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Case Report

# A Case of Retinal Detachment with Unique Optical Coherence Tomography Findings after Gamma Knife® Radiosurgery Treatment for Choroidal Melanoma

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**Keywords**
Choroidal melanoma · Gamma Knife® · Retinal detachment · Optical coherence tomography

**Abstract**
***Purpose:*** To report a case of retinal detachment with unique optical coherence tomography (OCT) findings after Gamma Knife® (GK; Elekta Instrument AB, Stockholm, Sweden) treatment for choroidal melanoma (CM). ***Case Report:*** A 48-year-old woman underwent GK therapy for CM in her right eye from the macula to the temporal side. While the tumor subsequently shrank, the patient developed radiation retinopathy, which was treated with laser photocoagulation. The tumor lesions later subsided; however, her visual acuity (VA) decreased 8 years after the initial treatment. Although the tumor lesions in the right eye had become scarred, a bullous retinal detachment with fixed folds occurred in the superior-nasal quadrants. OCT examination revealed a preretinal membrane, vitreoretinal traction, and an inner retinal break; however, no outer retinal break was clearly detectable. MRI scans showed no increase in tumorous lesions, and $^{123}$I-IMP SPECT imaging showed no photon accumulation.

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Thus, it was determined that there was no tumor activity. The corrected VA in her right eye was light perception, and it was determined that there was no indication for vitreous surgery. ***Conclusion:*** In this case, an inner retinal break was formed by the vitreoretinal traction around the scarred tumor and radiation retinopathy, thus suggesting the possibility of the development of a rhegmatogenous retinal detachment presumably complicated with an outer retinal break.



## Introduction

Choroidal melanoma (CM) is one of the most common malignant primary intraocular tumors in adults [1, 2]. The proper treatment for CM depends on the visual acuity (VA) of the affected eye and fellow eye, the size and activity of the tumor, and the patient's age and general physical health. Apart from enucleation of the eyeball, proper treatment methods include proactive eye-preservation treatments such as transpupillary thermotherapy, proton beam therapy, carbon-ion radiotherapy, and CyberKnife® (Sunnyvale, CA, USA) and Gamma Knife® (GK; Elekta Instrument AB, Stockholm, Sweden) radiosurgery therapy [3–5].

Although there have been some previous reports of retinal detachment following GK therapy for CM, most of the cases in those studies were exudative retinal detachment [6–11]. Here, we report a case of radiation retinopathy after GK therapy that caused a rhegmatogenous retinal detachment at a later stage.

## Case Report

A 48-year-old woman presented to our hospital complaining of loss of vision in her right eye. Her VA at the time of initial examination was measured at RV = (0.03), LV = (1.5), RT = 12 mm Hg, LT = 11 mm Hg. No abnormalities were observed in the anterior segment, optic media, and fundus of her left eye. However, in the fundus of her right eye, a grayish-white choroidal tumor-like lesion, 7 disc diameters in size, was observed from the macular region to the temporal side (Fig. 1a). With the fundus findings in mind, we diagnosed CM in the right eye after examination by B-mode ultrasonic scan and MRI. We therefore performed GK therapy on the tumor with 3 shots from an 8-mm collimator using a marginal dose (the lowest tumor dose) of 30 Gy, and a maximum dose of 60 Gy (50% isodose). Although the tumor gradually shrank after GK treatment, hard exudates began to appear around the tumor at 6 months postoperatively (Fig. 1b). Fundus fluorescein angiography revealed a retinal nonperfusion area in the inferior quadrants, and laser photocoagulation was performed upon diagnosis of radiation retinopathy. Although the corrected VA of her right eye improved from (0.01) to (0.03) and stabilized after laser photocoagulation, further deterioration of vision in that eye began to occur at 8 years after the initial treatment.

