth of 10 cm and 20 cm with standard field 10 cm x 10 cm. The result of Linac aircraft exposure with big 6 MV photon energy using Tissue Phantom Ratio (TPR) method is greater 0.98%, according to the research result obtained 0.66% from TPR Linac Siemens Aircraft, while Linac Elekta 0.67% BATAN standards are allowed at 3%).

Keywords: PDD; TPR; SSD; Photon; Quality File Index.

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1. Introduction

Linear accelerator (Linac) is designed to produce photons and electrons. Electron accelerator or Linac has become a standard treatment machine in radiotherapy centers [7]. This tool is used to irradiate cancer inside and on the body surface [4]. The existence of Linac aircraft is very beneficial and gives hope to cancer patients to recover. To calculate the dose at a given point in the patient determined some things that describe the effect of the dose so it is necessary to see the basic parameters such as energy of the beam, field size, depth of the desired calculation point and the surface distance of the source file. In using a dosimetry prototype the photon beam in the clinic must first consider the quality of the file [3]. For megavoltage the quality of the beam is determined by the concept of the penetration ability of the beam in water. By comparing the ability of different types of radiation energy to the pattern of the penetration of the beam in the water can be distinguished the quality value of each beam, the deeper the penetration of the beam in the water shows the higher the file quality. There are 2 set-ups for determining the dose measurements in the patient's Source Surface Distance (SSD) technique using the Precentage Depth Dose (PDD) method and Source Axis Distance (SAD) technique using Tissue Phantom Ratio (TPR) method [5]. Analysis of the depth dose characteristics may help the selection of appropriate files for radiotherapy treatment when various energy beams are available. This is a dosimetric parameter to confirm the number of doses of measured values in increasing accuracy in radiotherapy treatment [2]. A modified formula for defining TPR from photon rays but less effective in clinical applications [1] and small field ratios in TPR data generation for Elekta Agility 6 MV photon rays that result in similarities in the bulid up area to a depth of 2 cm and the meeting point at depth of 10 cm [8]. Previous research by Laksono and his colleagues [6] has measured and compared the PDD and TPR methods to determine the beam quality index on a 6 MV photon linear energy plane. The measurement of PDD method is done on 100 cm SSD and TPR method on SAD 100 cm. The quality of the files can be quantized so that an index or constant of various measurable radiation energies and parameters is called the file quality index which can be determined from the PDD or TPR value [9]. Sianturi and his colleagues [10] reported that the value of tube voltage deviation (kVp) and tube time (mAs) to meet the tolerance limit specified by PERKA BAPETEN No 9, 2011 to four X-ray devices in hospitals at Medan give only onedevice does not exceed the limited permitted by PERKA BAPETEN No. 9,2011. As per the BAPETEN No. 09 Year 2011 and Western Australia Standard, that the HVL for each voltage on the X-ray plane The general radiography tested in this study is still within the permitted minimum range. In relation to the accuracy of dosage TRS-398 (Technical Reports Series No.398) has provided practical guidance on the measurement of high energy photon radiation beam on medical accelerator to determine the file quality index using SSD technique with PDD method but theoretically using SAD technique with TPR method .

2. Materials and methods

The study was conducted in two Medan City Hospital. Materials and tools used in this study are Siemens M5782 aircraft, Linac Elekta Pricise 151614 aircraft and External Radiation dosimetry (Radiation Measurement Instruments). Measurement of field area is done on surface 10 cm x 10 cm with 100 cm SSD. Then do irradiation with a fixed SSD 100 cm by lowering the chamber from the surface with a depth of 0 cm to a depth of 25 cm. Afterwards, the measurements of 6 MV Siemens and Elekta TPR were measured on 10 cm × 10 cm surface with 100 cm SSD, then the chamber value was lowered to a depth of 25 cm from the surface with 100

cm SAD, perform irradiation by lowering the water level in phantom from the depth of chamber 25 cm from surface to 0 cm with SAD remain 100 cm.

3. Results and Discussions

1. PDD on Photon Energy 6 MV Siemens

From the measurement results of PDD 6 MV photon energy on the Siemens M5782 aircraft. Figure 1 shows the depth distribution of the dose of the PDD method on the Siemens 6 MV photon energy. Dmax at 6 MV Siemens photon energy occurs at a depth of 15 mm. Then the percentage of dose distribution will decrease gradually as the radiation on the medium will give its energy to the medium it passes.

