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Bolus silicone rubber with 2% silica composite for radiotherapy application

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ABSTRACT

Bolus is a device in external radiotherapy to increase a surface dose using electron beam. In this research, bolus was synthesized using silicone rubber (SR) and silica composite with dimension of 12 cm x 12 cm x 0.5 cm. In bolus synthesis, the SR mass was used with amount of 73 gram and catalyst volume with amount of 4 ml. Silica composite was added with 2% from SR mass, all of sample was mixed and poured into the mold and waited until the sample was completely hard and ready to lift from the molding. Bolus was charaterized using linear accelerator (LINAC) with electron beam to obtained a percentage of surface dose (PSD) in solid phantom surface and the electron beam energy were used 5 MeV and 7 MeV. The result show that the PSD value was increased with adding silica composite with PSD value are 105.55% and 99.76% for energy 5 MeV and 7 MeV, respectively.

Keywords: *Bolus, Electron Beam, Percentage of Surface Dose, Silica Composite.*

INTRODUCTION

Linear Accelerator (LINAC) is often used as external radiotherapy process for various tumors and cancer. LINAC can produce multi energy such as photon beam and electron beam so that LINAC can be used to treat cancer in various position [1]. Radiotherapy is an procedure to treatment a malignant tumor (cancer) by applying ionizing radiation, such as ionizing electromagnetic wave (x-ray and gamma ray) and particles (electron, neutron and proton) with high energy [1,2]. For the cancer case placed in skin surface, electron beam usually use to treat a skin cancer [3]. In the theoritical, the electron beam has a surface dose which not reach 100%, so to increase a surface dose until 100% it can be used a material that equals with tissue, which is known as bolus. Bolus in radiotherapy external has several function to (1) increase a surface dose, (2) giving a homogeneus dose for un-flat surface patient body, and (3) reduce penetration or reduce a kinetic energy of electron beam tohealthytissue [4,5,6]. In this paper, bolus was made by using SR material because SR material has various superiority such as it can be formed appropriately with the form of patient body, non-toxic, non-iritation of a skin surface and it had been proved can upgrade the dose of skin surface [3]. Then, with added a silica composite in SR for bolus material can increase the percentage of surface dose (PSD) its can so optimization in

radiotherapy process to treatment a skin cancer use electron beam.

MATERIAL AND METHOD

Bolus Synthesis

Bolus was produced using SR material that originates from silicone rubber RTV-52 with catalyst is bluesil catalyst 60 R as an amplifier of SR material and adding silica as a composite. In bolus preparation, bolus was molded with the dimension of 12 cm x 12 cm x 0.5cm. Bolus was produced with the composition of SR wtih mass amount of 73 gram and 2,9 ml of catalyst. Then, 2% silica composite from SR mass was added in SR. SR and silica composite material were mixed usinng mixer for 30 minutes. The mixing results was poured to the mold and waited until the material is completely hard and ready to lift from the molding.

Percentage of Surface Dose (PSD) Measurement

In this research, PSD value was obtained by giving electron beam radiation at solid phantom without using bolus and used bolus. Electron beam energy was from a linear accelerator (LINAC) with energy of 5 and 7 MeV. Applicator field used wide field 10 x 10 cm2and source to surface distance (SSD) arranged in a position of 1m from the solid phantom surface. The procedure of interpretation data was conducted by putting the detector of plan parallel chamber above the surface and depth position of maximum dose(Zmax) at the solid phantom. Value of Zmaxfor 5 and 7 MeV energy is amounted 1.1 cm and 1.5 cm, respectively. To calculation PSD value a following equation was employed:

$PSD = (Q_A / Q_B) \times 100\% (1)$

With QA is contents value that measured in surface position of solid phantom and QB is contents value that measured in position of Zmax [3].

RESULT AND DISCUSSION

Percentage of Surface Dose (PSD)

The value of percentage of surface dose (PSD) for each sample can be seen in Figure. 1. Based on Figure. 1, PSD value without using bolus are 84.80% and 86.05% for 5 MeV and 7 MeV, respectively. When using bolus, PSD value for Bolus without silica composite are 105.24% and 99.66% for 5 MeV and 7 MeV, respectively. For Bolus with silica composite, the PSD value are 105.55% and 99.76% for 5 MeV and 7 MeV, respectively. It is because the highest density material can give a lower stopping power value if compared with various solid material [7]. Electron particle will lose a kinetic energy and can give a surface dose in solid phantom surface can be increasing [8].

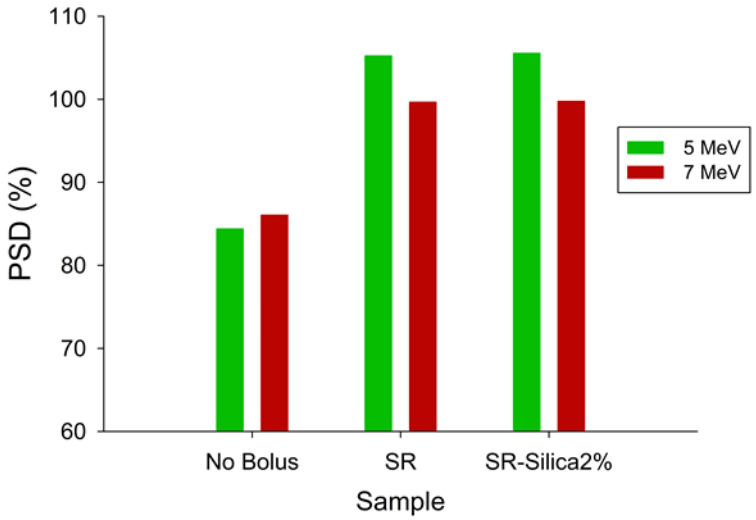

Figure 1. Percentage of surface dose (PSD) on the solid phantom surface for each sample

CONCLUSION

In this research, bolus was successfully made using SR material by adding 2% silica composite. The PSD value for using bolus with silica composite were 105.55% and 99.76% for 5 MeV and 7 MeV, respectively. The added a silicia composite in SR material can give surface dose increment and it can gives a optimization on radiotherapy process with an electron beam.

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