Upon examination, we found that a bullous retinal detachment with fixed folds had occurred in the superior-nasal quadrants of her right eye (Fig. 2a), and that the corrected VA was light perception. Scarring was found to have occurred around the tumor lesion, and laser scars from radiation retinopathy were also observed in the inferior quadrants. Optical coherence tomography (OCT) findings revealed a partial thinning of the macular retina, with the formation of a retinal inner break caused by traction resulting from the formation of preretinal membrane and posterior vitreous detachment (Fig. 2b). The outer retinal break was not clearly detectable. Serum levels of 5-S-cysteinyldopa (5-S-CD), a tumor marker for

CM, were within the normal range of 2.1 nmol/L, MRI findings showed no increase in tumorous lesions (Fig. 3a), and $^{123}$I-IMP SPECT imaging showed no photon accumulation (Fig. 3b), thus indicating that there was no tumor activity. The patient's VA was extremely poor, so it was determined that there was no indication for vitreous surgery, and we decided to follow her progress.

## Discussion

GK therapy is a form of stereotactic radiosurgery in which gamma rays emitted from 201 cobalt-60 radiation sources are concentrically arranged in a semicircular spherical shape and are focused at the center, thus allowing the minimum focus to be reduced to 4 mm [12]. Thus, the exposure dose received by the surrounding normal tissue is extremely low, making it possible to expose lesions to a high dose of radiation in a single treatment. While the treatment is reportedly indicated for conditions including benign and malignant brain tumors, brain arteriovenous malformations, hemangioma, and epilepsy [12, 13], its use in the field of ophthalmology has also been reported for metastatic choroid tumor and CM.

Although GK is a form of radiotherapy that results in relatively minor damage to surrounding tissues, the possibility of radiation retinopathy remains when treating tumors in areas adjacent to the retina, such as cases of CM. In GK therapy for CM, the crisis rate of radiation retinopathy has been reported at 13.5%. Radiation retinopathy and neovascular glaucoma have been reported to occur with high probability when the GK dosage was >50 Gy [14]. Since radiation retinopathy can develop after a prolonged period following GK therapy, an extended period of careful postoperative follow-up is necessary.

The 3 types of retinal detachment that occur after GK therapy for CM are exudative retinal detachment due to the therapy itself, tractional retinal detachment resulting from scarred tumor lesions or proliferative membranes secondary to radiation retinopathy, and rhegmatogenous retinal detachment in which a retinal break can develop as the result of such traction [6–11]. The majority of previous studies have been related to exudative retinal detachment due to the GK therapy itself. In our case, since no activity was observed in the tumor, and since the retinal detachment exhibited a convex shape toward the vitreous cavity consistent with proliferative vitreoretinopathy, we theorized that it was a case of rhegmatogenous retinal detachment.

Although no obvious retinal breaks could be detected ophthalmoscopically, the OCT findings revealed an inner retinal break by traction from posterior vitreous detachment and preretinal membrane in the vicinity of the tumor lesions. Even though no clear outer retinal break could be confirmed via OCT, the findings similar to retinoschisis in the retina prompted us to theorize that an outer retinal break must be present somewhere, and that a contact of these 2 breaks is what led to the detachment of the entire retinal layer. In this case, the retinal detachment occurred after an extended period of 8 years after GK therapy. Thus, this seems to have been a case of rhegmatogenous retinal detachment caused by a combination of factors, including the gradual progression of vitreoretinal adhesion, vitreoretinal traction, disruption of the structure of the retina, and posterior vitreous detachment.

To the best of our knowledge, this is the first report of the occurrence of retinal detachment after GK therapy for CM exhibiting these types of OCT findings, thus indicating that the patient in this study was a relatively special case.

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## Statement of Ethics

This case study was approved by the Ethics Committee of Osaka Medical College.

## Disclosure Statement

There are no conflicts of interest to report for all authors.

