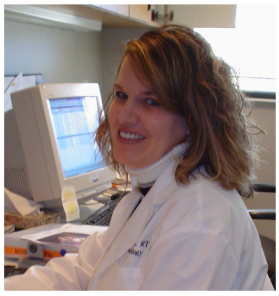
Solid IMRT Case Study



Site: Radiation Oncology Resources (McMinnville, OR)

IMRT Planner: Victoria LaCerba, M.S., CMD, RT(T)

Linear Accelerator: Siemens Mevatron 67 (6 MV)

Treatment Planning System: Pinnacle v7.6c

Solid IMRT: .decimal 3" brass, .decimal p.d v2.1

IMRT Planning Goals

The physician prescribed two target volumes, the right breast PTV (45 Gy) and expanded seroma (50 Gy, concurrent) in 25 fractions. This patient had a very large breast volume, making it difficult to balance dose coverage/uniformity with avoidance of high skin and lung dose In particular, clinicians paid special attention to minimizing skin damage in order to avoid cosmetic ramifications. Additionally, the max dose to the heart was to be as low as possible, with a goal of 10 Gy or less. Normally, a V20 optimization goal is ~5%, but for this patient's anatomy, this was too ambitious; instead, the V20 to the right breast was to be minimized as much as possible given the target goals.

Plan Results: Initial (with "Hot Spot") and Final (Decreased "Hot Spot")

5 beams were used, and a rare AP was added to boost the smaller target volume from an angle that would not add to skin dose from the lateral and medial beams. The initial plan was optimized, then breast modulators were designed in p.d and imported back to Pinnacle. This initial solid IMRT plan matched the optimized doses very well with one exception – a hot spot of 56.05 Gy (12% over the 50 Gy prescription, or 25% over 45 Gy). This was unsatisfactory, as the clinicians were wary of permanent cosmetic effects.

Because there was a difference between the optimized plan hot spot and the final solid IMRT plan hot spot, Mrs. LaCerba contacted .decimal support. She wanted to know if there was anything she could do to hold the excellent target coverage of the plan but reduce the hot spot magnitude and volume.

.decimal support first analyzed the situation to find the cause of the hot spot. In this case, it was found that for some of the Pinnacle ODMs (optimized density matrices) were putting a lot of transmission through small "pixels" in the beam's-eye-views. These islands of high fluence were getting enlarged in the p.d software. Why? Because for this setup, the tray distance of the modulator was small, around 41.9 cm, and in order to effectively mill this deep, steep valley, the BEV area had to be enlarged. This is part of the "special sauce" of the p.d software that tried to optimize the mill-ability of complex fields.

.decimal gave Mrs. LaCerba two viable options to decrease these islands of dose: 1) Turn the special sauce off to avoid growing the island in the BEV; or 2) edit the few pixels of the original ODMs to reduce the magnitude of the islands. As it turns out, both methods worked to reduce the hot spot volume and magnitude.

In this case, the 2nd method was employed to produce the final plan. The small changes in the ODM pixels are shown in Figure 1. The hot spot max was reduced to 54.48 Gy (9.0% over the 50 Gy prescription, or 21% over 45 Gy), but more importantly, the hot spot volume was reduced. See Figure 2 for the visual decrease in hot spot volume. The DVHs in Figure 3 also illustrate the reduced hot spot volume (at the upper tail end of the red PTV curves).

All in all, this was a very challenging plan that required clinical trade-offs and complex solid IMRT devices (see Figure 4). However, the large breast volume, multiple target volumes, and difficult planning objectives, combined with the interaction between the customer and .decimal staff, make it an interesting case study.

After all, we learn the most when the plans are difficult rather than easy, do we not?

