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Teaching Case

Adaptation of the Stanford technique for treatment of bulky cutaneous T-cell lymphoma of the head

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Electron beam radiation therapy is an effective treatment for cutaneous T-cell lymphoma (CTCL).[1,2] The first description of total skin electron therapy came from Stanford University.[1,3] Prolonged treatment to ≥3000 cGy in 6 to 7 weeks is not feasible for many patients in a palliative setting. Hypofractionated regimens are associated with high response rates.[4-8] We describe a case of bulky CTCL of the head treated with a unique adaptation of the Stanford technique.

Case Report

A 76-year-old female presented for consideration of radiation therapy for CTCL with large cell transformation. She was diagnosed 4 years prior and treated with light therapy. The disease transformed into a more active state 3 years after diagnosis and progressed through 5 different systemic therapies. Findings at consultation included disfiguring head tumors (Fig 1). The largest lesion measured 4.0 × 3.0 × 2.0 cm. The lesions were pruritic and bled easily. Palliative external beam radiation therapy was recommended.

Treatment was delivered using an adaptation of the Stanford 6-field technique with a linear accelerator. The standard 6-MeV electron beam could not be used because of the desired treatment depth being several centimeters; therefore, 12-MeV electrons were used. The 25 × 25 cm^2 cone was used to cover the patient's head and neck, at extended distance. The patient stood 10 cm behind a Plexiglas spoiler (91 cm × 91 cm × 0.4 cm) located 140 cm from the electron source. Eye and mouth shields were not used. The gantry was rotated to 270°. The projected light field was used as a guide for centering the patient's head and neck during treatments. Lead sheets were secured to the spoiler to reduce dose inferior to the treatment area. Six fields were delivered per treatment using 1000 MU/minute dose rate with the patient rotating 60° clockwise between fields.

The conversion factor to calculate the MU required to deliver 400 cGy per fraction was determined using a Markus-type parallel plate ion chamber and an electrometer. The parallel plate chamber was cross calibrated with an Accredited Dosimetry Calibration Laboratory–calibrated Farmer chamber. Initially, a cGy/nanoCoulomb calibration factor for the 12-MeV beam was obtained using a 10 × 10 cm^2 standard cone. The front surface of the ion chamber was placed at a 2.6-cm depth in solid water at 100 cm source-skin distance (SSD), and the charge resulting from 100 MU was recorded. The chamber and phantom were then moved behind the spoiler to the treatment geometry of 150 cm SSD to the

Conflicts of interest: None.

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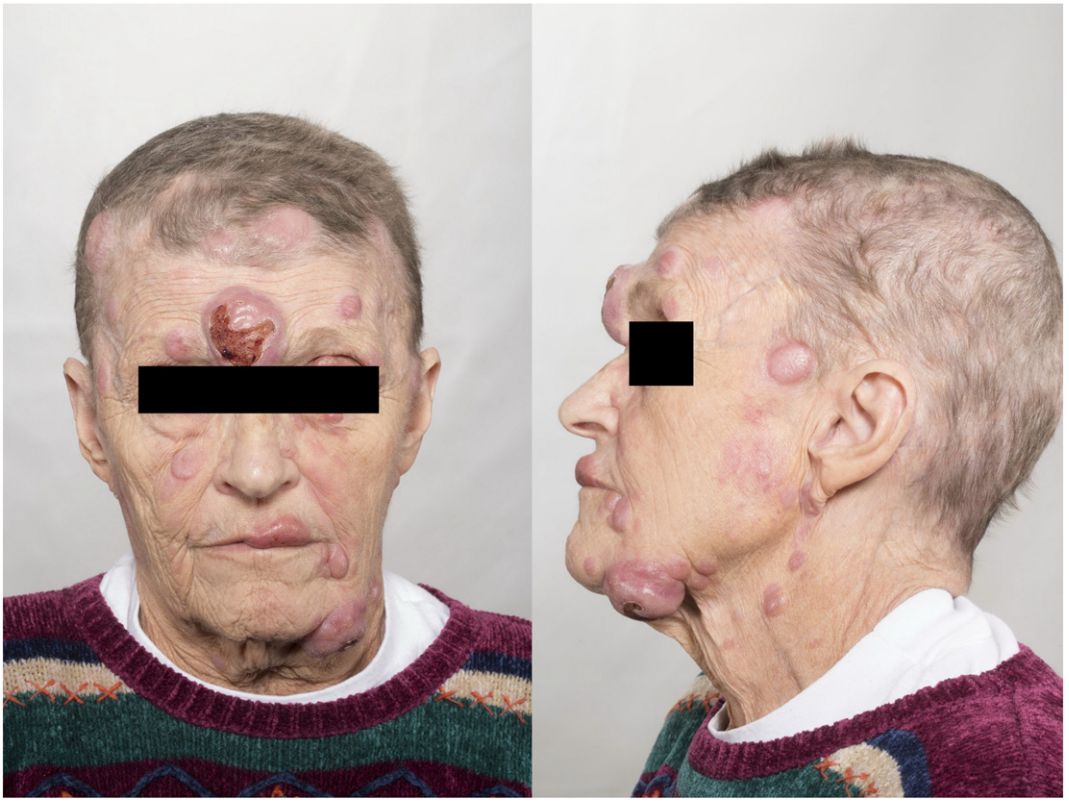

