Acrylic Scleral Shell Spacer to Prevent Skin Damage During Gamma Knife Radiosurgery of Ocular Melanoma

Michael O. Hughes
Artificial Eye Clinic of Washington, DC
Vienna, Virginia

Brian P. Conway
M.D.
Professor and Chair
Dept. of Ophthalmology
University of Virginia
Health Sciences Center
Charlottesville, Virginia

Jonni Henofer
R.N., C.R.N.O.
Coordinator, Collaborative
Ocular Melanoma Study
University of Virginia
Health Sciences Center
Charlottesville, Virginia

Dheerendra Prasad
M.D.
Clinical Instructor
Neurosurgery
Lars Leksell Fellow
Dept. of Neurosurgery
Gamma Knife Center
University of Virginia
Health Sciences Center
Charlottesville, Virginia

Ladislau E. Steiner
M.D., Ph.D.
Professor, Neurosurgery &
Radiology
Dept. of Seurological Surgery
Gamma Knife Surgical Unit
Health Sciences Center
Charlottesville, Virginia

ABSTRACT: *Gamma knife radiosurgery is a new treatment for ocular melanoma. Its advantages include treatment during a single session and highly accurate delivery of a high dose of y-radiation to an intraocular target, preventing damage to neighboring healthy tissue. Although this treatment modality limits the damage to surrounding structures, unacceptable skin radiation can occur in tumors that are anteriorly located. During treatment of a ciliary body melanoma, we placed a 5.0-mm acrylic spacer to elevate the lid away form the tumor and decrease the radiation exposure of the eyelid.*

INTRODUCTION

One of the benefits of working at a teaching hospital is the exposure to many new methods and technologies. The University of Virginia has become a leading U.S. center for the technique of gamma knife radiosurgery (Figure 1). This treatment modality is being applied to ocular melanoma. Ocularist can help ensure an optimum outcome for patients in this application of gamma knife radiosurgery.

UVEAL MELONOMA: DEFINITION AND TREATMENT OPTIONS

Uveal melonoma affects the pigmented layers of the eye, including the iris, the ciliary body, and the choroids. Following cancer metastases, uveal melanoma is the most common primary ocular neoplasm in adults.[1] Several treatment options have recently become available. These options include the traditional treatment of enucleation, eye-wall resection of the tumor, laser photocoagulation, and irradiation. Radiation can be delivered by radioactive plaque (brachytherapy) or by remote radiation sources (teletherapy). Most teletherapy has been performed using heavy-charged particles, such as protons or helium ions. Recently, the gamma knife, a unique gamma irradiation source, has been employed in selected cases of ocular melomoma.

HISTORY OF GAMMA KNIFE RADIOSURGERY

Dr. Lars Leksell, a medical pioneer, was the first neurosurgeon to introduce medical uses of ultrasound.[2] In 1951, he proposed the use of ionized radiation beams in neurosurgery, defining the technique as "radiosurgery."[3] Radiosurgery became more practical when, in 1968, Leksell developed a closed sterotactic system, which he dubbed the "sterotactic gamma knife." What makes this type of radiation treatment unique is that the radiation affects only the area pinpointed by the beam, preserving the nontarget tissues and structures between the source and the focal point at the tumor (Figure 2).

Dr. Lakislau Steiner, M.D., Ph.D, had played an important role in subsequent developments in the field of gamma knife radio-