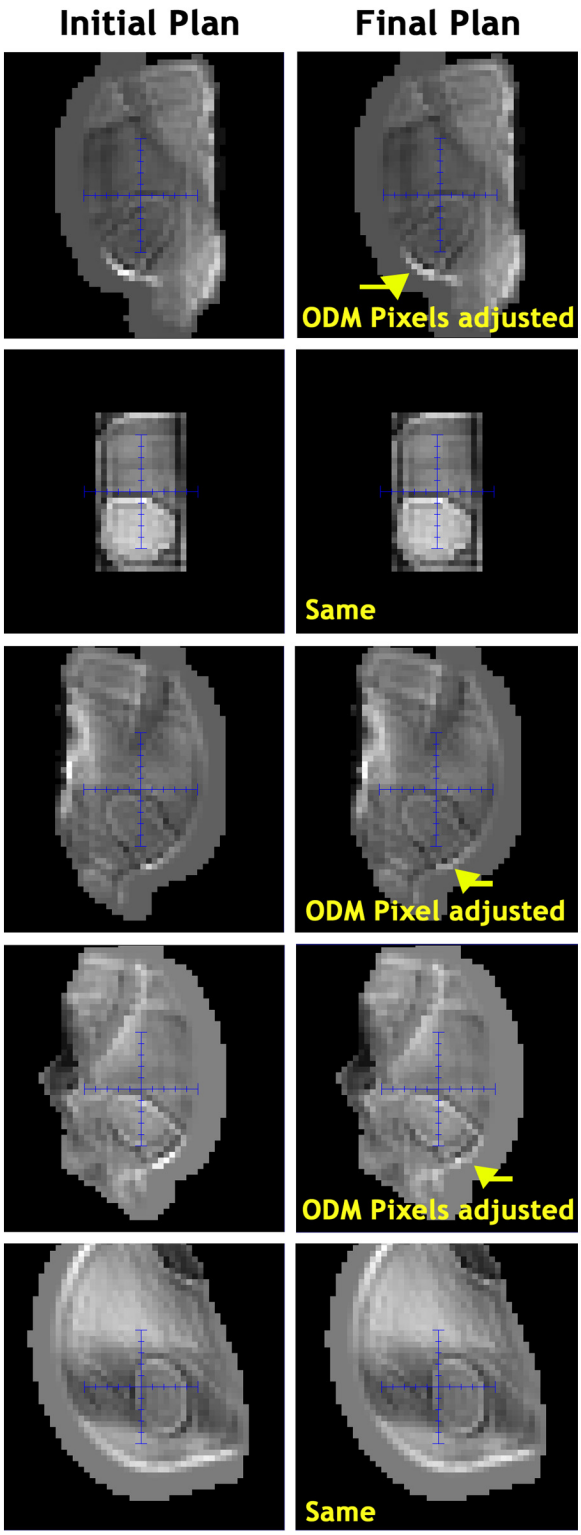


Figure 1. Minor adjustments to Pinnacle ODM files.

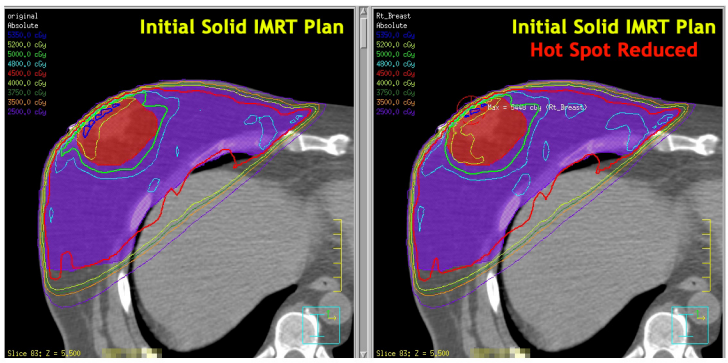


Figure 2. Initial (left panel) and final (right panel) hot spot volumes.

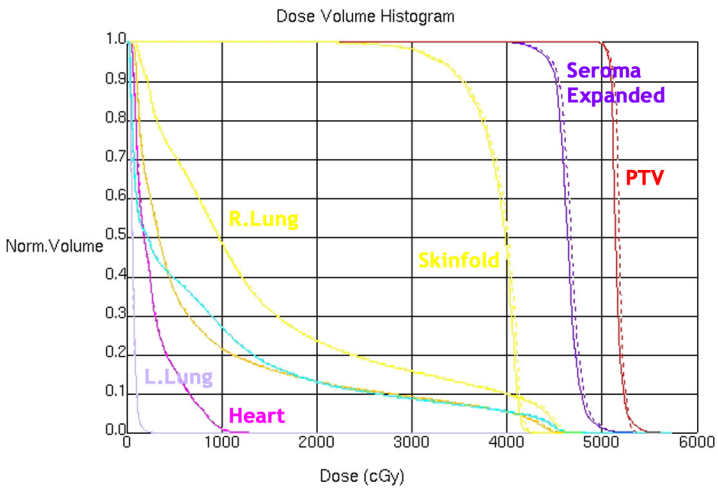


Figure 3. DVH. Initlal (solid curves) and final (dashed curves).