Radiotherapy and ophthalmology: time for a friendly re-acquaintance

Many ophthalmologists expect radiotherapy to be accompanied by late morbidity and therefore reserve it for desperate situations. The radiation tolerance of ocular and orbital structures is now well appreciated, and many sequelae of radiotherapy may be prevented by careful radiation dose and modern techniques. Ophthalmologists should be aware that there is a tenfold difference in dose between the cataract threshold and the dose required to harm the retina by conventional external beam radiation.

Superficial x ray therapy

Superficial x ray therapy is curative for basal cell and squamous carcinomas of the lids and, with careful fractionation, ectropion, nasolacrimal duct stenosis, and other complications are rarely encountered; the globe is protected by lead 'contact lens' shields placed behind the lids. Conjunctival malignancy (and pterygia) responds well to \( \beta \)-therapy from strontium plaques - made 'double sided' to treat malignancy involving the tarsal as well as bulbar conjunctiva; the \( \beta \)-rays do not penetrate to the lens in cataractogenic doses. Haemangiomas of the lids and conjunctiva regress with radiotherapy, as does the conjunctival Kaposi sarcoma associated with AIDS.

Lacrimal gland malignancy may be improved by radiotherapy after surgery, but this does not compensate for radical surgical clearance where this is possible.

Intraocular uses

Low dose radiotherapy may be beneficial in certain benign ocular conditions. Juvenile xanthogranuloma of the iris is extremely radiosensitive, and diffuse choroidal haemangiomas also respond well. The dose is delivered by a lens-sparing technique developed for retinoblastoma (see below). For localised intraocular tumours the now standard use of iodine-125 and ruthenium-106/rhodium-106 ocular plaque brachytherapy has reduced the dose to the operator, and such plaques are replacing the cobalt plaque in both retinoblastoma and melanoma work. The pure \( \beta \)-emissions of ruthenium (with their intense dose to the tumour base, causing infarction) may have further advantages in melanoma therapy. The proton beam data on ocular melanomas look impressive; this too may owe at least some of its effect to damage to tumour vasculature. However, the proton work needs to be compared prospectively with conventional plaque therapy. There are good data suggesting that orbital radiotherapy reduces the local relapse rate after extracapsular extension of a melanoma.

External beam radiotherapy remains the basis of treatment when focal methods fail to control the spread of retinoblastoma (Fig 1). In more advanced disease (where enucleation of an only eye is unacceptable to parents), induction chemotherapy followed by radiotherapy is under intense study with good results.

Other globe malignancies that respond well to radiation are choroidal involvement by leukaemia and metastases from solid cancer. In leukaemic children receiving prophylactic cranial irradiation, the back of the eye receives some radiation and this may explain the lower ocular relapse rate. Choroidal metastases (especially from breast carcinoma) may be associated with cerebral metastases, and thus a computed tomography scan is performed before recommending radiotherapy to the eye alone. Similarly, ocular lymphoma is also associated with an increased incidence of intracerebral disease.

Orbital disease

Benign disease of the orbit may respond to low dose therapy now that sophistication of techniques allow protection of the anterior chamber, lacrimal gland, and lens. Thus Langerhans cell histiocytosis (histiocytosis X) of the orbit is one example, and orbital haemangioma may also benefit.

The management of Graves' ophthalmopathy generates considerable debate. Radiotherapy has been advocated for many years but only recently have modern methods obviated treatment related morbidity. Thus, current radiation methods allow effective treatment for steroid resistant disease - particularly with optic nerve compression, exposure keratitis, and painful orbitopathy. Recent analyses showed that surgical decompression or radiotherapy were effective but that surgical decompression gave a slightly greater decrease in proptosis; however ocular movements were better assisted by radiotherapy. This last observation, when coupled with the safe track record of the current technique, may increase the indications for radiotherapy. However, other authors have not found such improvements in ocular motility.

Orbital pseudotumours are sensitive to low dose radio-

**Figure 1** Child on 'set-up' for bilateral lens-sparing retinal radiotherapy (for bilateral retinoblastoma) by this technique.
therapy and midline ocular structure shielding is practised routinely.2021 The patient with benign disease may be warned of the carcinogenic potential, which is of the order of magnitude of 10−4.

True orbital lymphomas contain a highly curable group of extranodal non-Hodgkin’s lymphomas. The high grade tumours (approximately 20%), and those with extraorbital extension, require chemotherapy first. The majority of lymphomas are low grade B tumours confined to the orbit; and relatively low dose radiotherapy is curative.26

Orbital sarcoma in childhood is usually embryonal rhabdomyosarcoma with a good prognosis (following a chemotherapy programme). These tumours are usually confined to the orbit and such patients have a more than 80% survival rate on current treatment protocols. Late effects due to radiation have recently been reported22 with a radiation dose prescription of 5000–6000 cGy in 200 cGy fractions. In current protocols the total dose is 4000–4500 cGy in lower daily dose fractions and the late sequelae may be confidently predicted to be lower. Alveolar histology (approximately 10%) or extracocular spread may demand the higher dose (Fig 2). Adult sarcomas of the orbit are more resistant, and surgery and radiotherapy are the mainstays of treatment, with continued debate as to whether adjunctive chemotherapy has a role. Equally debated is the order: preoperative radiotherapy (to facilitate surgical excision with clear margins) versus postoperative radiotherapy (to sterilise microscopic disease left behind).

Optic nerve gliomas receive radiotherapy if they extend back to the chiasm with deteriorating vision. Optic nerve meningiomas in adults have also been treated by radiotherapy, with anecdotal cases of improved vision after carefully fractionated radiotherapy.27

Occasionally, difficult tumours occur at the back of the orbit, extending through the optic canal intracranially. A recently introduced focal stereotactic external beam radiotherapy method is now available to deliver extremely high doses to stereotactically mapped lesions anywhere in the cranium; the isodoses fall off very sharply at the target perimeter. Of proved use for intracerebral AVMs this technique may be useful in orbital disease. Using the St Bartholomew’s focal method, we have recently treated a prolactinoma (resistant to bromocriptine and previous external beam radiotherapy) which had extended from the pituitary fossa through the orbit to the back of the orbit. A very high treatment dose was delivered and the tumour has regressed but the critical point is that the abutting (and previously irradiated) optic chiasm received less than 20% of the treatment dose (Fig 3). Such technology has also been used for focal treatment of choroidal melanoma in lieu of protons28 and will have further applications for locally aggressive tumours, particularly at the orbital apex.

In summary, modern radiotherapy has much to offer patients with ocular problems. Knowledge of the radio-biological tolerance of normal ocular structures, enhanced technical precision, and better appreciation of limits of usefulness and morbidity pitfalls have all led to improved therapeutic ratios (success: morbidity).

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5 Wright JE, Rose GE, Gartner A. Primary malignant neoplasms of the lacrimal gland. [Submitted.]
21 Lawson JWM, Rosen PH, McGarry B, Koussoulides L, Lighthman S, Fells P,
Radiotherapy and ophthalmology: time for a friendly re-acquaintance


29 Deutsch M. Personal communication.

Radiotherapy and ophthalmology: time for a friendly re-acquaintance.

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doi: 10.1136/bjo.76.5.307

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