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Research Article

Dosimetric Comparison of Electron Cutout Measurement for Breast Cancer Boost Versus RadCal Dosimetry in Radiation Therapy

Huda I Al-Mohammed*

Radiological Sciences Department, College of Health and Rehabilitation Sciences, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia

***Corresponding Author:** Huda I Al-Mohammed, Radiological Sciences Department, College of Health and Rehabilitation Sciences, Princess Nourah Bint Abdulrahman University, Riyadh, Saudi Arabia.

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Abstract

External radiation therapy treatment with electron boost for the chest wall is the treatment protocol for breast cancer after mastectomy with positive axillary lymph nodes. followed by a local electron boost to the local lymph nodes with a total dose of 10 Gy. Outstanding locoregional control was shown in the majority of patients treated with this strategy, with a 3-year survival rate of 90% and a 5-year survival rate of 87%, and a 3-year survival rate of 61% and a 5-year survival rate of 47% without distant metastases.

Purpose and Objective(s): The study's objective is to compare the computed monitor units with RadCal software dosimetry in order to evaluate the monitor unit of electron cutout boost for treatments of the chest wall following the external beam radiation therapy.

Material/Methods: 15 patients with mastectomy, aged range from 35 to 75 years. They all went for a single electron boost field with dose of 10 Gy using 12 MeV beam. Then the delivered dose MU were compared with RadCal software dosimetry.

Results: The result showed no statistically significant difference between the MU measured with electron filed and the calculated MU with the RadCalc software dosimetry. The excellent result outcome achieved with electron cutout with comparison with the RadCal and found to be statistically significant (P = 0.025).

Conclusions: The result showed a assess the monitor unit of electron cutout for treatments in chest wall irradiation after mastectomy boost in external beam radiation therapy in comparison with the calculated monitor units with RadCalc software dosimetry.

Keywords: Breast Cancer; Axillary Node; Electron Beam; Electron Cutout; RadCal; Radiation Therapy

Introduction

Cancer of the breast is the most prevalent malignant tumor seen in females across the world and the leading cause of mortality among women [1]. Surgery is almost always the first line of defense for treating breast cancer in its early stages [1]. The complete reseaction of the primary tumor with negative margins, in order to reduce the risk of local recurrences, and the pathologic staging of the tumor and axillary lymph nodes, in order to provide necessary prognostic information, are the goals of breast cancer surgery. These objectives are intended to be accomplished by the surgeon. During a modified radical mastectomy, the epidermis, the areola, the nipple, and the majority of the axillary lymph nodes are removed; nevertheless, the pectoralis major muscle is not affected in any way. Historically, the procedure known as a "modified radical mastectomy" was the most common form of therapy for breast cancer [2]. However, for breast cancer of the chest wall that has progressed to a late stage following a mastectomy and positive axillary lymph nodes, the treatment of choice is external photon beam radiation therapy with a dosage of 50 Gy, followed by a local electron boost to the local lymph nodes with a total dose of 10 Gy [2,3]. [Note:] [Note:] [Note:] [Note:] [Note:] [Note:] [Note:] The regimen that was used in this method displayed remarkable locoregional control in the majority of patients, with a 3-year survival rate of 90% and a 5-year survival rate of 87% [4], and with

a 3-year survival rate of 61% and a 5-year survival rate of 47% without distant metastases [5]. The electron boost field, which is normally designed as a single field, is applied to the tumor bed in order to treat it as well as the breast scar [6]. The accuracy of the computation performed on the monitor units is an essential requirement for all treatment planning systems [6,7].

Material and Methods

Fifteen patients had mastectomy and axillary lymphonodectomy for primary breast cancer. Ages ranged from 35 to 75 years (median: 55). All patients had chest wall that will be irradiated by an electron beam of 12-Mev (10Gy). Daily fractions of 200 cGy by external photons beam then 12-Mev electrons boost to the scar of mastectomy for 10 Gy/2 fractions. The photon supraclavicular field was matched with the electron field in the upper region. The electron beam plan used a single electron field with cutout indivisually for each patient as shown in figure 2. The electron beam plans was created using Eclipse treatment planning system (TPS) (Varian Medical Systems Palo Alto, CA) with RadCal software (RadCalc delivers completely automated dosimetric calculations for most radiation therapy treatment procedures) to calculate the monitor units for the plan algorithm for dose calculations in external beam radiation therapy, it is widely available for dose calculations. The measured result of electron cutout on linac TrueBeam SN 1193 (Varian Medical Systems, Inc. 3100 Hansen Way, Palo Alto, CA) using ionization chamber is compared to the results of Eclipse TPS with RadCal. The Ethics and Research Committee approved the study.