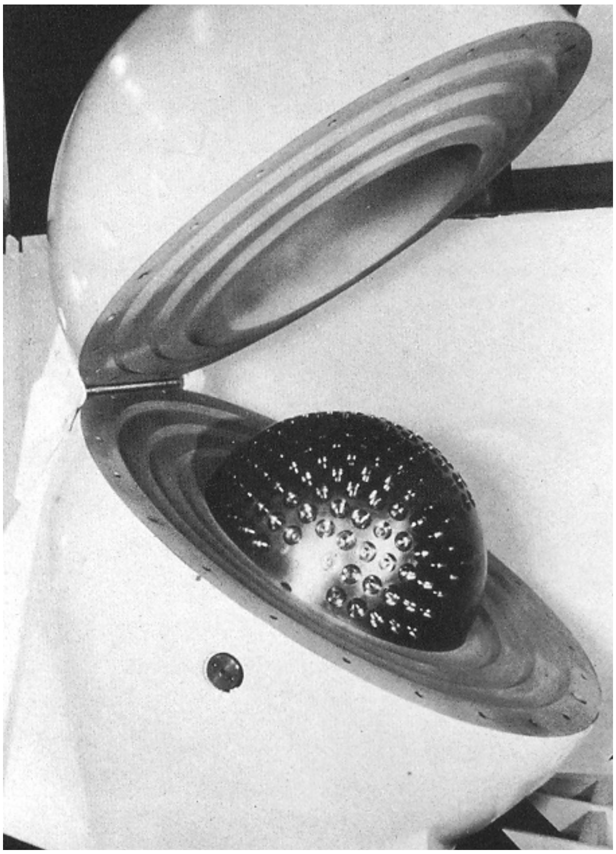

FIGURE 1. Gamma unit has multiple Co60 (Cobalt 60) sources rigidly fixed in heavily shielded core to ensure mechanical accuracy

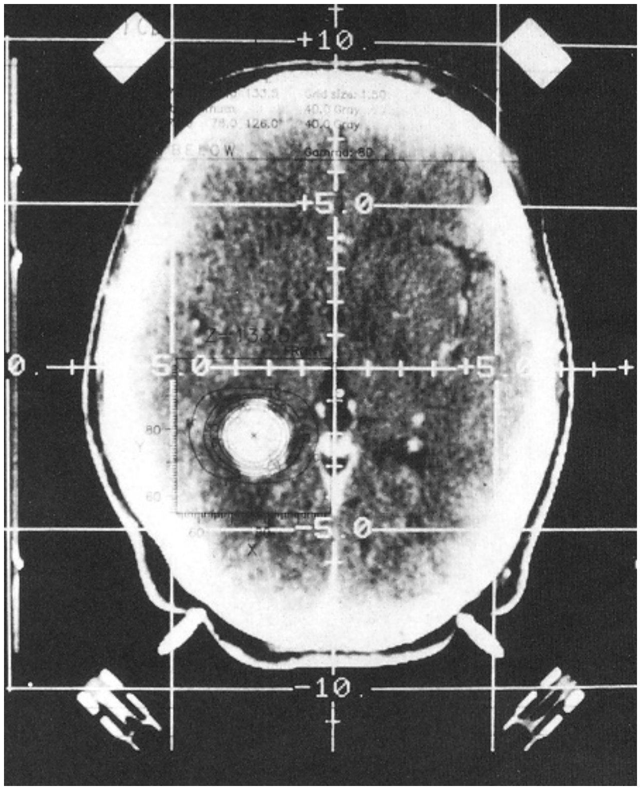

FIGURE 2. Assigning X, Y, and Z coordinates to intracrania target.

surgery. He first proposed the use of the gamma knife to treat arteriovenous malformations and, in 1970, the first patient was selected. The instrument was also redesigned in 1970 to make appropriate for use in cases involving tumors or vascular malformations. In 1992, Chinela introduced the use of traction sutures through the rectus muscles ("bridle sutures") to immobilize the eye during some cataract procedures. Use of this technique in 1993 was adopted when the first uveal melanomas was treated with the gamma knife.[4] In 1995, Marchini et al. reported on 12 cases of uveal malanoma treated by gamma knife surgery. Although six patients showed a significant reduction (10% to 41%) in echographic thickness of the tumor during a 3-month to 12-month followup period, tumor size was unchanged in four patients after 1 month to 10 months. A longer followup period is required before any definite conclusion about the efficancy of treatment can be reached. The side effects of gamma knife radiosurgery seem in this group were similar to those seem with other types of radiation: radiation retinopathy, tissue necrosis, vitreous hemorrhage, recalcitrant uveitis, and the loss of the eye.[5]

CASE REPORT

A 31-year-old woman complaining of blurred vision in her right eye was seen in December 1995. Examination showed a large ciliary body melanoma protruding into the root of the iris (Figure 3). The tumor was too anterior and too large to be treated with the conventional radioactive I – 125 plaque under the collaborative ocular melanoma study (COMS) protocol. Gamma knife radiosurgery offered the advantage of customizing the radiation field to the size of the tumor to limit the damage to surrounding structures. This objective was particularly desirable in this case since the patient's vision was correctable to 20/20.

