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PROFILE DOSE ANALYSIS OF 6MV LINEAR ACCELERATOR WITH CCD ELECTRONIC PORTAL IMAGING DEVICE

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Abstract— Profile dose analysis of 6 MV linear accelerator use CCD Electronic portal imaging device has been ivestigated. The aim of that research is analysis the profile dose curve of CCD EPID. The analysis include calculate the linierity. Symetrisity and penumbra value. Linier accelerator electa compac and CCD EPID are the material of that research. CCD EPID beamed with 10 x 10 cm field with 5 kind of MU. The MU value are 20 MU until 100 MU. The image of CCD EPID converted to grey-scale. Than we calculaated the grey scale value become profile dose curve in cross-line and inline position. The result are we get simetrisity and penumbra less than 2%, but linierity value more 0,2% more than 3%. It means that the symetrisity and penumbra agree with AAPM TG no. 47. But the linerity must has more investigated to decrease he value until 3%.

Keywords— profil dose, corection, CCD EPID

I. INTRODUCTION

This Modern irradiation techniques, such as intensity-modulated radiation therapy (IMRT) or volumetric modulated arc therapy (VMAT), offer excellent conformity of the dose to the target volume while keeping the dose delivered to organs at risk to a minimum. However, these highly technical treatments make it necessary to have a solid quality assurance (QA) system working in parallel to ensure that the dose delivered to the patient respects the medical prescription.[1]

Most modern linear accelerators that used IMRT or VMAT techniques are outfitted with an Coupled Charge Device (CCD) Electronic Portal Imaging Device (EPID). CCD EPID capable of collecting images in both integrated and continuous mode Although the primary objective of EPID is to check patient set-up before starting treatment, several teams have shown that it can also play a fundamental role in QA of IMRT plans [1–3]. Therefore, analysis of multi-leaf collimator (MLC) performance [4–6], patient specific pre-treatment verifications [7–9] and EPID-based in vivo dosimetry [10–14] have become major domains of research over the last 10 years [15].

EPID have been investigated for the purpose of treatment verification. (2–19) While several reports have considered the stability and accuracy of using an EPID for dosimetric purposes, (15-16) there are generally four different ways of using the EPID for dose verification. One method is to compute the dose to the EPID for each beam to compare to the EPID image of each beam. (15-17) A second method is to use the EPID to verify the leaf positions for intensity-modulated fields. (16–18) A third method considers reconstructing the dose to the patient using the exit image acquired during treatment. (19). Finally, prior reports (18-19) have considered using a fourth method (1) that converts the EPID image to an incident fluence distribution and uses this fluence distribution as input to a dose algorithm, which computes the dose to the patient. This method has several advantages over using the exit dose. Use of the exit dose requires subtracting the scatter generated within the patient that reaches the imaging device. This fluence must then be traced back through the patient to derive the incident fluence, which is then used to compute the dose to the patient. In addition, the patient support system may be in the exit path of the beam. Deriving the incident fluence from EPID mmeasurement without the patient avoids such difficulties and, therefore, may be more accurate and reliable. Renner

The present investigation is a variant of the fourth method and consists of converting the EPID images to a fluence map, based on the images acquired for each of the fields of the patient's treatment plan. For every beam, the measured fluence is used as input to the treatment planning system to perform a dose calculation in the patient anatomy. By doing so, we use the same dose calculation algorithm for both the initial treatment plan and for the patient specific pre- treatment QA. This allows us to eliminate any dose algorithm specific variations for the comparison of the initial plan and the EPID-based reconstructed plan. Furthermore, we maintain the integrity of the original treatment beam geometry and we use the same evaluation tools for the dosimetric analysis of both plans. Consequently, any changes in the plan quality between the physician approved and delivered plan will be attributed to errors introduced by the delivery since all other parameters are kept constant

II. MATERIAL AND METHODE

An Elekta Compac 201165 Linear accelerator with Camera Coupled Charge Devise based Electronic Portal Imaging Device and Monaco 5.11 software was used in this investigation. The Elekta linac could only be programmed for source to detector distance (SDD) of 160 cm. The maximum size of the fluence map that can be calculate based on EPID measurements is a 25 x 25 cm^2 field. In order to accurately take into account the penumbra region of the IMRT field, a maximum filed size of 22 x 22 cm^2 is recommended Quinno et al. Have describe about many challenges for dose reconstruction using an EPID: a) the EPID response dependence on energy, b) the effect on the image from the backscatter attributed to the EPID support arm, c) transmission associated with the MLC tongue and grove effect, and d) MLC interleaf leakage. In the present study, the energy dependence response of the EPID has been incorporated by obtaining calibration images for every beam energy and by constructing a unique calibration curve that is linac and energy specific.

