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Technical Report

# Management of paranasal sinus metastasis by percutaneous CT-guided permanent seed brachytherapy

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**Abstract**

**Introduction:** A painful maxillary sinus metastasis in previously irradiated tissue required palliation.

**Methods and materials:** Lesion was treated by computed tomography–guided palladium103 implantation as an outpatient procedure; the lesion and its attendant facial pain and swelling resolved completely.

**Conclusion:** Computed tomography–guided permanent seed brachytherapy is a novel, rapid, effective, and low resource cost method of treating paranasal malignancy.





## Introduction

We describe the first reported case in the literature of a paranasal sinus malignancy treated with the unique technique of computed tomography (CT)-guided permanent seed brachytherapy. The patient is a 58-year-old white woman who had a transoral excision of a buccal extension of a parotid adenoid cystic carcinoma with positive margins. This was followed by 63 Gy external beam radiations over 35 days, including the parapharyngeal space and maxillary sinus up to the base of skull (completed January 2009). Multiple toxicities occurred, including trismus and dental decay.

Four years after the initial surgery, an adenoid cystic carcinoma metastasis presented in a maximally irradiated maxillary sinus by CT evaluation with painful swelling of the face. Biopsy-proven bilateral pulmonary metastasis appeared at that time as well. Two years later, biopsy-proven recurrence in the parotid bed was noted, with no further local therapy given because of the lack of local progression.

At that time, the patient received 6 cycles of pembrolizumab with no change in size of her pulmonary metastasis. In mid-2016, we saw her for the first time; 12 sites were implanted in bilateral lungs with regression/disappearance of implanted lesions.

At the end of 2016, she presented again and had 6 pulmonary sites implanted with good regression/disappearance of implanted lesions. At this admission, the right maxillary metastasis had become painful with facial swelling and was also implanted. Eight-month CT follow-up showed near-total lesion regression and resolution of facial swelling. The patient has reported total relief of facial pain as well. No skin changes were noted.

## Methods and materials

Our CT-guided outpatient permanent seed implant technique has been previously reported.[1]

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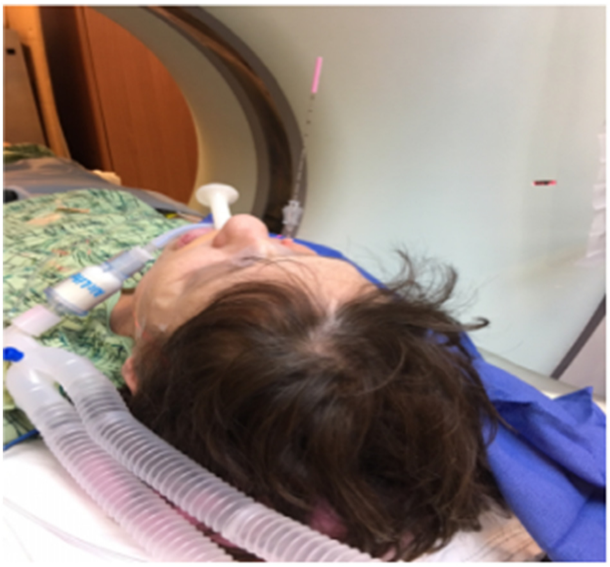

**Figure 1** Implant needle in place.

The patient was placed face up in the CT/fluoro scanner (Siemens Somatom) and given endotracheal general anesthesia because of her trismus (Fig 1). CT scanning was carried out, and images were reviewed by the lead author and interventional radiologist (IR) in the CT suite. The IR placed a single 13-gauge bone marrow biopsy needle under general anesthesia into the maxillary mass under CT fluoroscopic guidance. An 18 gauge prostate implant needle (Bard) was inserted through the biopsy needle and imaged. The lead author was at the couch-side during needle placement. The IR placed the tip at the distal edge of the lesion. Tip position was again reviewed with the lead author. A Mick applicator (Mick Radio-Nuclear Instruments) was attached, and 15 seeds of palladium$^{103}$, each containing 3.77 U, were implanted along the needle track (Fig 2). Intermittent CT-fluoroscopic imaging during the seed deposition was used to confirm seed positioning.

Preplanning of the implant had been carried out several days prior. A recent CT scan was imported into the planning system (MIM Symphony). The isocenter was selected and optimal needle angle determined. The clinical target volume was designated and 1- to 2-mm margins were expanded to create the planning target volume. Optic nerve, optic chiasm, retina, and lens doses were calculated. A standard planning template geometry was used to create an ideal implant. Planning was accomplished assuming needle parallelism with the understanding that intraoperative replication would be difficult. The planned minimum dose to the clinical target volume was 100 Gy. The maximal dose was disregarded because of the desire for achieving high intratumoral dose and the calculated negligible dose to sensitive structures.

The patient had postimplant CT scans for postimplant dosimetry calculation at the completion of the implant.