One potential problem in treating a tumor in this anterior location is radiation to the skin. Experience with other applications of the gamma knife suggests that a skin dose of greater than 600 rads will cause cosmetically undesirable vascular changes in the skin (telangiectasia). In higher does, necrosis of the skin is possible. Preliminary calculations indicated that the skin dose would be unacceptably high in the treatment of this tumor unless the skin and other eyelid structures could be moved farther away from the tumor.

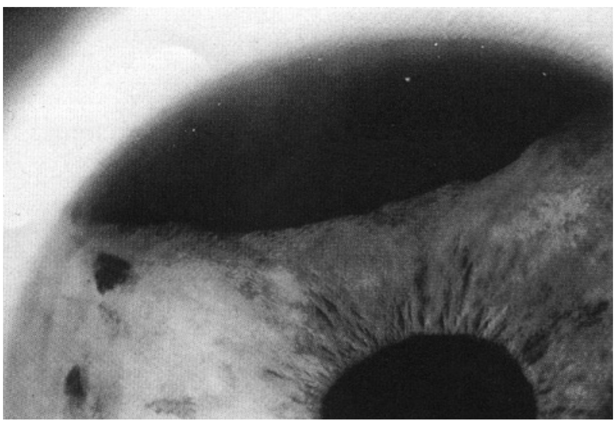

FIGURE 3. Large ciliary body melanoma protruding into root of iris.

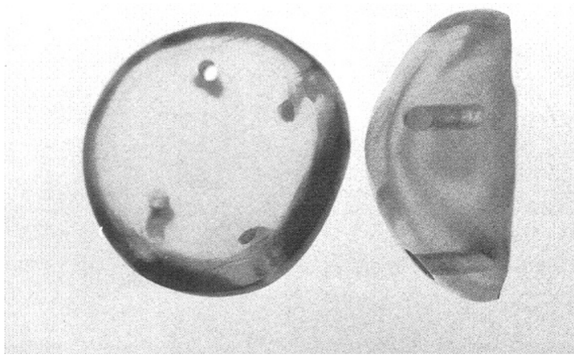

FIGURE 4. Speically fabricated scleral shell spacer.

FIGURE 5. 3.0-mm scleral shell positioned over anterios tumor of right eye.``````````````

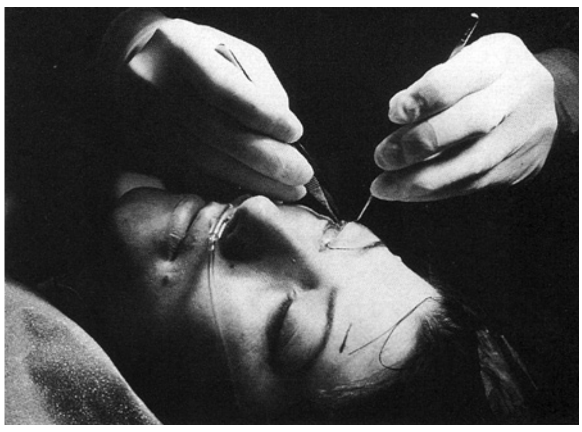

FIGURE 6. Placement of scleral shell with bridle suture noted at medial canthus.

Use of Scleral Shield

Using a 3.0-mm scheral shell we initially attempted to lift the skin of the eyelid away from the tumor (Figure 4). The original fabrication occupied both the superior and inferior fornices. During the initial treatment session, we found that the dose rate to the skin would be unacceptable high (Figure 5). Only partial treatment was completed. When the patient returned two weeks later, a 5.0-mm spacer occupying only the superior fornix was installed. Holes were drilled in the nasal and temporal margins of the scleral shell to allow for passage of bridle sutures (Figure 6). This procedure also prevented to scleral spacer from slipping out of the superior fornix (Figure 7). In addition to the bridle sutures, the patient was given a retrobulbar injection of 10 ml of 0.75% bupivacaine (Marcane). The injection immobilized the eye and also allowed the patient to tolerate the large scleral shell during the four hours needed to perform the magnetic resonance imaging (MRI) scan (Figure 8) required for the dosage calculations and then for the gama knife treatment itself. With the 5.0-mm spacer in place, the radiation dose to the skin of the eyelid was decreased to acceptable levels (Figure 9).

