



First application of total skin electron beam therapy for Mycosis Fungoids in Iran

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ABSTRACT

Total skin electron beam therapy (TSEBT) is internationally considered as a treatment modality for cutaneous T-cell lymphoma for either curative purpose or palliative care. The first attempt to apply TSEBT in Iran took place at department of clinical oncology of Rock Center of Karaj. Irradiation was done by precise linear accelerator (ELEKTA) and was performed in the standing position of patient. To evaluate the treatment reliability and determination of physical characteristics of the clinical electron fields, specific measurements were done using thermoluminescent dosimeters. The results revealed that TSEBT can be routinely used by providing accurate dosimetric measurements to get homogenous dose coverage.

Indexing terms/Keywords

Total skin electron beam therapy; Mycosis Fungoides; Dosimetry; TLD.

Academic Discipline And Sub-Disciplines

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1. INTRODUCTION

Mycosis Fungoide is the most frequently observed Cutaneous T-Cell Lymphoma (CTCL) with an indolent evolution characterized by cutaneous lesions in forms of patches, plaques or skin tumors [1,2]. TSEBT has been used in the treatment of various skin diseases either for curative or palliative purposes. The aim of this treatment is to deliver the prescribed dose to patient skin without damaging any healthy organ. In fact, with this method, the entire surface of the body is treated uniformly to a limited depth [3,4]. TSEBT can be performed by three methods: a) standing patient technique, b) rotary method and c) translational approach [5,6].

The main features of TSEBT are applying an extended SSD, wide electron fields and low energy electrons [7].

The aim of this study is to evaluate the homogeneity of dose distribution in the broad electron fields.

2. MATERIALS AND METHODS

2.1. Dosimeter

GR-207A thermoluminescent dosimeters (TLDs) manufactured by Fimel company (Fimel, Velizy, France), were used to measure the absorbed dose of patient's skin. TLDs need to be calibrated before using and it should be done in two processes which are determining element correction coefficients (ECC) and plotting calibration curve.

In order to acquire ECCs, each TLD was positioned in specialized hole on a perspex slab at the depth of maximum dose, irradiated by 6MV photon beams produced by a precise linear accelerator (ELEKTA). A dose of 100 cGy was irradiated to TLDs and this parameter was calculated from equation 1.

$$ECC_j = \frac{\langle TLD \rangle}{TLD_j} \quad (1)$$

Where $\langle TLD \rangle$ and TLD_j are the average reading of the total TLDs and individual readings, respectively [8].

Calibration process included 8 dose steps consisting of 5, 10, 30, 50, 80, 100, 150, 200 cGy delivered by 6MeV electron beams and one for considering background radiation. Adequate slabs were used to prepare electron equilibrium conditions. TLDs were read out by TLD reader (Fimel, Velizy, France) and calibration curve (count versus absorbed dose) was plotted.

2.2. RANDO phantom

At onset of the study dosimetry was performed on a RANDO phantom. In this process, the RANDO phantom was set in the standing position at the fixed distance from the isocentre (SSD=400 cm). Dose measurements were obtained by placing TLDs in the hole grids near the skin surface which are contrived at all sections of the phantom.

2.3. Patient selecting and treatment qualification

The TSEBT was performed on an erythrodermic mycosis fungoides candidate (old female patient, age: 54 years old). Immobilization and dose uniformity throughout the skin are two important parameters in patient positioning. By considering these two features, Stanford technique (standing position) was implemented for this patient.

The biggest electron applicator ($25 \times 25 \text{ cm}^2$) was applied at distance of 400 cm from the isocentre. Because of inadequate field coverage, two electron therapeutic fields were matched at each direction of patient positioning. Figures 1 and 2 show the schematic view of the fields and patient positioning, respectively. As can be seen, 6 therapeutic fields were treated each day.

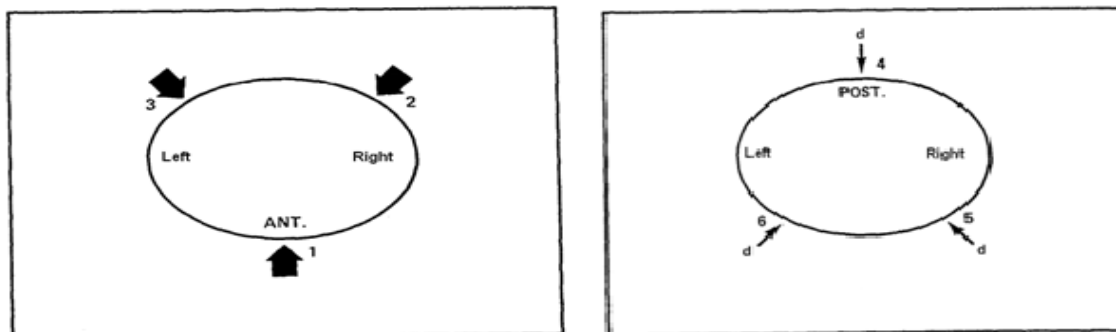


Figure1. The schematic view of 6 treatment fields [3].



