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DENTAL TECHNIQUE

# Fabrication of a custom brachytherapy appliance

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## ABSTRACT

This article reviews the prosthodontic and laboratory steps in the fabrication of a custom brachytherapy appliance. This technique is described through the treatment of a patient with recurrent orbital rhabdomyosarcoma. After a non–eyelid-sparing orbital exenteration of a 7-year-old boy, an impression of the orbital defect was captured to fabricate a custom brachytherapy appliance with mock catheters. One week later, the prosthesis was placed in the orbit, and the device was loaded with radiation catheters to deliver targeted radiation. The prosthesis was secured with Velcro straps fitted into slots made in the prosthesis and wrapped around the back of the patient's head. Brachytherapy appliances have been used to provide effective therapy for patients receiving care at Memorial Sloan Kettering Cancer Center. (J Prosthet Dent 2019;121:535-7)

Rhabdomyosarcoma is the most common soft tissue sarcoma of childhood, constituting 3% to 5% of all malignancies.[1] The mean age of diagnosis is 6.8 years, with rare but possible diagnosis in early adulthood.[2] The head and neck site accounts for 35% of all tumors, and 10% of rhabdomyosarcomas develop in the orbit. The prognosis for this malignant tumor is excellent, with greater than 85% of overall survival.[1] In patients who have recurrent orbital rhabdomyosarcoma and have received radiation and chemotherapy, additional surgery is necessary. However, operations can result in the inability to completely remove microscopic remnants of the tumor. In these situations, surgery combined with brachytherapy is a proven local treatment modality. The advantage of this combination therapy is the ability to remove disease and limit side effects.[2-5] Brachytherapy is an adjuvant cancer treatment where a high radiation dose is given near or within the tumor while reducing the radiation exposure in the adjacent healthy tissues.[1] Brachytherapy requires interdisciplinary care from the ophthalmologists, radiation oncologists, and maxillofacial prosthodontists. The purpose of this article was to review the prosthodontic and laboratory steps in the fabrication of a custom brachytherapy appliance.

## TECHNIQUE

1. For non–eyelid-sparing orbital exenteration (Fig. 1), capture an intraoperative impression. Block out undercuts within the orbit with Xeroform sterile petrolatum gauze. Mark the area with the most extensive disease based on preoperative imaging with marking pen. Inject polyvinylsiloxane impression material (Affinis; Coltène) into the orbital socket and around the orbit. Extend impression material to the surrounding areas of the orbit to provide additional surface area for the appliance to seat in the correct orientation (Fig. 2).
2. Pour the definitive cast in Type III gypsum (Denstone Golden; Kulzer GmbH) (Fig. 3).
3. Construct the brachytherapy appliance with base plate wax (TruWax; Dentsply Sirona) to the ideal contours on the definitive cast, including the wings.
4. Flask the appliance and process with a clear, heat-polymerizing polymethylmethacrylate (Microlon Denture Resin; Coltène) (Fig. 4).
5. Place a resin marker (Pattern Resin LS; GC America) in the superior-medial corner of the appliance as an orientation guide for proper placement.
6. Adhere mock catheters to the internal surface of the appliance with autopolymerizing methyl methacrylate resin (Pattern Resin LS; GC America). Place as

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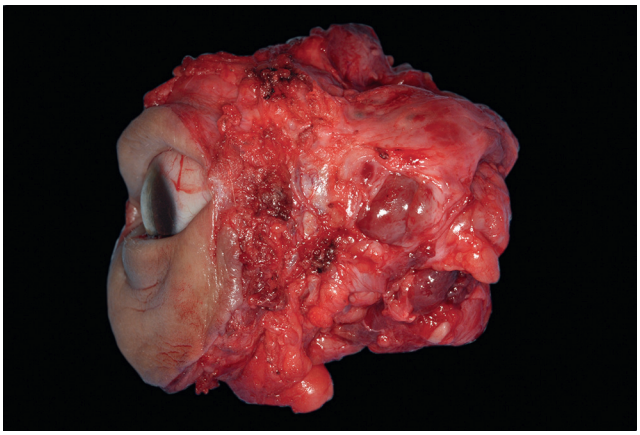