FIGURE 7. Bridle Sutures in place.

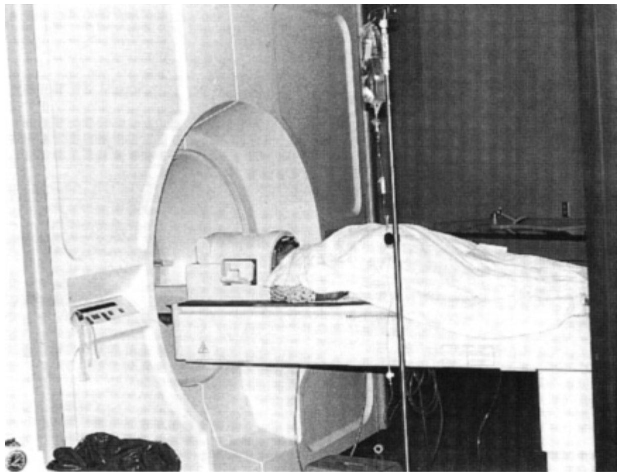

FIGURE 8. Head position of gamma knife patient entering MRI machine

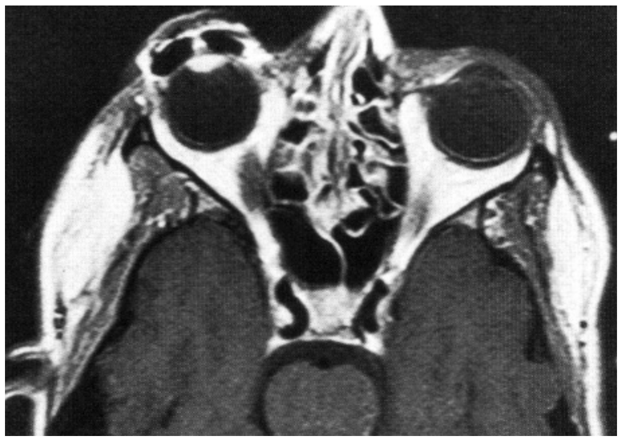

FIGURE 9 5.0-mm scleral shell positioned over anterior tumor of right eye.

The patient tolerated the treatment well; ocular side effects consisted only of conjunctival irritation. Based on experience with radiotherapy of only tumors, if the treatment had been successful, it may be 6 months to 24 months before a measurable change takes place in the tumor.

CONCLUSION

Gamma knife radiotherapy is a new and potentially useful method of treating ocular melanomas. As this case study demonstrates the possibility of skin damage needs to be considered in very anterior tumors. Ocularists can assist in preventing this damage with suitably fabricated devices, such as scleral shell spacer.

REFERENCES

1. EGA KM, Seddon JM, Glynn RJ, Gradoudas ES, Albert DM. Epidemiolocical aspects of uveal melanoma. Surv Ophthamol 1988; 32: 239-251.
2. Steiner L. Lindquist, C, Karlsson B, Guo W, and Steiner M. "Gamma knife radiosurgery in cerebral vascular malformations." In *New Trends in Management of Cerebro-Vascular Malformations*, ed. A. Pasqualin and R. Da Pian. Austria: Spinger-Vergla, 1994.
3. Leksell L. The sterotaxic method and radiosurgery of the brain. Acta Chir Stand 1951; 102: 316-319.
4. Chinela AB, Zambrano A, Bunge HJ, Antico JC, et al. "Gamma knife radiosurgery in uveal melanomas." In *Radiosurgery: Baseline and Trends* ed. L. Steiner. New York: Ravens Press, 1992
5. Marchini G, Babighian S, Tomazzoli L, Gerosa MA, Nicolato A et al. "Sterotactic radiosurgery of unveal melanomas: preliminary results with gamma knife treatment." Proceedings of the 1994 meeting of the Leksell Gamma Knife Society, Kyoto, Japan, May 8-11, 1994. Stereotactic Funct Neurosurg 1995; 64 (suppl 1): 72-79.

CORRESPONDENCE TO:

Michael O. Hughes, Ocularist
Artificial Eye Clinic
307 Maple Ave, Suite B
Vienna VA 22180-5607