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CASE REPORT

Dosimetric Results of Postoperative Tomodirect Radiotherapy of Keloid on Ear Cartilage

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In radiotherapy following surgical excision of a keloid, radiation has been delivered using various techniques, doses, and fractions. TomoDirect (TD) is a static delivery mode of TomoTherapy (Accuray, Sunnyvale, CA, USA), allowing for the use of a fixed gantry angle in place of rotational beam delivery. Described in the present report is the first instance of TD used for postoperative radiotherapy of keloid scar. A 21-year-old woman presented with keloid scar that had developed and gradually progressed on the left ear cartilage following a piercing 2 years prior. The patient underwent TD radiotherapy with 2 tangential beams 33 hours after excision. Dose to planning target volume (PTV) was 15 Gy in 3 fractions of 5.0 Gy daily, every other day, and V95 was 100%. Mean dose of left parotid was 0.21 Gy, and maximum doses of brain and left lens were 0.34 Gy and 0.02 Gy, respectively. Optimal dose and technique for safe and effective postoperative keloid radiation therapy are unclear and depend upon keloid area and size. Treatment of keloid on ear or other sites with TD radiotherapy may be an optimal strategy.

Keywords: TomoDirect; keloid scar; radiotherapy.

Introduction

Keloids are fibroma-like lesions characterized by progressive fibrosis arising from abnormal healing response to skin injury, and do not spontaneously regress.[1] Keloids most frequently occur on the ear lobe. Radiotherapy following surgical excision of a keloid is a treatment modality widely used to prevent regrowth of the tissue, and the radiation has been delivered using various techniques, doses, and fractions, including external-beam radiotherapy with electrons, low- or high-dose-rate brachytherapy, or Sr-90 brachytherapy.[2–6] TomoDirect (TD) is a static delivery mode of TomoTherapy (Accuray, Sunnyvale, CA, USA), allowing for the use of a fixed gantry angle in place of rotational beam delivery. Described in the present report is the first instance of TD postoperative radiotherapy of keloid scar. Written informed consent was obtained.

Case Report

In December 2015, a 21-year-old woman presented with a keloid scar that had developed and gradually progressed on the cartilage of the left ear following a piercing 2 years prior (Figure 1a). The lesion was approximately 18×15 mm. The patient underwent therapeutic scar excision (Figure 1b), and upon reexamination 24 hours after surgery, the incision site was marked with fiducial markers. The patient was immobilized with a thermoplastic head mask and underwent computed tomography (CT) simulation with 3-mm slice spac-

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Fig. 1. **(a)** Keloid scar on left ear cartilage. **(b)** Incision site 24 hours after surgery.

ing, preliminary to radiotherapy. The incision site, as the clinical target volume (CTV), CTV+ 1 mm as the planning target volume (PTV), and the brain, left parotid gland, and left lens, as the organs at risk, were defined and contoured. Dose to PTV was prescribed as 15 Gy in 3 fractions of 5.0 Gy daily, every other day. Beam angles were arranged to cover CTV and to minimize doses to normal critical structures. TD plan was developed to include a 5.048-cm fixed field, a pitch of 0.5, and a modulation factor of 2.0. External beam radiation

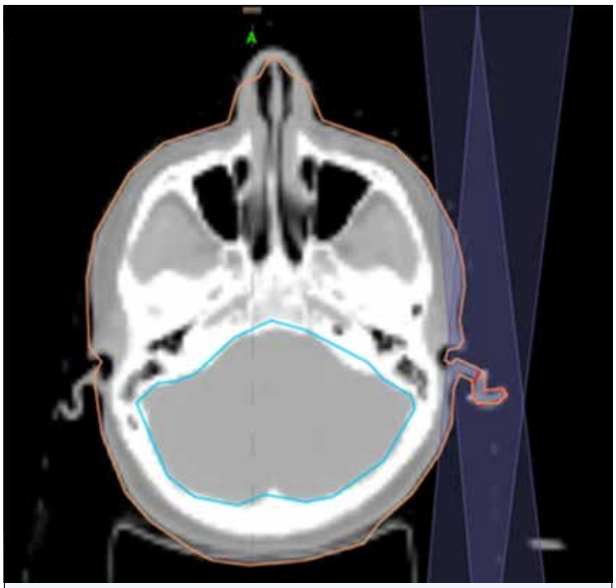

Fig. 2. TomoDirect plan with 2 tangential beams.

therapy (EBRT) was administered using 2 TD tangential beams with 6-MV photon (Figure 2). Time interval between surgery and radiotherapy was 33 hours. Minimum, maximum, and mean doses of PTV were 14.61 Gy, 16.97 Gy, and 15.67 Gy, respectively (Figure 3). V95 (the percentage of target volume receiving ≥95% of prescribed dose) was 100%. Mean dose of left parotid was 0.21 Gy, and maximum doses of brain and left lens were

