

Radiation Safety Aspects for GammaTile Implant Brachytherapy

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INTRODUCTION

In this study the exposure rates and safety precautions following GammaTile brachytherapy implant for brain tumors were considered. Data from 13 patients were used to evaluate the exposure rates at 1 m from implanted cavity and doses received by the medical staff.

METHOD

GammaTile presents a modular structure that allows several tiles to be abutted to cover the resection cavity. GammaTile is a collagen tile (Saturable DuraGen Matrix, Integra Lifesciences, Plainsboro, NJ) containing four stranded titanium embedded Cs-131 (Model CS-1, Rev. 2) seeds (IsoRay Medical Inc., Richland, WA) (Figure 1a and 1b) and is permanently implanted in the resection cavity immediately after tumour resection (Figure 2).

This study prospectively analysed exposure rate for 13 patients who were treated with GammaTile. Exposure rates were measured immediately after implant at 1 m from the ipsilateral and contralateral sides of the resection cavity. Patient survey was performed using a calibrated Invision 451B (Fluke Biomedical, Everett, WA) ionization chamber survey meter. A G-M counter was used to survey the operating room after implant.

During the implant procedure, the neurosurgeon, radiation oncologist, and medical physicist wore dosimeter ring badges. Metal shielding tray is used for handling tiles during implant procedures (Figure 3). No additional personal shielding was used during surgery, although ALARA principles were utilized throughout the procedure.

A radiation safety officer was charged with educating nurses in the unit on how to care for implanted patients. For the first few patients, nurses wore body badge dosimeters in order to estimate doses received by the nursing staff. Patient release criteria from hospital included exposure rates below 6 mR/h at 1 m from the implanted site (1). Radiation safety procedures were reviewed with patients and their families upon release from hospital (2, 3).

RESULTS

Table 1 shows that immediately after the implantation, the mean, maximum, and minimum exposure rates at 1 m were: ipsilaterally: 1.83 mR/hr, 3.5 mR/hr, and 0.5 mR/hr, respectively; and contralaterally: 0.2 mR/hr, 0.5 mR/hr, and 0.1 mR/hr, respectively.

Ring badge dose equivalent readings integrated over two implant procedures for right and left hands were respectively: for neurosurgeon 0.97 mSv and 0.59 mSv, for radiation oncologist 0.45 mSv and 0.25 mSv, and for medical physicist 0.60 mSv and 0.55 mSv.

For nurses, body badge dose equivalent readings for a single patient over the entire hospital stay ranged from 0.01 mSv to 0.05 mSv.

The operating room was within background levels after the patient was sent to recovery. Finally, exposure rates for all patients were below 6 mR/h at 1 m from the resection cavity.



Figure 1a: Single GammaTile and 1b: Set of six pre-sterilized package of GammaTiles

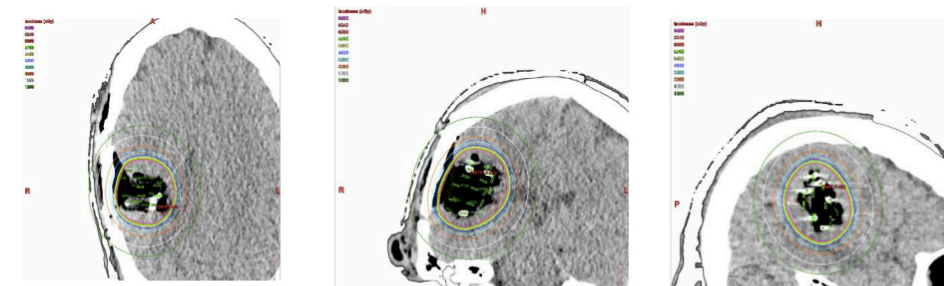


Figure 2: CT scan of implanted tiles and isodose lines at different planes (axial, coronal, sagittal)

Table 1: Mean, Median, Maximum and Minimum GammaTile parameters for 13 implanted patients:

| Parameter | Mean | Median | Maximum | Minimum |
|--------------------------------|------|--------|---------|---------|
| Ipsilateral at 1m (mR/hr) | 1.8 | 1.8 | 3.5 | 0.5 |
| Contralateral at 1m (mR/hr) | 0.2 | 0.2 | 0.5 | 0.1 |
| Activity per Seed (U) | 3.5 | 3.5 | 3.5 | 3.5 |
| Number of Tiles Implanted | 7.0 | 6.0 | 12.0 | 5.0 |
| Total Number of Seed Implanted | 26.9 | 24.0 | 48.0 | 14.0 |
| Total Activity (U) | 94.3 | 84.0 | 170.0 | 49.4 |

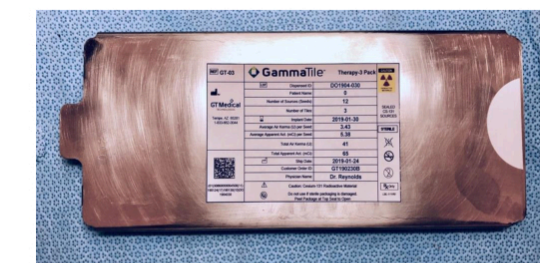


Figure 3: Metal shielding trays for handling tiles in the OR are provided by the vendor.

CONCLUSIONS

According to our clinical experience, the exposure from implanted GammaTile were at safe levels for healthcare professionals and for the general public. In addition, as exposure rates were below NUREG 1556 guidelines, and the radiation protection issues were very controllable during the immediate postoperative period and after discharge from the hospital. Moreover, based on the results of exposure rates and dose equivalent readings, Cs-131 tiles GammaTile therapy showed to provide radiation exposure below recommended limits to medical staff and family members.

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