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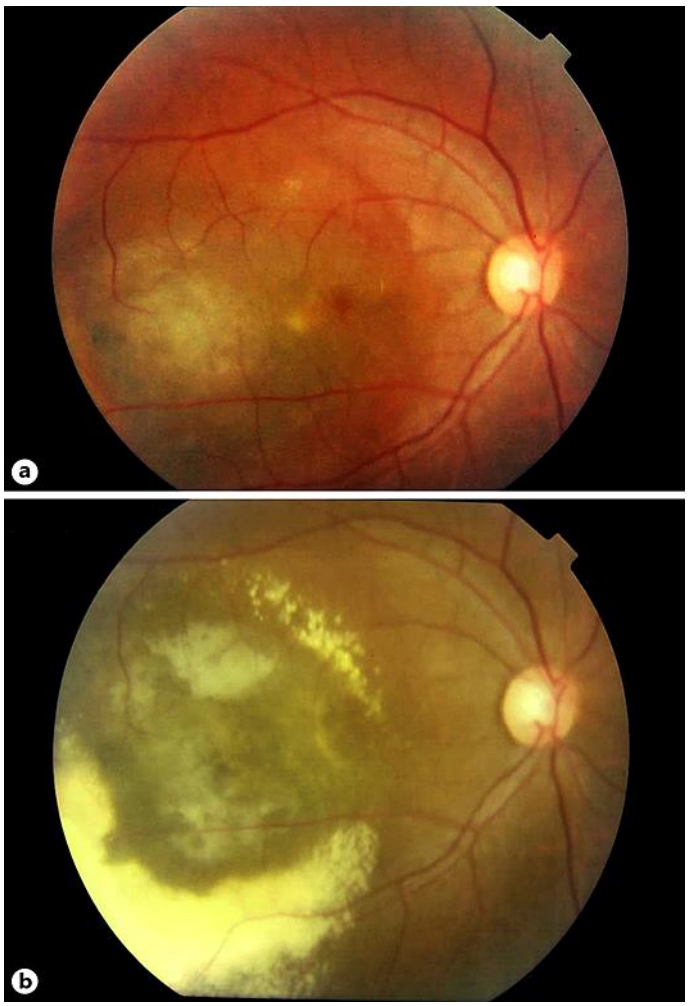


**Fig. 1.** Fundus photographs of the patient's right eye obtained before and after Gamma Knife® (GK) radiosurgery treatment. Choroidal melanoma was observed from the macular region to the temporal side (**a**). Although the tumor gradually shrank after GK treatment, hard exudates began to appear around the tumor at 6 months postoperatively (**b**).