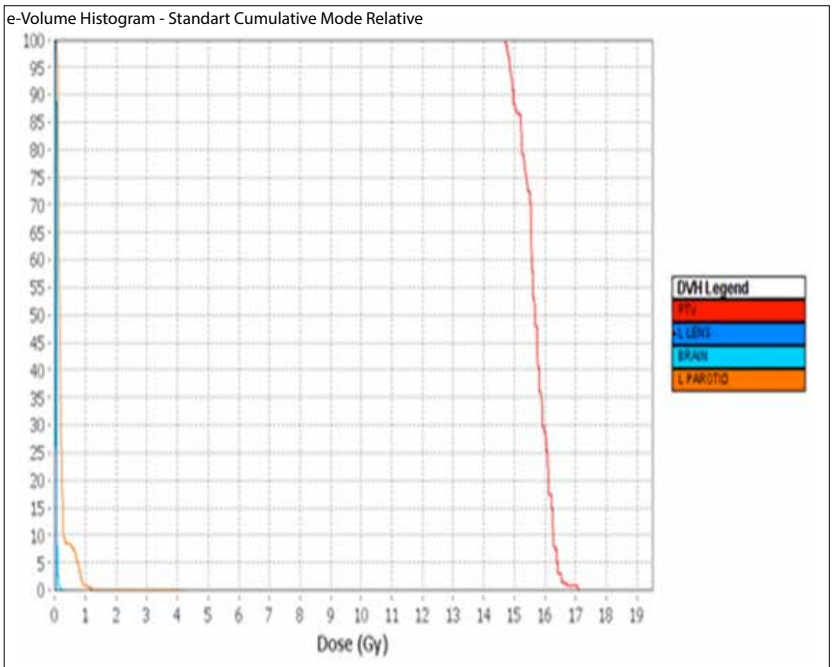

Fig. 3. Dose-volume histogram of planning target volume and critical structures.

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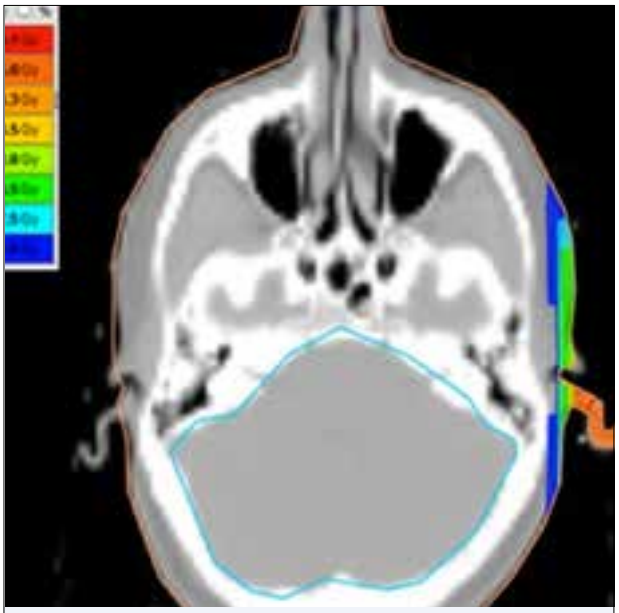

Fig. 4. Dose painting of TomoDirect plan.

0.34 Gy and 0.02 Gy, respectively (Figure 4). No acute side effect of radiation was observed upon examination following radiation therapy.

Discussion

Radiotherapy following surgical excision is a widely used treatment modality because keloid scars are particularly refractory to most other therapeutic modalities. The radiation has been delivered with various techniques, doses, and fractions. Ogawa et al.[7] postoperatively treated patients with electron-beam irradiation. Rösler et al.[8] used low-energy x-rays, strontium 90, or electrons. Lo et al.[9] used single-fraction radiation with variable doses and electron energies ranging from 1.5 to 3.5 MeV. Optimal dose fractionation schedule, radiotherapy energy, and time interval between surgery and radiotherapy have yet to be confirmed. Ogawa et al.[11] suggested that postoperative radiation therapy of 10 to 20 Gy delivered as 5 Gy per fraction are safe and efficient means of keloid treatment in adult patients. In a dose–effect analysis, Kal and Veen[10] concluded that recurrence rate was <10% when biologically effective dose values were higher than 30 Gy, and that radiation treatment should be administered within 2 days of surgery. In the present case, radiation therapy was performed with 15 Gy in 3 fractions, 33 hours after excision. In a review, Flickinger[11] reported that postoperative EBRT had been performed with 45–100 kV x-rays in 27.0% of cases, 1.5–9 MeV electrons in 26.5%, 120–250-kV x-rays in 11.1%, Sr-90 in 4.7%, and Co-60 in 1.9% of cases. It was concluded that lower rates of resected keloid recurrence followed deeper-penetrating radiotherapy such as electron or Co-60. By using 6-MV-based TD technique, better local control and lower dose to normal structures was achieved in the present case, as was excellent target dose coverage, with almost no dose to surrounding tissues.

Conclusion

Optimal dose and technique for safe and effective postoperative radiation therapy are unclear, and depend upon keloid area and size. TD radiotherapy may be the optimal treatment of keloid scar on the ear or other sites. However, large, randomized, controlled trials are necessary to determine optimal dose fractionation and technique.

Disclosure Statement

The authors declare no conflicts of interest.

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