Figure 1: Electron cutout calibration setup showing the electron applicator, cut our and the ionization chamber.

Figure 2: Electron cutout from Eclipse Treatment planning.

Statistics

Data from each sample were run in duplicate and expressed as means ± standard deviation (SD) (n =15). The results were compared using one-way ANOVA analysis followed by Tukey's test for multiple comparisons. Differences were not considered statistically significant at $P<0.05$.

Results and Discussion

The results, which are shown in table 1 and figure 3, revealed that there was no statistically significant difference between the MU measured with an electron field and the MU computed with the RadCalc software. This was shown to be the case by the fact that there was no statistically significant difference between the two. When compared to the RadCal, the good result that was produced by utilizing the electron cutout was demonstrated to be statistically significant ($P = 0.025$). Both the electron boost cutout monitor units and the RadCal calculating monitor units were utilized in the investigation, and both contributed to the successful completion of this study.

External radiation therapy treatment with electron boost for the chest wall is the treatment protocol for breast cancer after mastectomy. The use of electron beam as a boost for the chest wall still use in the modern days to spare the normal tissue and healthy organs in the meantime irradiated the superficial node that is set superficial in the chest area [9].

Patient number	Site	Prescribed Dose 200 cGy	Planned MU	Measured dose versus planned MUs
1	Rt Breast	200	280	283
2	Rt Breast	200	280	282
3	Rt Breast	200	225	223
4	Rt Breast	200	253	254
5	Rt Breast	200	280	278
6	Rt Breast	200	248	250
7	Rt Breast	200	280	280
8	Lt Breast	200	248	246
9	Lt Breast	200	225	227
10	Lt Breast	200	280	279
11	Lt Breast	200	258	256
12	Lt Breast	200	225	226
13	Lt Breast	200	280	282
14	Lt Breast	200	225	223
15	Lt breast	200	248	247

Table 1: The different between the planned MUs and the measured MUs according to the prescribed Dose for electron cutout.

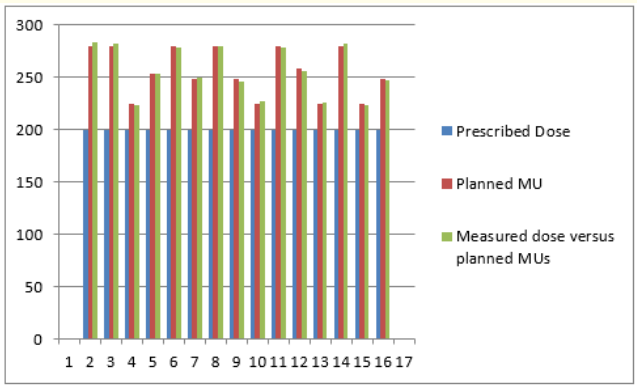

Figure 3: The different between the planned MUs and the measured MUs according to the prescribed Dose for electron cutout.

For the fifteen selected patients who had mastectomy and axillary lymphonodectomy for primary breast cancer, different energy beams were aimed at the skin through precisely positioned cuts emanating from a central isocenter and gantry angle to create the external electron fields. The photon supraclavicular field was matched with the electron field in the upper region. We have shown in this study the use of electron cutout factors that are measured for a linac TrueBeam SN 1266 (Varian Medical Systems, Inc., 3100 Hansen Way, Palo Alto, CA) for electron beams with energies 9–15 MeV. SSDs used were 115 cm as recommended by the AAPM's TG-25 [10]. We used the EMC 11.3 for the Eclipse planning system patient-specific measurements were made for every electron cutout. The 15 × 15 cm2 applicator with 9, 12, and 15 MeV were measured. All measurements were taken using a source-to-surface distance (SSD) of 100 cm. at 100 cm SSD and for selected fields 15 × 15 cm2 at 115 cm as shown in figure 1(Electron cutout calibration setup showing the electron applicator), cut our and the ionization chamber. The data are normalized to the open cone for which the insert is designed for all measured and calculated sets. The measured MU for the electron cutout showed no significant different in comparison with RadCal software.

Conclusions

Based on the measured results from this study, it can be said that the measurements were precise and useful for obtaining cutout factors, that the RadCal calculation and the measurement agree

with one another, that the agreement between the measurements and the calculations is within approximately 5%, and that the result shows that RadCal calculations for cutout factors agree with careful measurements within 2%.

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Conflict of Interest

The author of this study certify that this manuscript has not been published in whole or in part nor is it being considered for publication elsewhere. The authors indicate no disclosure of potential conflicts of interest.

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