Figure 1 Exophytic lesions present on head and neck at time of radiation oncology consultation.

surface of the chamber with no buildup. The charge resulting from 1000 MU delivery was recorded. These values were used to calculate the cGy/MU conversion factor for the treatment geometry.

The body factor for this beam energy and treatment conditions was measured using Gafchromic EBT3 film (Ashland ISP Advanced Materials, Bridgewater, NJ) and a cylindrical solid water phantom 15 cm long × 25 cm in

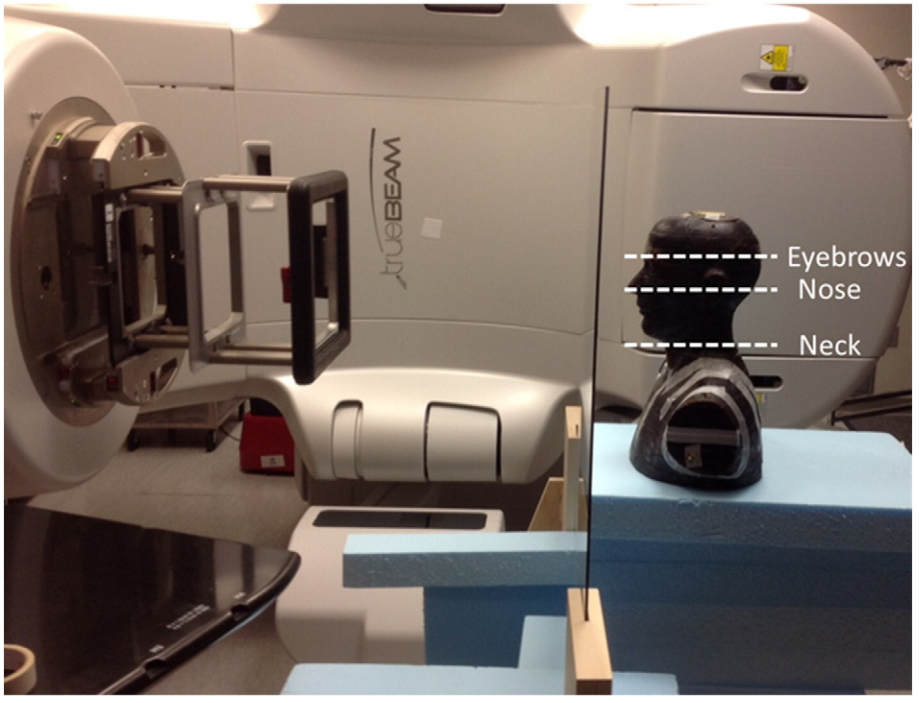

Figure 2 Setup for pretreatment dosimetric verification using a Rando phantom and Gafchromic EBT3 film. The dashed lines indicate the location of films placed axially at the level of the eyebrows, nose, and neck.