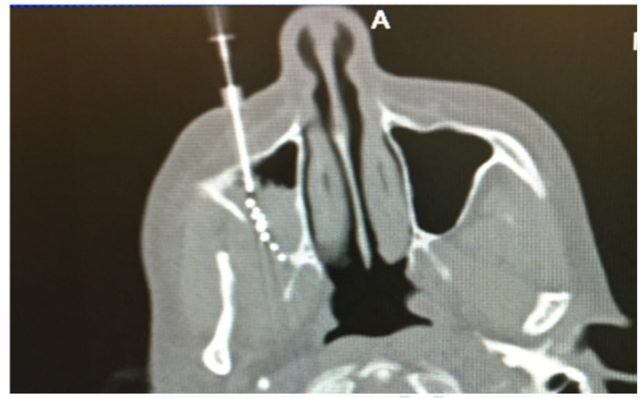


**Figure 2** Seeds deposited.

Further lung implants were performed, and the patient was sent to recovery and discharged home the same day.

Postimplant dosimetry was immediately performed showing a D90 of 92% (Fig 3). The dose to the right optic nerve and lens was 0 Gy. A follow-up CT scan 8 months later showed complete resolution of metastasis and facial swelling (Fig 4).

## Discussion

Three-dimensional conformal radiation therapy, intensity modulated radiation therapy, and proton therapies have been used to treat paranasal sinus malignancy. In this case, the presence of prior intensity modulated radiation therapy contraindicated further external beam radiations because of the concern for overdosing adjacent sensitive structures. Reirradiation of paranasal sinus recurrences with both photons and protons has been reported with significant grade 3-4 toxicities.[2–4] One-year survival after reirradiation was reported as 62%.[2]

High-dose-rate (HDR) brachytherapy using implanted catheters has been used as treatment for paranasal sinus cancers but requires a major surgical procedure and has attendant complications. The Ir$^{192}$ used in HDR brachytherapy has an energy of 380 kV, which is far more penetrating than the 21 kV energy of Pd$^{103}$. Additionally, HDR brachytherapy is costly and resource intensive, requiring a shielded room and a substantial coterie of personnel.[6]

We believe this is the first reported use of CT-directed permanent seed brachytherapy for paranasal sinus malignancy. Freehand permanent seed brachytherapy requires considerable prior experience with treatment planning, Mick applicator, seed placement, and real-time mental dose visualization. Close collaboration before and during the procedure with interventional radiology is essential for an optimal outcome. Extra seeds can be kept on hand in the event of suboptimal needle placement so that an additional needle pass and further seed placement can occur.

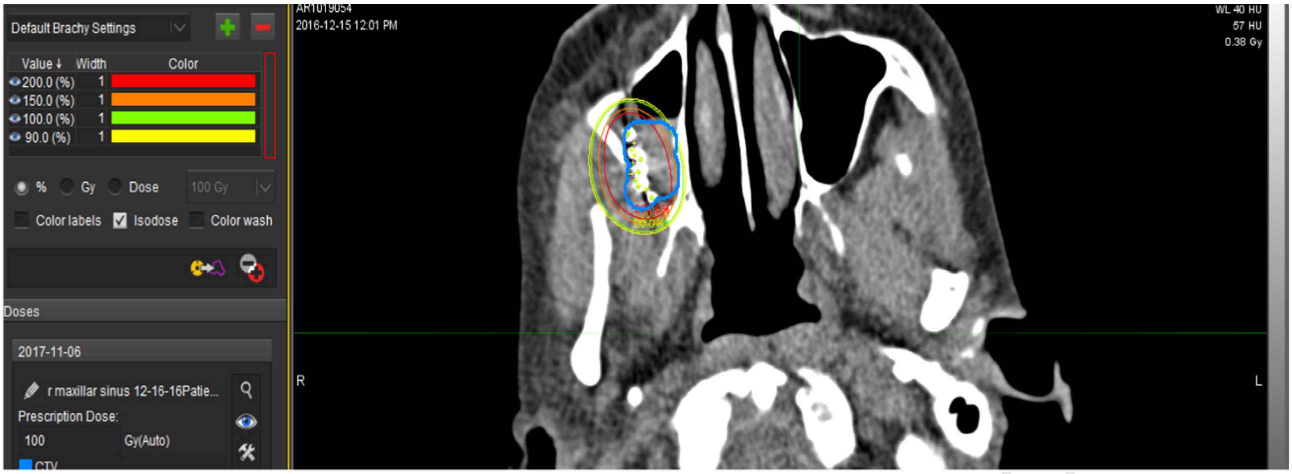


**Figure 3** Postimplant dosimetry.

**Figure 4** Eight months after implant.

CT-guided permanent seed brachytherapy can be used at any site in the upper aerodigestive tract; its low-energy 21-KV gamma rays penetrate minimally. This allows the accumulation of a high dose in the implanted tissue and a rapid falloff to closely abutting tissues. In this case, the ocular structures, optic nerve, and optic chiasm received essentially no dose from the implant.

The technique is not resource intensive, requiring only a CT fluoroscopic imaging device and facility for intravenous sedation or general anesthesia. It is cost effective compared with other forms of radiation therapy. CT-guided permanent seed brachytherapy is a safe and effective means of treating recurrent malignancies in the paranasal sinuses as well as other sites in the head and neck.

Our patient had complete resolution of CT-visualized mass and complete resolution of facial pain and swelling after palladium[103] implant. Further follow-up is warranted to document long-term local control and toxicity.

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