Mechanisms of post-radiation optic atrophy with neuroretinal rim thinning

Dear Editor,

We read with interest the article “Optic disc cupping after circumpapillary PD-103 slotted plaque radiation therapy.” 1 Finger et al. examined a cohort of patients managed with slotted plaque radiotherapy for peripapillary, juxtapapillary, or circumpapillary choroidal melanoma and found that treatment was associated with subsequent increase in cup-to-disc ratio.

We recently published a series of patients managed with round Collaborative Ocular Melanoma Study plaques and found that of 78 patients, 41 developed post-radiation optic atrophy, and 15 had concomitant neuroretinal rim thinning,2 a phenotype matching that described by Finger et al. These findings are not unique to a slotted plaque design, but they could be more likely in the setting of greater radiation dose to the optic disc and posterior ciliary arteries. In our series, we found that all patients with neuroretinal rim thinning also developed some degree of optic disc pallor. Although Finger et al. found no significant increase in pallor after treatment, we suspect this may have been due to small sample size, especially given p = 0.051 and a change in both the median and minimum pallor grade from zero to one after treatment.

In our study, we found an additional association between higher baseline intraocular pressure (IOP) and development of post-radiation optic atrophy, with a further association of higher maximum IOP and the phenotype of neuroretinal rim thinning. Finger et al. emphasized that higher post-treatment IOP was likely not responsible for neuroretinal rim thinning in their series, but our data suggest that higher IOP, even if within the “normal” range, may increase susceptibility to post-radiation optic atrophy, perhaps due to connective tissue stress and strain.3

We applaud Finger et al. for their application of optical coherence tomography angiography. Optic disc cupping in their study correlated to changes in vessel length and density, leading to the hypothesis that radiation-induced ischemia could be responsible for the optic disc changes. Overall, we were excited to see validation of findings we have observed in our own practice, and we agree that prospective studies including correlation of visual field defects are necessary to better understand how post-radiation optic atrophy compares with glaucomatous optic neuropathy.

Lauren A. Dalvin, Gavin W. Roddy
Mayo Clinic, Rochester, Minn.

Originally received Mar. 8, 2022. Accepted Mar. 24, 2022.

Correspondence to Lauren A. Dalvin, MD; dalvin.lauren@mayo.edu.

References


Footnotes and Disclosure

The authors have no proprietary or commercial interest in any materials discussed in this article.

Supported by: Mayo Foundation

Reply: Mechanisms of post-radiation optic atrophy with neuroretinal rim thinning

Dear Editor,

Thank you for the opportunity to respond to Drs. Dalvin and Roddy’s letter to the editor regarding our recently published original observations describing “Optic disc cupping after circumpapillary Pd-103 slotted plaque radiation therapy.” 1 They point out that their recently published article in the Journal of Neuroophthalmology noted, “Post radiation optic atrophy is associated with intraocular pressure and may manifest with neuroretinal rim thinning.”2 We read their article (which was published within 30 days of ours) with great interest. They reported that their posteriorly placed radiation plaques resulted in either no optic neuropathy, or optic neuropathy without neuroretinal thinning or...
19.2% with neuroretinal thinning (Table 1). In contrast, in our study, plaque therapy resulted in 88.5% with optic disc cupping.1 Let’s closely examine some of the differences between these two studies.

The tumors selected and methods of treatment were quite different.1,2 For example, in Finger et al., we selected only peripapillary, juxtapapillary, and circumpapillary tumors. Due to their peripapillary location, treatment required 8 mm wide, variable-depth slots to be cut away from standard Collaborative Ocular Melanoma Study plaques to accommodate the retrobulbar optic nerve sheath within the plaque (thereby overcoming its obstruction).3 These plaques covered the entire tumor plus a margin of normal-appearing tissue around the melanoma (American Brachytherapy Society [ABS] “normal” plaque position).3 As a result, Finger’s Slots uniquely allowed the plaques to be seated on the posterior pole to directly irradiate most or all of the posterior ocular circulation located immediately beneath the plaque.

In contrast, Dalvin and Roddy’s tumors were selected to be within 6 mm of the optic disc.4 It is unlikely that many tumors were juxtapapillary, peripapillary, or circumpapillary because most centers prefer not to treat them with the round Collaborative Ocular Melanoma Study plaques used in their study. In that the optic nerve sheath diameter extends 1.5 mm beyond the intraocular edge of the optic disc, there is no anatomical chance Dalvin and Roddy’s round plaques could have achieved ABS “normal” plaque position, much less be seated over most or all the papillary and peripapillary circulation.

Studies have revealed, however, that round juxtaneural plaques tilt along their posterior extent and thus spray radiation in the direction of the posterior, typically uncovered melanoma and (of interest for this comparison) the neural and perineural circulation.1,4 The use of plaque-tilt during radiation therapy challenges a medical physicists’ ability to determine the actual dose to the optic nerve and emissary blood vessels. Dalvin and Roddy were likely considering this when adding transpupillary thermotherapy (TTT) at the time of plaque removal for 23 eyes (Table 1).3 Clearly, the fact that TTT was used on 27% of the 15 nerves that went on to develop neuroretinal thinning is a confounding factor.2

Failure of local tumor control adds further evidence of plaque decenteration seen with their approach. Though no reason was given, we noticed that three of their eyes came to enucleation (Table 1).2 In contrast, in that Finger’s slotted plaque technique allowed for “ABS normal” plaque positioning, there was no need to treat uncovered tumor margins with adjuvant peripapillary TTT, and there were no failures of local control.1,5,6

Our study does not suggest that neuroretinal rim thinning is unique to slotted plaque brachytherapy. Our research revealed a phenomenon where radiation was delivered directly to the papillary and peripapillary vasculature, which resulted in a greater incidence of optic nerve cupping (88.5%) versus (19.2%) neuroretinal thinning observed by Dalvin and Roddy (Table 1). We appreciate, however, that Dalvin and Roddy’s research offers supporting evidence that radiation can induce optic nerve cupping.1,2 Specifically, our study is the only one where quantifiable and reproducible measures of radiation were placed to cover the posterior neural and perineural circulation of the eye.1 This is reflected by the numbers of patients who later developed progressive (optical coherence tomography-angiography—documented) ischemic radiation vasculopathy at the posterior pole along with secondary optic disc cupping.1

Paul T Finger, Anthony Fam, Ankit Singh Tomar, Nathan M Radcliffe
The New York Eye Cancer Center, New York City, NY.
Originally received Mar. 21, 2022. Accepted Mar. 24, 2022.
Correspondence to Paul T. Finger, Director, The New York Eye Cancer Center; pfinger@eyecancer.com.

References


Footnotes and Disclosure

The authors have no proprietary or commercial interest in any materials discussed in this article.

Supported by: The Eye Cancer Foundation, Inc. (https://eyecancercure.com)