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A TECHNIQUE USING ELECTRONS AND PHOTONS IN THE RADIOTHERAPY OF ORBITAL NEOPLASMS

Sir—Radiation therapy of the orbit often requires careful individual planning with attention to nature, site, and extension of the treated lesion and to avoid too large radiation doses in lens, corneal region, brain, and contralateral eye. In the present case report we describe a method using megavoltage x-rays and electrons with anterior chamber blocks.

Case Report. A 40-year-old man presented in June 1985 with difficulty in focusing his eyes. Examination revealed a mass in the right medial periorbital region and generalized lymphadenopathy. Biopsy was consistent with diffuse histiocytic non-Hodgkin lymphoma. He was assigned to stage III. At the end of 7 cycles of combination chemotherapy the patient had residual tumor in his medial periorbital and retroperitoneal regions. These areas were treated with radiation therapy.

After immobilizing the head with aquaplast, simulation was performed with the central axis coinciding with the center of the cornea. CT scans were obtained in the treatment position (Fig. 1). To determine an optimal technique to deliver an adequate dose to the tumor and to stay within lens tolerance, film and the thermoluminescent dosimetry (TLD) were done using polystyrene slabs as phantom material (8).

The patient was treated with anterior fields using 20 MeV electrons (AECL Therac-20) and ^{60}Co gamma rays with a Dmax dose ratio of 3:1. The patient received photon and electron treatment every day. An anterior chamber block (ACB) was hung a few mm from the corneal surface from the blocking wire mesh during electron radiation therapy (Fig. 2). The electron ACB was 1.5 cm long and 8 mm in diameter. A 25% transmission divergent ACB used during photon radiation therapy was positioned on a plastic blocking tray. The shadow over the cornea measured 7 mm. Treatment set-up was overseen by a physician every day.

After a given dose (Dmax) of 40 Gy, the patient had 0.5 cm residual mass. An additional 9 Gy boost was administered with a field measuring 4×3 cm which was 1 cm medial to the limbus. The patient had minimal erythema of conjunctiva and epilation and is NED in the orbit at the present time (8 months) with no complications.

Our dosimetric measurements show the dose to the cornea and lens to be <15% of the Dmax. There is satisfactory build-up of dose behind the anterior chamber. Fig. 3 shows combined (^{60}Co: 20 MeV electron ratio 1:3) central axis dose, with and without ACB. This data was obtained using film dosimetry.

Discussion

Different techniques have been described in the treatment of orbital neoplasms, varying from simple anterior photon or electron fields to more complicated multiple photon fields or electron fields (1–7, 9, 10). No single technique can be used in all patients as each of the reported techniques have their own advantages and disadvantages. Selection of the technique should be tailored to the particular clinical situation and extent of the disease.

The technique here described has the following advantages: 1) It is simple and easily reproducible. 2) Filling-in behind the ACB by electrons allows protection of the cornea and lens with dose build-up behind the anterior chamber. 3) Dose in the brain and pituitary are negligible. (From our calculations, the pituitary received about 7% of given dose.) 4) By mixing photons with electrons the skin, conjunctiva, and cornea receive lower dose than when using electrons alone.

Fig. 1. Computed tomography of right orbit, taken in the treatment position, shows a soft tissue mass in the medial canthus of the palpebral fissure which extends to the lacrimal fossa (→). The mass silhouettes the medial margin of the globe and appears to destroy the medial orbital wall (→). Position of a plastic wire (→), which marks the lateral margin of the anterior field.

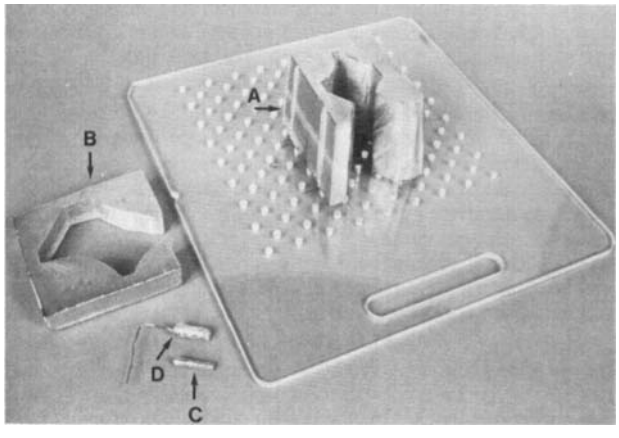

Fig. 2. Cerrobend blocks used during photon (A) and electron (B) beam irradiation are shown. Anterior chamber blocks used (C and D during photon and electron radiation therapy respectively) are also indicated.