The MU-EPID software has been developed using Matlab version 9.0. The graphical user interface (GUI) has two principle functions which are a) EPID image calibration and b) IMRT QA. Step wedge and uniform irradiation are the two options currently implemented for the calibration of the system. The IMRT QA routine includes the IMRT processing function where the DICOM images from the EPID are processed and converted to fluence maps for the TPS dose calculation. An IMRT evaluation function is available for dose profile comparison and for planar dose difference and gamma analysis between the measured and TPS exported planar doses

1. EPID Linearity Test
2. EPID Images Conversion to Fluence
3. EPID-IMRT QA procces

Validation IMRT patient specific QA

III. RESULT AND DISCUSSION

All The result image from CCD EPID than we change to the grey scale value use matlab program. We take the greysclae value from inline and crossline to made a profil dose curve. The x axis for the field and the y axis for the dose value. For the pixel value of CCD EPID 876 x 876 with true size 27 cm x 27 cm we take a middle of data in the crossline and inline in value 478.

The result of all of MU value, we can see in the figure 1.

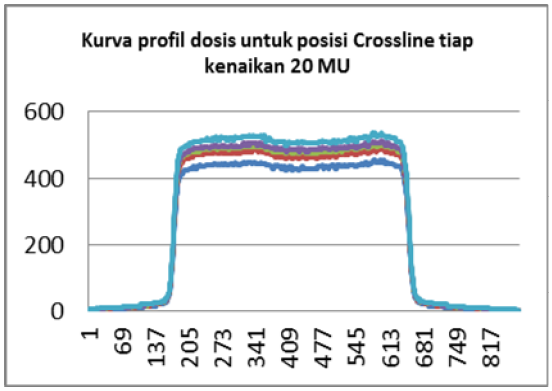

Figure 1. profil dose curve for crossline position

We can see the spread of the dose by the curve. For the bigger MU we take tho the CCD EPID, made the the higher curve. The dose value is the result of normalism for ggreyscale value. If we have no normalism, we get reverse curve. For the profil dose curve from CCD EPID images, we can calculate the correction of profil dose. The corection of profil dose include linierity, simetrisity and penumbra value. And the result is in tabel 1.

TABLE I - RESULT OF CROSSLINE POSITION

MU	average	Standard error	Simetriisity (%)	Linierity / flatness(%)	penumbra
20	448,82±6,83	0,33	0,51	3,4	0,040
40	473,38±7,08	0,36	0,51	3,1	0,049
60	486,94±7,47	0,30	0,50	3,0	0,052
80	493,94±7,38	0,17	1,1	3,5	0,054
100	515,34±7,84	0,17	1,0	3,3	0,060
100	515,34±7,84	0,44	1,7	3,3	0,06

The inline position, we can see that curve in figure 2

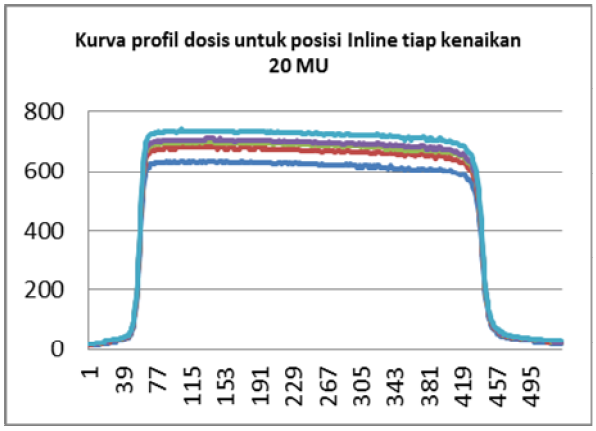

Fig 2. profil dose curve for inline position

The correction of this inline position, we can see in the table 2.

MU	average	Standar Error	Simetrisity(%)	Linierity / Flatness(%)	Penumbra
20	438,81±6,83	0,38	1,6	3,4	0,04
40	473,38±7,09	0,39	1,5	3,1	0,05
60	486,94±7,47	0,41	1,6	3	0,05
80	493,94±7,38	0,41	1,9	3,5	0,05

After we can see the result of the profil dose curve, we can anlysis the curve. The first curve in crossline position the simetrisity value no more thn 3% value and so does penumbra value. Its agree with AAPM TG no.47. but the linierity value have little more than 3%. Inline position have the same disscusion with crossline position. But in inline position, the simetrisity value bigger than crossline position. Its because the direction of the radiation.

IV. CONCLUSIONS

For the two of position inline and crossline, have the same result. Symetrisity value and penumbra value have average less than 3% agree with AAPM TG no. 47. But for linierity have litle more value than 3%. But that value still good the make dosimeter with CCD EPID. The inline positian has bigger symetrisity than crossline position. Its because the direction of the x-ray in the linac.

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