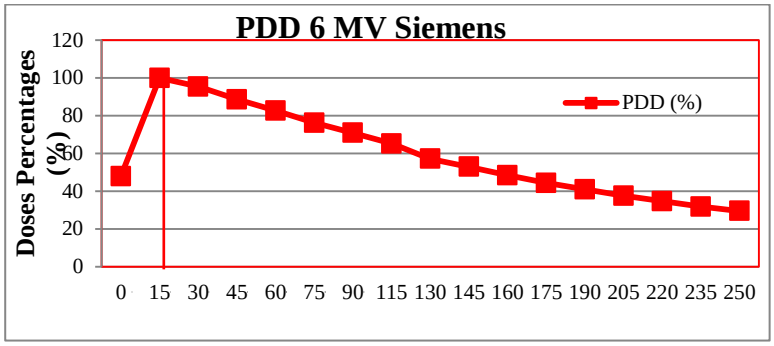

Figure 1: Graph of Siemens PDD on Photon Energy 6 MV

2. PDD on Photon Energy 6 MV Electa

From the measurement result of PDD of 6 MV photon at Linac Electa Pricise 151614 plane. Figure 2 shows the depth distribution of dose of PDD method on Electa 6 MV photon energy. Dmax at 6 MV Electa photon energy occurs at a depth of 16 mm. Then the percentage of the dose distribution will drop gradually as the radiation on the medium will give its energy to the medium. Then the percentage of dose distribution will decrease gradually as the radiation on the medium will give its energy to the medium it passes.

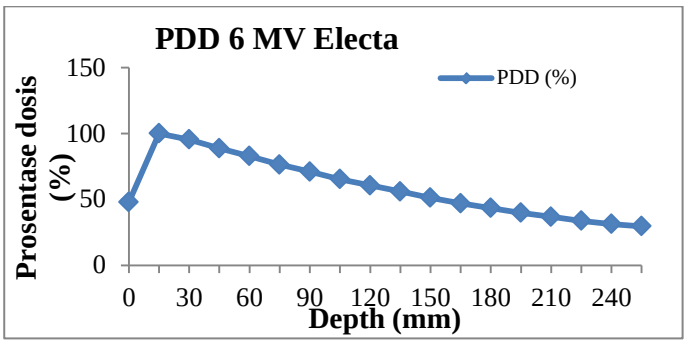

Figure 2: Graph of Electa PDD on Photon Energy 6 MV

From the measurement results of PDD energy of 6 MV and 10 MV photons on Linac Siemens M5782 and Electa Pricise 151614 aircraft. Figure 3 below shows the depth distribution of dosage of PDD method on the energy of 6 MV Siemens and 6 MV Elekta photons. In the build up region the distribution of doses is almost identical in the line graphs almost coincidental until the maximum dose (Dmax) is just far apart. Dmax at 6 MV Siemens photon energy occurs at a depth of 15 mm while at 6 MV Elekta photon energy occurs at a depth of 16 mm, Then the percentage of dose distribution will decrease gradually as radiation on the medium will give its energy to the medium it passes. From the second Linac plane at the same energy of 6 MV there is a difference of () x 100% = 93.75%, this result in accordance with the standard BATAN allowed 3%.

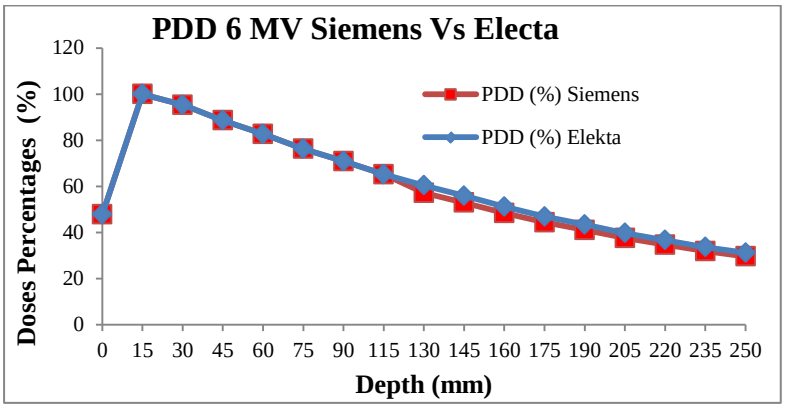

Figure 3: Graph of PDD Siemens and Elekta on Photon Energy 6 MV

4. Conclusions

6 MV photon energy PDD method, Dmax Linac Elekta aircraft is larger than 0.94% compared to Dmax Linac Siemens aircraft, according to research results Dmax Plane Linac Siemens is at a depth of 15 mm while Elekta is at a depth of 16 mm. At 6 MV photon energy Tissue Phantom Ratio (TPR) method, TPR Linac Elekta plane 0.98% larger, according to the research results obtained TPR Plane Linac Siemens obtained 0.66% while Linac Elekta aircraft 0.67%

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