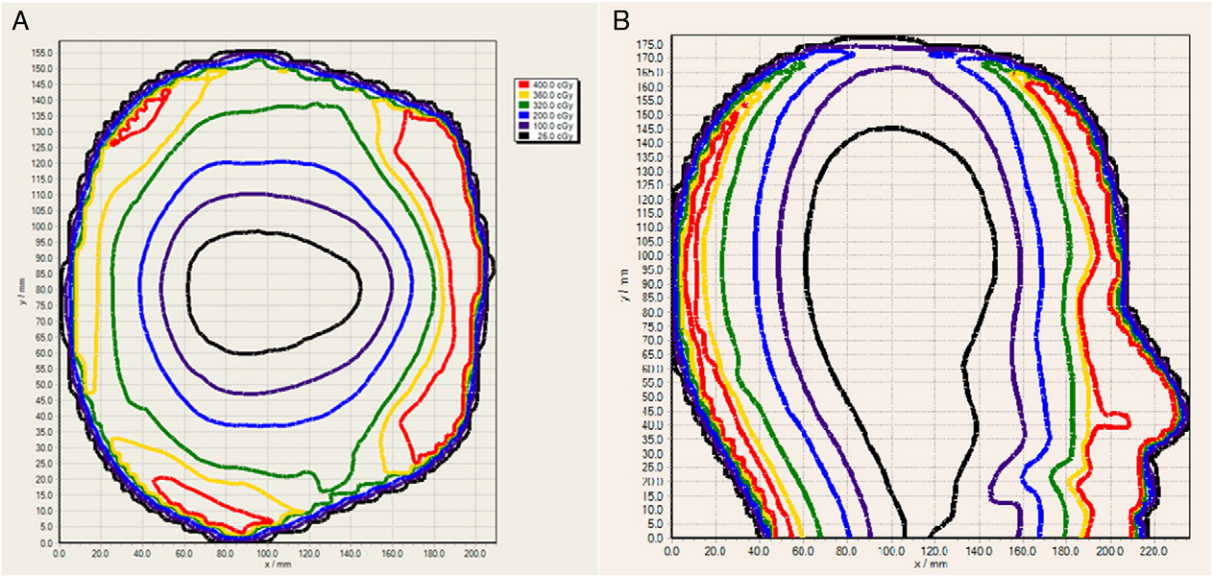

Figure 3 Results of dosimetric film measurements in the axial plane on the Rando phantom at eyebrow level (A) and in the sagittal plane (B). The thick, protruding ears caused a dose-shadowing effect responsible for the 380 to 400 cGy isodose lines breaking up circumferentially in the axial plane.

diameter. A body factor of 3.1 was calculated as the ratio of dose delivered to a point on the phantom rotated through all 6 treatment fields to the dose delivered from a single anterior field.

Before delivery to the patient, the treatment plan was verified with dosimetric measurements using Gafchromic EBT3 film and a Rando anthropomorphic phantom (The Phantom Laboratory, Salem, NY). The phantom was placed in treatment position using Styrofoam blocks to simulate the patient's height (Fig 2). Gafchromic films were placed axially within the phantom at the level of the eyebrows, nose, and neck. The phantom was rotated 60°