Figure2. The position of patient in each treatment field [3].

The electron dose rate of 600MU/min was selected at 400 cm distance from the isocentre. Two fields were in anterior and posterior directions of the patients and four of them in anterior and posterior oblique directions. This method was done both for upper and lower limbs. Gantry angle was set to be 90°, electron beam energy was 6 MeV and also 100cGy per fraction (33 cGy per each field) in 36 fractions were uniformly irradiated ($\pm 10\%$) along the patient body.

3. Results

3.1. Calibration curve

Initially, by using ECCs, calibration curve (thermoluminescent response versus absorbed dose) was obtained. As dose steps were within 0.5 μGy -12Gy, the calibration curve exhibited a linear behavior and it is depicted in figure 3.

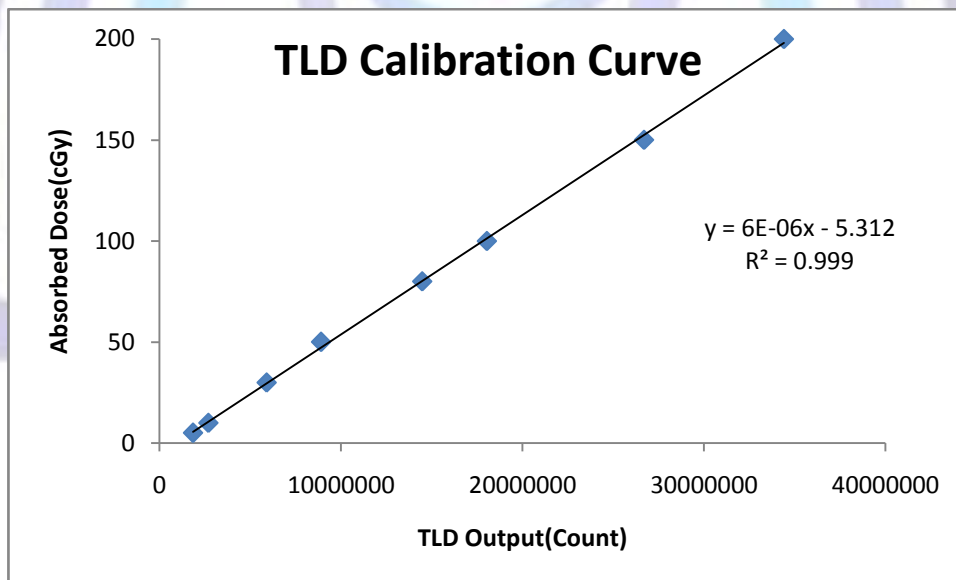


Figure3. TLD calibration curve.

3.2. Dosimetry

The results of dosimetry on phantom and patient skin showed that a uniform absorbed dose was obtained along the patient body with the maximum standard deviation of $\pm 10\%$. Figure 4 shows the position of the tested points and the corresponding results are tabulated in table 1.

