◈ Original Article ◈

The Usefulness of Bolus of Radiation Therapy in Patients with Whole Breast Cancer

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Abstract

Radiation Therapy has been used in the treatment of breast cancer for over 80 years. Technically, it should include a part or all of such areas as chest wall or breast, axilla, internam mammary nodes and supraclavicular nodes. The purpose of this study is treated breast cancer patient to use 6 MV, 10 MV with bolus so that we observe changing of skin dose and evaluate those usefulness. Using woman's phantom, after CT simulate scanning, Through RTP system to make treatment plan, select three any place. And then, we measure that dose rate. After moving the phantom to linac, we put for TLD to three point same as RTP system which we put on the phantom. We exposed 6 MV, 10 MV with bolus and without so that it is measured dose by TLD device(4000 Harshaw). As a reult expose 6 MV,10 MV, it differences 10%, 15% according to bolus and withoout bolus where lateral point from RAO, LPO beam, other one is 20% where the furthest from both beams. To use bolus in the hospital is material to include closely part at skin among tissue of breast cancer. Acquired skin dose from RTP system is uncertainity. So it has to test another system likely TLD or other dosimetry system. Also exposed field of breast cancer is included inhomogeneity such as lung, bone and so on. Therefore it has to be accomplished a dose calculating of inhomogeneity part from treatment plan.

Key Words : Radiation therapy, Breast cancer, Bolus, TLD

Ⅰ. Introduction

The total number of breast cancer patients in 1996 was 3,801. In 2006, it increased to 11,275 which is more than 3 times in 10 years. Although there is not an accurate proof of rapid increasement of breast cancer, there are some well known causes; obesity by eating too much westernized high calorie food, decrease of birth rate and reluctance of breast feeding.[1~3] There are several breast cancer treatments such as surgical treatment, chemical treatment, radiation therapy and etc.[2~6] Bolus is an instrument that is used in breast cancer radiation treatment. It exposed 6 and 10 MV which increases the surface dose value. The following experiment will assess the effectiveness of bolus by measuring the surface dose value.

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Ⅱ. Material & Method

1. Material

As experimental subjects, woman phantom(Anthro pomorpic Phantom, Huestis) was used. It executed computerization treatment Computed Tomography (Brilliance Big−Bore, CT−Sim, Philips) in order to acquire image. According to expose high energy (6~10 MV) and existence of bolus and nonexi− stence of bolus, the dose measured through The RTP−system. Linear accelerator was used for exposing phantom(C linac 2100 C, 6 MV, 10 MV X−ray, Varian, USA). Breast board was used to fix the phantom.

2. Computed Tomography scan and treat− ment plan method

Plastic catheter was put into phantom to acquire CT image. It was to appear outer contours of human body we scanned the phantom using CT. Measurement position was same as Figure 1.

CT image was sent to RTP system. It made a treatment plan for using image. For it measured effect of bolus, We made four occasions. and then, we measured a dose acquired from treat− ment plan. There were four occasions. The first was exposed 6 MV with bolus. The second was exposed 6 MV without bolus. The third was exposed 10 MV with bolus. The last was exposed 10 MV without bolus. Measurement position were 1.5 cm point from Right anterior oblique beam center area, 1.5 cm point from left posterior oblique beam center area and the furthest point from both beams(Fig. 2, 3, 4, 5).

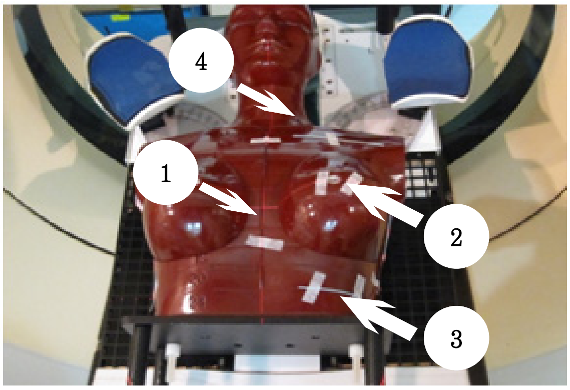

Fig. 1. The position of plastic catheter (① Medial : midsternum ② Lateral : midaxillary line ③ Caudal: 1.2 cm below the inframammary line ④ Cephalad : at the base of the clavicle heads)