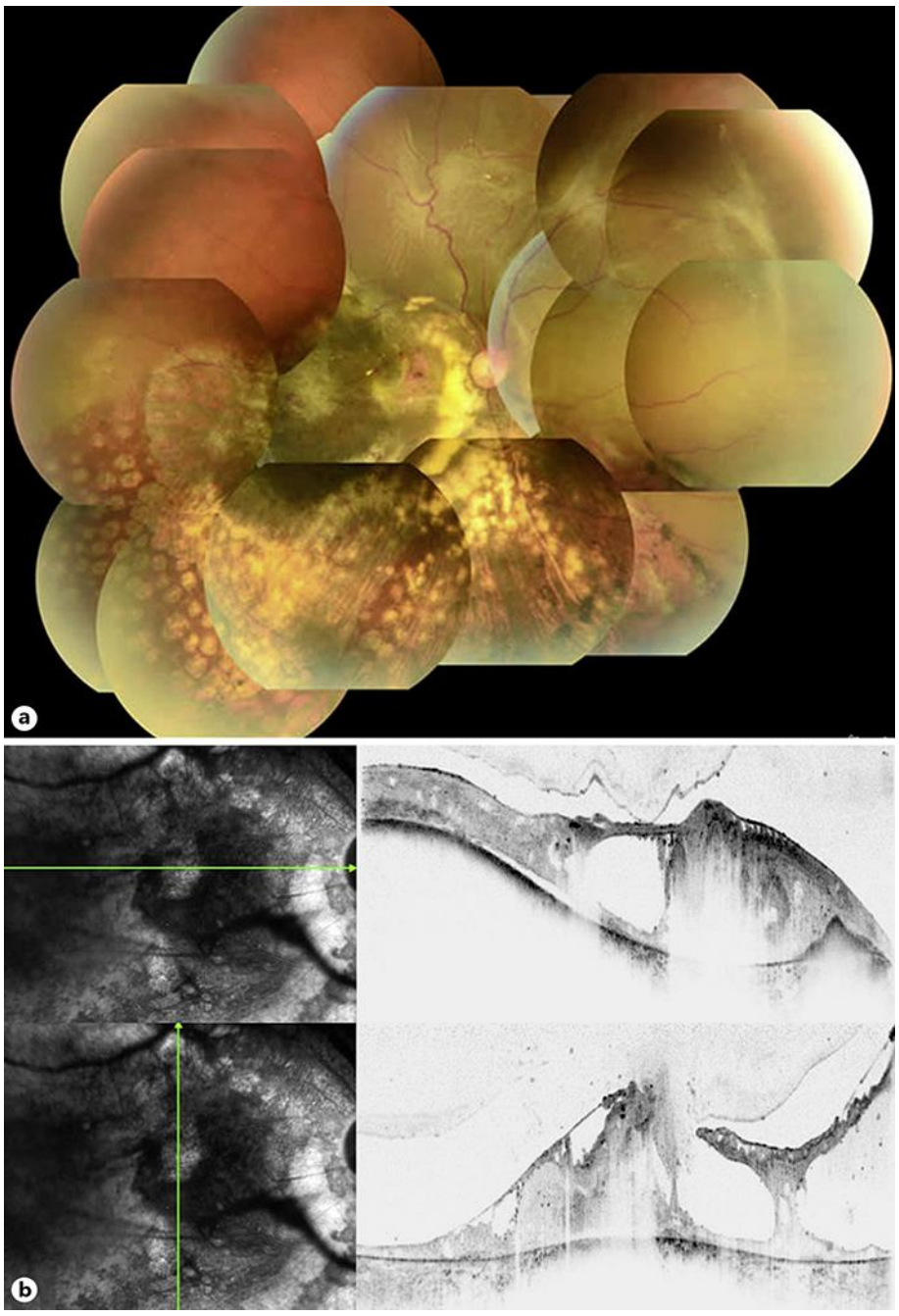


**Fig. 2.** Fundus photograph and optical coherence tomography (OCT) images obtained at 8 years after the initial treatment. A bullous retinal detachment with fixed folds occurred in the superior-nasal quadrants (**a**). OCT revealed partial thinning of the macular retina, with the formation of a retinal inner break caused by traction resulting from the formation of preretinal membrane and posterior vitreous detachment (**b**).

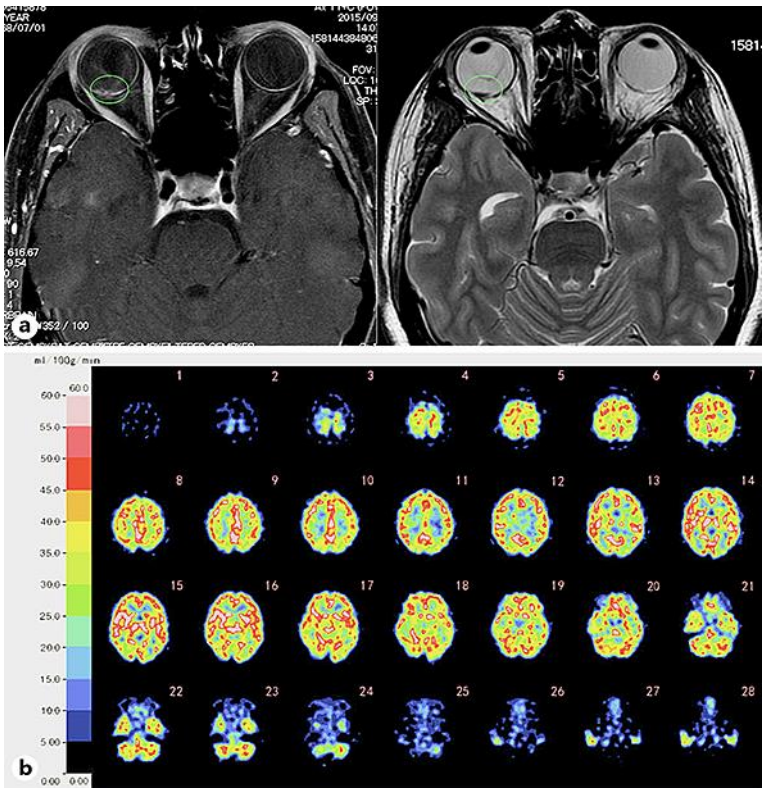


**Fig. 3.** MRI and $^{123}$I-IMP SPECT images obtained at 8 years after the initial treatment. MRI showed no increase in tumorous lesions (**a**), and $^{123}$I-IMP SPECT imaging revealed no photon accumulation (**b**), thus indicating no tumor activity.