SHORT COMMUNICATION

Workflow guide to delivering a safe breast treatment using a novel stereotactic radiation delivery system

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INTRODUCTION

The GammaPod (Xcision Medical Systems; Columbia, MD) is a breast-only stereotactic radiosurgery device. Its capabilities, commissioning, and use have been described previously.(1-8) The GammaPod is currently used for single-fraction boosts to the lumpectomy cavity and accelerated partial-breast irradiation (APBI). Similar to the GammaKnife, the GammaPod uses a large number of non-coplanar Co-60 beams to produce a sharp dose fall-off. This rapid dose fall-off along with its unique geometry and vacuum-assisted immobilization system enables the GammaPod to reduce the amount of heart and normal breast tissue treated. Previous studies have shown that the amount of normal tissue treated correlates with cosmetic outcomes (9). Initial clinical trial experience has shown encouraging results with the GammaPod comparing favorably to standard techniques such as brachytherapy and VMAT.(10)

The GammaPod workflow was initially developed by a team of physicians, physicists, nurses, and therapists. This workflow consists of patient selection, daily quality assurance (QA), breast cup fitting, CT imaging, treatment planning, and treatment.

Patient selection

For boost treatments: Patients undergoing a lumpectomy as part of breast-conserving therapy can be eligible for a GammaPod boost treatment. This includes women who have had neoadjuvant chemotherapy, adjuvant chemotherapy, or have early-stage or locally advanced disease. If the lumpectomy cavity cannot be easily visualized (unable to target) or is predominantly located in the axillary tail, then patients are not candidates for GammaPod treatment. For patients who appear to be borderline at the time of whole-breast simulation, appropriate patient education is provided regarding the possibility of providing the GammaPod boost.

APBI treatments: Patient selection for APBI follows the American Society for Radiation Oncology consensus guidelines.(9) Patients who fall in the cautionary category but are interested in partial-breast irradiation are counseled regarding the risks and benefits of partial-breast irradiation.

Pretreatment daily QA

QA is performed each day of treatment. The entire QA process takes 30 mins. The first step is the built-in...
daily QA procedure. This utilizes the vendor-supplied PodScope [Figure 1a)] to check the isocenter position [Figure 1b]), door, cup lock, pump, interrupt, and motion stop interlocks along with the timer and couch motion. The second step is an output measurement utilizing the vendor-supplied polymethylmethacrylate QA phantom and an ion chamber.

Cup fitting

The first step in patient treatment is cup fitting. The cup serves as both the immobilization and stereotactic coordinate system, much like the Gamma Knife frame and coordinate box. The cup system consists of a rigid outer cup with an embedded stereotactic wire, a semirigid inner cup that contacts the breast, and a flexible silicone flange that connects the 2 cups and attaches to the patient to create a vacuum seal. The outer cup comes in 2 diameters (medium and large), and the inner cup comes in the same 2 diameters with 10 depths. Patients are fitted with both inner and outer cups. The sizes of the cups are determined by the breast size. The outer cup size correlates with a woman’s chest width and/or bra band size, and the inner cup size correlates with the bra cup size (A, B, C, etc.). Once the cup is placed and the flange is attached to the skin with adhesive, the vacuum pump is attached and turned on. Any air leaks preventing a seal must be addressed and may necessitate refitting. The fitting takes 10–20 mins on the first day and 5 min on subsequent days.

CT imaging

Once fitted with the cup, the patient steps up onto the image loader [Figure 1c]) and the breast cup is fitted into the loader and locked into place [Figure 2b)]. The therapists lower the image loader along with the patient onto the CT table. A CT scan is performed with 1-mm slice thickness. The scan is sent to both the GammaPod treatment planning system and the system used for contouring (if applicable).

Treatment planning

Treatment planning in the GammaPod system is similar to the Gamma Knife, with distinct differences. The user imports the CT and registers the stereotactic coordinate system as done in the box in the GammaKnife. Unlike the Gamma Knife, the GammaPod solely uses inverse planning; therefore, contours must be created. Once the contours are created, the dose prescription and OAR constraints are entered and the optimization is performed. After optimization, the plan is reviewed and exported to the treatment unit. It is important to note that GammaPod produces a homogeneous dose distribution that is prescribed to the 95% isodose line with hotspots on the order of 10%, whereas the Gamma Knife is routinely prescribed to the 50% isodose line with hotspots of 100% and a very inhomogeneous dose distribution.

Time required for the GammaPod optimization varies with the size of the planning target volume (PTV). The larger the PTV, the longer the optimization. For example, a PTV on the order of 50 cc takes 5 min to optimize, whereas a PTV >200 cc can take >20 min.

Treatment

Once the plan is ready, the patient steps onto the patient loader and is loaded on the machine. If vacuum pressure in the cup is lost at any time the patient must return to CT and

Figure 1. a) PodScope for daily QA. b) Isocenter testing c) CT image loader in patient loading position.
start the process over again. The length of the treatment will depend on the size and location of the PTV; the larger the PTV and the deeper the tumor, the longer the time. The age (decay) of the sources also contributes to the time. With a dose rate of 3.0 Gy/min, a treatment prescribed to 8 Gy will take around 10–15 min for a target between 50 and 100 cc. For targets >200 cc, treatment times can be 30 min.

SUMMARY

We have described the daily workflow of the GammaPod program with estimates of times for each step (Table 1). Similar to the Gamma Knife the entire multi-disciplinary team must be involved to create and sustain a high-quality program.

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