**Figure 1.** Specimen after non–eyelid-sparing orbital exenteration.

**Figure 2.** Polymerized full-extension polyvinyl siloxane impression.

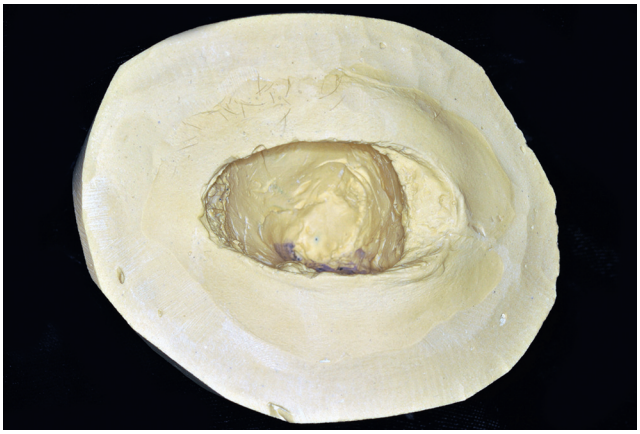

**Figure 3.** Definitive cast in Type III gypsum.

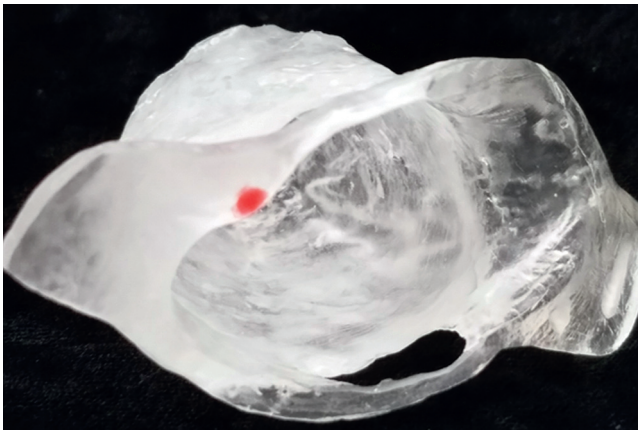

**Figure 4.** Clear, heat-polymerized polymethyl methacrylate appliance with colored resin orientation marker.

many catheters as possible approximately 5-mm apart, ensuring the catheters are not in contact with one another (Fig. 5).

7. Construct channels in the lateral wings for head straps to help retain the appliance.
8. Place the custom brachytherapy appliance into the orbit 1 week after the orbital exenteration (Fig. 6). Secure the appliance and deliver high-dose concentrated radiation to the tumor bed.

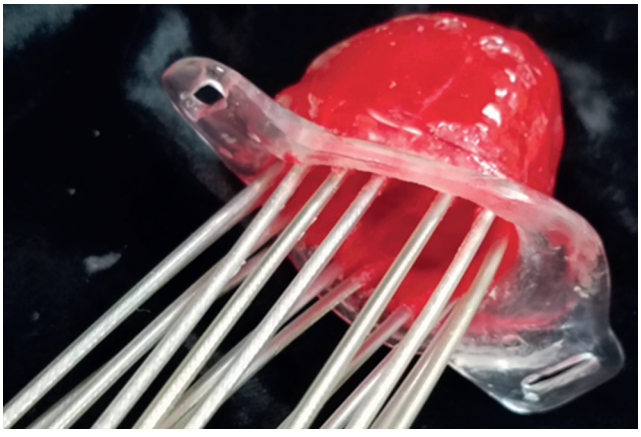

**Figure 5.** Mock catheters adhered to intaglio surface of appliance with autopolymerizing methyl methacrylate resin.

## DISCUSSION

Brachytherapy is a proven treatment modality to eliminate local disease. A computed tomography scan of the brachytherapy appliance in its proper orientation will aid in the generation of the radiation treatment plan. For this patient, high-dose-rate brachytherapy was delivered under general anesthesia. The plan was to deliver 28 and 21 Gray in 7 fractions at 0.2-cm depth from the surface with an iridium-192 source. The radiation was delivered over several minutes while being monitored from outside the operating room. The patient experienced minimal postradiation dermatitis. A definitive orbital prosthesis can be fabricated approximately 3 months after radiation treatment. Presently, there are no adequate alternatives (second-line chemotherapy, second course of radiation,

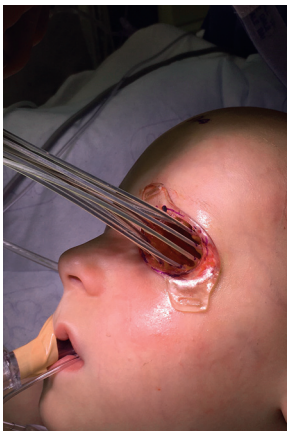

**Figure 6.** Custom brachytherapy appliance placed into orbit.

or surgery) to this technique. The advantage of this technique is that radiation can be delivered while avoiding healthy adjacent tissues and organs. The disadvantage of this technique is the inability to capture the full extent of the surgical defect due to anatomic undercuts. Digital scanning may improve the accuracy of this technique.

## SUMMARY

A custom brachytherapy appliance can be fabricated from an accurate intraoperative impression using conventional dental acrylic resin. The ink from the pen used to mark the area with the most extensive disease based on preoperative imaging transfers to the impression and to the definitive cast. Clear acrylic resin allows the provider to evaluate for pressure areas at the time of insertion. The lateral wings allow the prosthesis to be well secured around the patient's head. The primary advantage of this technique is that targeted high-dose radiation can be delivered to the areas of remnant disease while sparing adjacent anatomic structures.

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