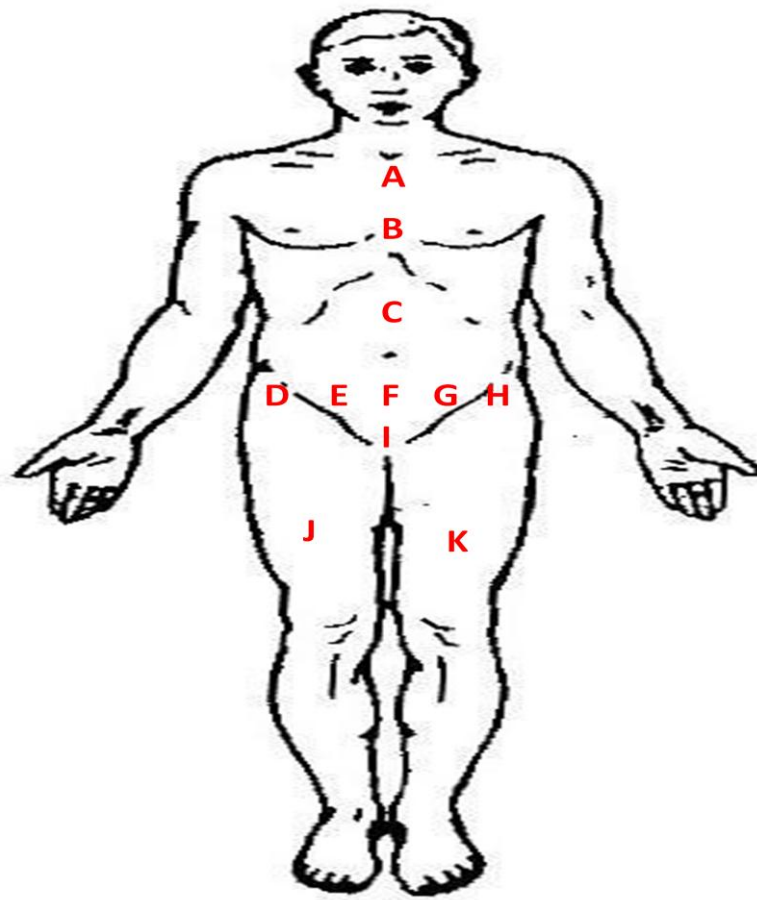


Figure4. The position of the tested points.

Table1. The corresponding results of absorbed dose at the tested points

Points	Absorbed Dose(cGy)
A	33.28
B	32.81
C	33.40
D	33.74
E	35.61
F	34.98
G	35.80
H	32.35
I	34.32
J	33.82
K	32.38



4. Discussion

The results of dosimetry (table1) show a uniform dose distribution on skin surface of the patient. Standard deviation of dose distribution was 9.64% which can be negligible. The maximum and minimum absorbed dose was 35.80 and 32.35 cGy which are equal to 104.48% and 98.03% of the prescribed dose, respectively.

Variability of dose distribution in different points of patient skin arises from two elements: a) statistical errors and experimental uncertainties, b) irregular surface contouring.

Following up the clinical response of patient showed that she got improved after 36 fractions and therefore TSEBT can be considered as one of the most effective and reliable methods for treating Mycosis Fungoides.

The capability of this method to treat the skin related diseases depends on some parameters such as choosing appropriate patient positioning, electron energy, total dose and uniform dose delivery. It is better to determine dose delivery on phantom prior to patient skin to make sure that dose delivery is quite homogenous. Moreover, other parameters such as age and staging can be operative factors in results of TSEBT, too.

5. Conclusion

By providing homogeneous dose coverage on patient skin, TSEBT can be considered as one of the most excellent and effective palliative and curative therapeutic modalities for Mycosis Fungoides.

Uniform dose distribution needs an appropriate patient positioning and the results of treatment depend on the total dose and number of fractions which are determined by staging of cancer.

References

1. C.A. Keehn, I.P. Belongie, G. Shistik, N.A. Fenske, L.F. Glass The diagnosis, staging, and treatment options for mycosis fungoides. *Cancer Control*, 14 (2007), pp. 102–111.
2. G. Jones, L.D. Wilson, L. Fox-Goguen. Total skin electron beam radiotherapy for patients who have mycosis fungoides *Hematol Oncol Clin North Am*, 17 (2003), pp. 1421–1434.
3. C. Karzmack Total skin electron therapy: technique and dosimetry (1987) Report No. 23.
4. E. Pope, S. Weitzman, B. Ngan *et al.* Mycosis fungoides in the pediatric population: report from an international Childhood Registry of Cutaneous Lymphoma *J Cutan Med Surg*, 14 (Jan-Feb (1)) (2010), pp. 1–6
5. G. Marinello, F. Jaffre, K. Ślosarek, J.P. le Bourgeois Total skin electron irradiation *Rep Prac Oncol Radiother*, 3 (1) (1998), pp. 19–22
6. T. Piotrowski The rotary-dual technique of the total skin electron irradiation *Rep Prac Oncol Radiother*, 9 (S2) (2004) 239-239.
7. T. Piotrowski, J. Malicki The rotary dual technique for total skin irradiation in the treatment of mycosis fungoides – a description of the applied method *Rep Prac Oncol Radiother*, 11 (1) (2006), pp. 29–37.
8. N Banaee, H.A.Nedaie Evaluating the effect of energy on calibration of thermoluminescent dosimeters 7-LiF:Mg,Cu,P (GR 207A) . *International Journal of Radiation Research*, 11 (1) (2013), pp 51-54.