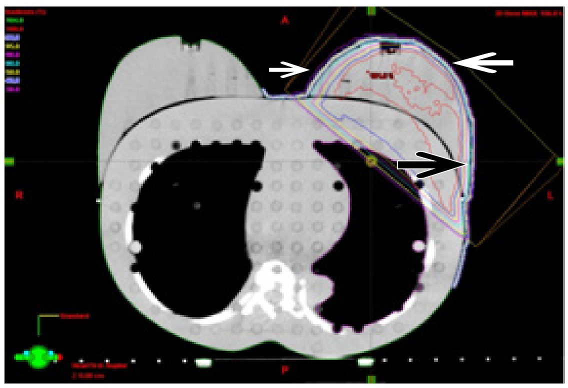
Fig. 2. 6 MV, with bolus 3 mm, 1.5 cm point from RAO beam CA(Small white arrow), The farthest point from both beam(Big white arrow), 1.5cm point From LPO beam CA(Black arrow)

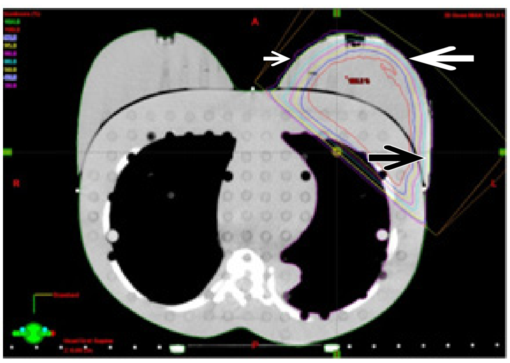
Fig. 3. 6 MV without Bolus 3 mm

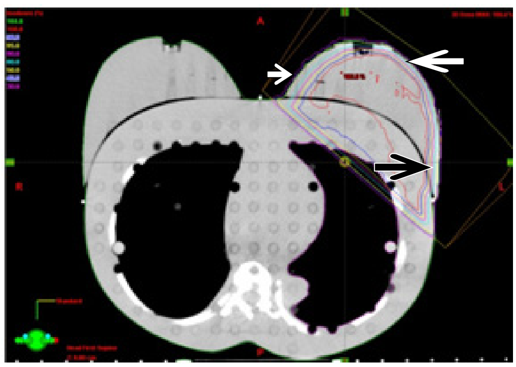
Fig. 4. 10 MV with Bolus 5 mm

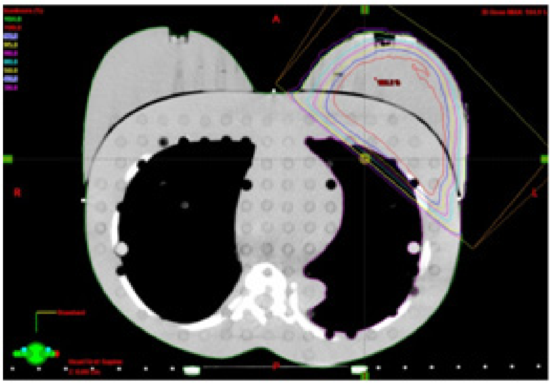

Fig. 5. 10 MV, without bolus, 1.5 cm point from RAO beam CA(Small arrow), The farthest point from both beam(Big arrow), 1.5 cm point from LPO beam CA(Black arrow)

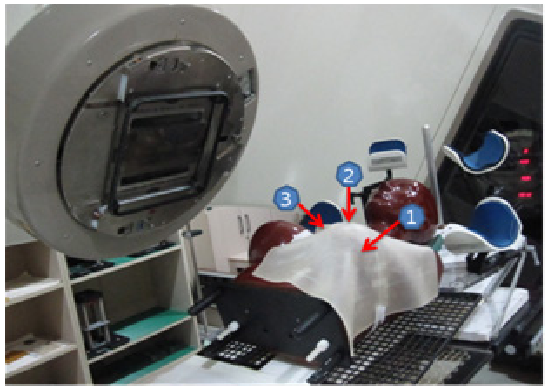

Fig. 6. The experiment which uses the linear accelerator. ① 1.5 cm point from RAO beam CA, ② The farthest point from both beam, ③ 1.5 cm point from LPO beam CA

3. The method of dose evaluation after treatment through Linac

The phantom was moved to treatment room. we put a thermo luminescence dosimeter(TLD) on the phantom. position was same as measurement point which had used RTP system(Fig. 6).

It was exposed four times by linac. The first exposure was 6 MV with bolus. Second one was 6 MV without bolus and third on was 10 MV with bolus. The last was 10 MV without bolus. Through TLD measurement device, we measured dose of TLD which was exposed by Linac. Measurement device was 4000 Harshaw.

Ⅲ. Result

1. The dose evaluation which using RTP system

Analyzing acquired dose distribution from RTP system. The dose of exposure as 6 MV with bolus were 15~30% higher than same energy without bolus. The dose of exposure as 10 MV with bolus were 25~40% higher than same energy without bolus. The result was same as Table 1.