In order to guide us in choosing one of the many described techniques under a specific clinical circumstance, a knowledge of the dimensions of various orbital contents is a necessity (Table). We measured these dimensions (Fig. 4) in 15 CT scans of the head/orbit. Twenty-three to 25 individual observations of normal orbits were made with a caliper. No measurements were taken in diseased eyes or if clarity was lacking. It is important to note that the distance from cornea to the apex of the orbit (c in Fig. 4) has a range of 3.0 to 4.8 cm. The choice of electron energy, electron-photon mix ratio, and the necessity to use a lateral port to make up dose deficiency caused by ACB (1, 2), etc. will depend on these dimensions. The necessity to individualize treatment techniques and the importance of using CT scans for planning the treatment of orbital neoplasma are obvious.

Key words: Therapeutic radiology; technology, orbital neoplasms, electrons, photons, treatment planning.

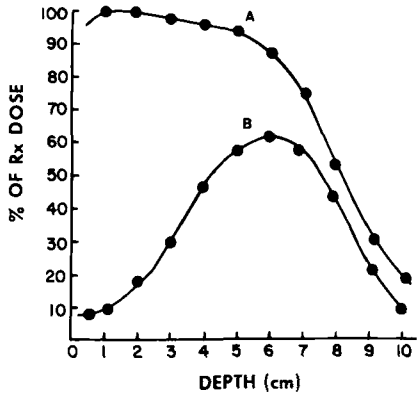

Fig. 3. Dmax dose profile obtained with film dosimetry is depicted for ^{60}Co: 20 MeV electron ratio 1:3. Curve A was obtained without ABC; Curve B with a 3 HVL ACB for photons and full-thickness block for electrons. Lens receives less than 15% of given dose. Dose is about 50% at 4 cm depth and the curve B follows curve A from 6 cm depth.

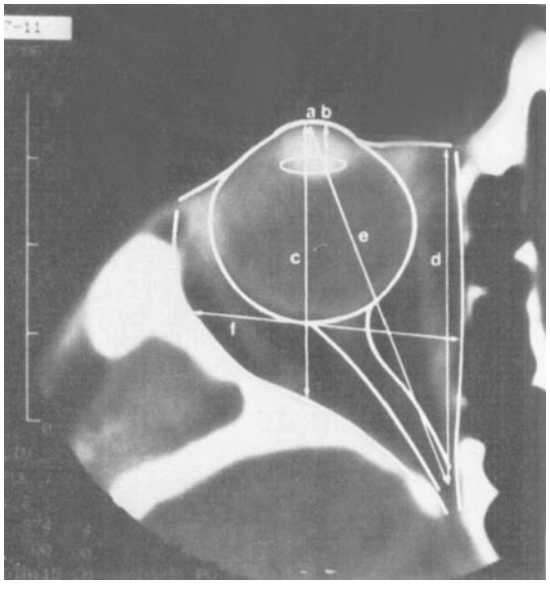

Fig. 4. The dimensions measured with a caliper in normal orbits are detailed in the Table. a=0.5, b=0.9, c=3.6, d=4.6, e=5.5, f=3.5 cm.

Table

*Dimensions of importance in the treatment of orbital neoplasms (cm). *Dimensions represented in Fig. 4*

	Cornea to anterior surface of lens (a)*	Cornea to posterior surface of lens (b)*	Cornea to apex of orbit along (c)*	Medial canthus to apex (exit of optic nerve) (d)*	Cornea to optic nerve exit (e)*	Maximum width of orbit (f)*	Width of lens
No. of observation	23	23	25	25	25	25	23
Mean±SD	0.50±0.08	0.90±0.07	3.70±0.39	4.60±0.40	5.36±0.40	3.48±0.22	0.88±0.10
Median	0.5	0.9	3.6	4.6	5.5	3.5	0.9
Range	0.4–0.6	0.75–1.0	3.0–4.8	3.5–5.4	4.5–6.0	3.1–3.4	0.7–1.0

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