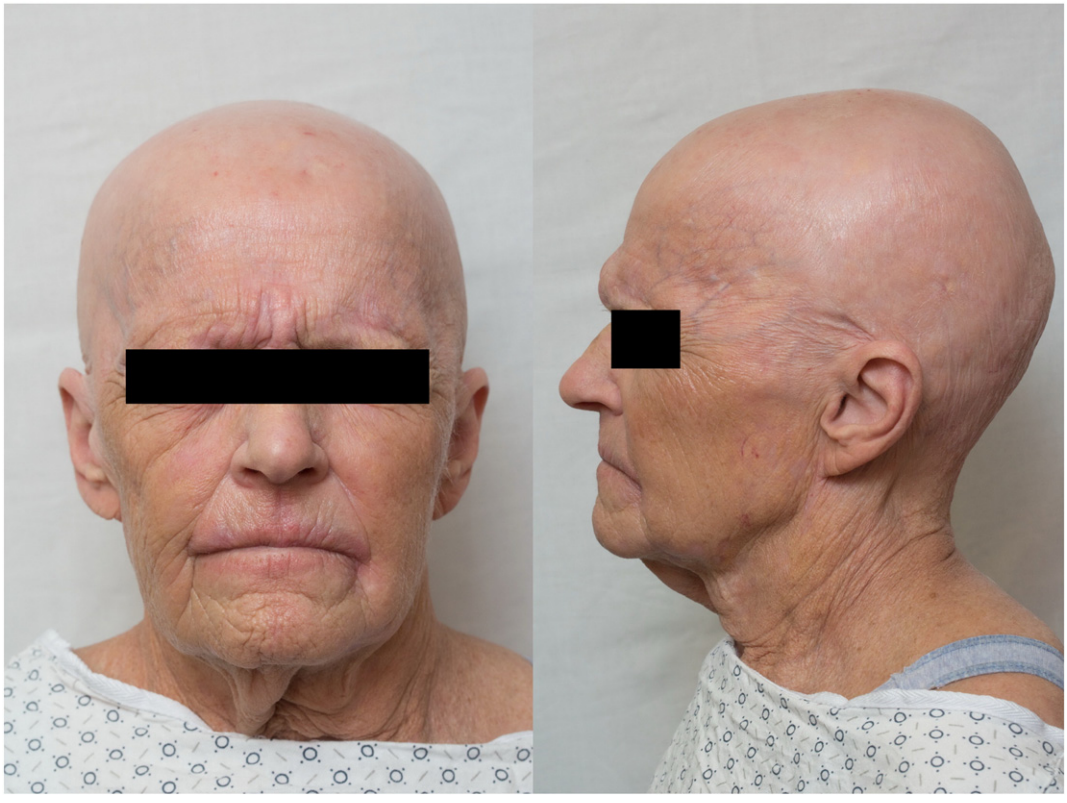

Figure 4 Complete response 2 months following last treatment.

between fields maintaining treatment distance (150 cm SSD) at each position. All film analysis was performed with FilmQA Pro software (Ashland ISP Advanced Materials) using a 1-scan protocol[9] and triple-channel dosimetry.[10] Fig 3 shows the isodose profile results of the film measurements.

Slight adjustments (<10%) to monitor units used for treatment were made based on results of in vivo dosimetry measurements. These measurements were made by taping 2×2 cm^2 pieces of Gafchromic film, each wrapped in a single layer of plastic wrap, onto the patient's surface. The plastic wrap was used to keep films clean for scanning and analysis. Left cheek and neck, right cheek, anterior chin, and posterior neck locations were monitored.

The patient received 1600 cGy in 4 weekly fractions. Follow-up 1 week after the last fraction revealed a near-complete response of all head lesions. Evaluation 2 months later revealed a complete response (Fig 4). At this time, the patient reported complete alopecia and mild xerostomia.

Discussion

CTCL almost always recurs after treatment, especially in tumor-stage disease. Accordingly, palliative therapy aimed at controlling lesions and minimizing toxicities is indicated. Our case demonstrates feasibility of a Stanford technique adaptation with reduced radiation dose and fewer treatment fractions in a patient with extensive head tumors.

The original Stanford technique used multiple fields to administer ≥3000 cGy over 6 to 7 weeks.[1,3] Complete response rates for tumor-stage disease are lower than rates for limited plaques: 36% versus 98%.[3] The lengthy course and toxicities associated with higher doses are additional disadvantages. Thomas et al reported a 94.4% complete response rate with a single 700 to 800 cGy fraction.[6] Of the 34 lesions with tumor morphology, 25 had a complete response in all treated sites. Similarly, Neelis et al reported a 92% complete response rate with 800 cGy in 2 fractions.[5] A total of 400 cGy once weekly is also an effective technique, with a 90% complete regression rate.[4,8] Alternatives to the traditional standing position are also effective Stanford adaptations.[11]

The nonstandard nature of our approach required dosimetric verification before delivery. Placement of Gafchromic film within the Rando phantom allowed for visualization of the treatment depth and approximate dose distribution. However, because of differences between the phantom and patient geometry, combined with uncertainties resulting from a clinical setup, in vivo dosimetry should also be performed. Gafchromic film secured directly on the patient is useful in this regard because it is nearly tissue-equivalent, exhibits no angular or dose-rate response, and requires no wires or electronics that may interfere with patient positioning.

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