2. The dose evaluation which using TLD

There was no big difference between the result which measured and the result which measured from RTP system. Difference of dose that accor-

Table 1. The dose which acquiring from RTP-system

Energy	Measurement position	With bolus(%)	Without bolus(%)
6 MV(3 mm)	1.5 cm point from RAO beam CA	75%	50%
	The farthest point from both beams	90%	60%
	1.5 cm point from LPO beam CA	75%	60%
10 MV(5 mm)	1.5 cm point from RAO beam CA	75%	50%
	The farthest point from both beams	90%	50%
	1.5 cm point from LPO beam CA	75%	50%

Table 2. The dose acquiring TLD

Energy	Measurement Position	With Bolus(%)	Without Bolus(%)
6 MV(3 mm)	1.5 cm point From RAO beam CA	75%	65%
	The farthest point From both beam	90%	70%
	1.5 cm point From LPO beam CA	75%	65%
10 MV(5 mm)	1.5 cm point From RAO beam CA	74%	60%
	The farthest point From both beam	90%	70%
	1.5 cm point From LPO beam CA	75%	60%

ding to energy(6, 10 MV), existence of bolus and nonexistence of bolus was 20%. Measurement position is that the furthest point from both beams. Difference of 6 MV exposure were 10% each, but difference of 10 MV exposure were 14%, 15%. Measurement position were both 1.5 cm point from RAO beam CA and 1.5 cm point from LPO beam CA. The result was same as Table 2.

Ⅳ. Discussion

There was difference of dose between RTP system and TLD. The uncertainty of Surface dose from computerization treatment plan system is high. Therefore it has to test another system likely TLD or other dosimetry system.[7~8] However, the part which is confirmed as TLD is a point as of surface part and thickness of bolus is impossible to measure deeper than this. Uncertainty of TLD is ± 3%. It will be able to make an error while it verify dose.[9~10]

Ⅴ. Conclusion

Use of bolus in treating a breast cancer patient as high energy(6~9 MV) is able to pull a build up depth as far as surface. Therefore, use of bolus can be essential. However, in case of 4 MV exposure does not need a bolus. Because Depth of build up is close to surface. Use of bolus is able to useful as treatment other cancer where close to the surface.

References

1. Lee YH, Park KR, Lee JY, Lee IJ, Vahc YW, Lee KK. Consideration of Surface Dose and Depth of Maximum Dose Using Various Detectors for High Energy X-rays. Radiat Oncol J 2003; 21: 322-9.
2. Kweon DC, Lee JS, Goo EH, Kim MJ, Jung JE, Dong KR, et al. An Overall Stem Effect, including Stem Leakage and Stem Scatter, for a TM30013 Farmer-type Chamber. Journal of the Korean Physical Society 2011; 58: 1688-96.
3. Kweon DC, Lee JS, Goo EH, Kim MJ, Jung JE, Chung WK, et al. Comparison of the Measured Stem Leakage Correction Factor for an Ionization Chamber in Air to the Monte Carlo Simulation. Journal of the Korean Physical Society 2011; 58: 1184-94.
4. Lee JS, Kim GH, Jeong KH, Kweon DC, Goo EH, Park CW, et al. Manufacture of Immobilization Device (Vac-lok) and the Usefulness of Evaluation for Reproducibility of Patients in the Radiotherapy. J Korea Asso Radiat Prot 2011; 36: 8-15.
5. Kron T, Metcalfe P, Wong T. Thermoluminescence dosimetry of therapeutic x-rays with Lif ribons and rods. Phys Med Biol 1993; 38: 833-45.
6. Dong KR, Kweon DC, Chung WK, Goo EH, Kevin D, Choe JH. Study on the angular dependence of personal exposure dosimeter (Focus on thermoluminescent dosimeter and

photoluminescent dosimeter) Annals of Nuclear Energy 2011; 38: 383–8.

7. Mobit P, Nahum A, Mayles P. A Monte Carlo study of the quality dependence factors of common TLD materials in photon and electron beams. Phys Med Biol 1998; 43: 2015–32.
8. Han EO, Kwon DM, Dong KR, Han SM. A Model for Protective Behavior against the Harmful Effects of Radiation based on Medical Institution Classifications. J Korea Asso Radiat Prot 2010; 35: 157–62.
9. Pradhan AS. Thermoluminescence dosimetry and its applications. Radiat Prot Dosim 1981; 1: 153–67.
10. Jung Y, Dong KR, Kweon DC, Kevin D, Goo EH, Ahn SY. A Study on the Effects of Scattering Dose on Eyes and Thyroid for Panoramagraphy (Focus on TLD and PLD). J Korea Asso Radiat Prot 2010; 35: 1–5.