EASTERN MAINE MEDICAL CENTER
EMHS MEMBER

Cancer Care

Evaluate Robustness of dose inhomogeneity in Hypo-Fractionated Planned Breast using RayStation's Perturbed Dose Function.

Jason Metzger, B.S., RT(T), CMD

Department of Radiation Oncology, Eastern Maine Medical System, Bangor ME

Introduction

- Hypo-fractionation for whole breast irradiation is becoming more prevalent in radiation oncology.
- Hypo-fractionation has been proven to be convenient, practical, and therapeutically equivalent to conventional fractionation schemes for select patient populations.
- The primary side effect of skin toxicity has been directly linked to the global maximum dose of hypo-fractionated treatment plans.
- Large volumes of higher dose inhomogeneity are associated with an increase in secondary cosmetic side effects such as breast fibrosis and induration.
- Plans often use field in fields to limit dose inhomogeneity.

Methods

- 10 patients with clinically approved hypo-fractionated plans were selected and analyzed. 266cGy x 16fx's = 4256cGy
- These patients were treated on Varian linear accelerators. They were planned with RayStation 5.0.2.
- The treatment delivery was performed with tangential fields with sub field-in-fields, using 6MV and 10MV energies.
- The plans were computed with RayStation's perturbed dose function to evaluate a given know setup error. 1cm distance was used to calculate dose offset from its original planned state. These offsets were: X+1, X-1, Y+1, Y-1, Z+1, and Z-1.
- Three elements were analyzed to evaluate a plan's robustness: the global maximum dose (cGy), the volume (cm3) receiving 107% of the prescription dose and the volume (cm3) receiving 105% of the prescription dose.

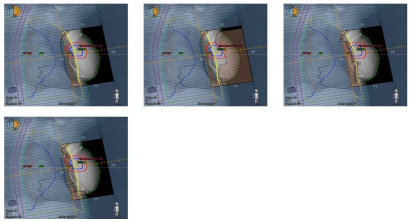
Results

1. Global hot spots averaged 2.5% higher than planned in one-directional shifts with a high of 15%.
2. Volumes of 107% inhomogeneity increased up to 36%.
3. Volumes of 105% inhomogeneity increased up to 49%.
4. Simulated state is perturbed by modest shifts.

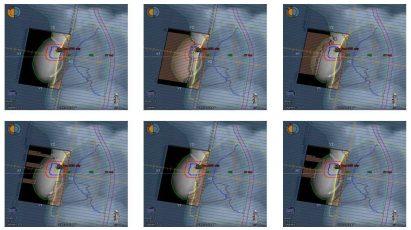
Typical field in field to decrease dose inhomogeneity

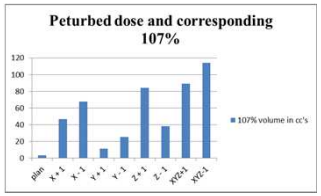
(Plans in study averaged 7.1 total fields per plan, with fewest 6 most 12

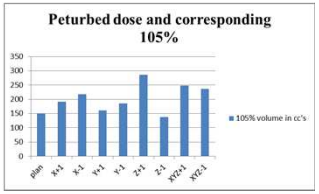
Medial beam

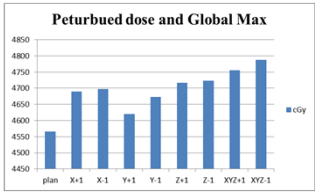


Lateral beam



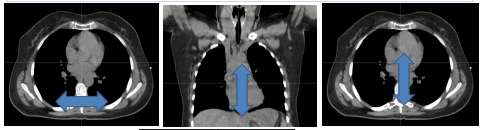


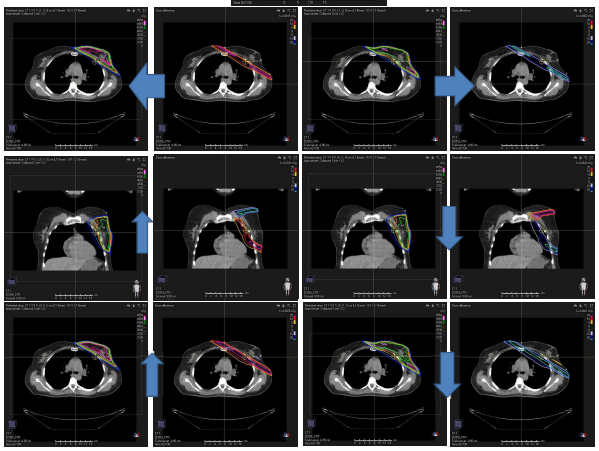




Data set shift

RT X+1 : LT X–1 **IN Y+1 : OUT Y-1** **DOWN Z+1 : UP Z-1**





Conclusion

- It is imperative that people enrolled in hypo-fractionation breast treatments are able to be setup in an accurate and reproducible manner.
- Since these plans are highly leveraged, small geometry variances can lead to larger than desired dose inhomogeneity and thus, potentially, higher rates of sequelae.
- A department's approach to breast irradiation setups should consider image guidance and be stringent to eliminate variance, i.e. distance itself from a, "pseudo-clinical," set-up.
- Utilize breast shape and tissue densities with separation for hypo-fractionation selection.
- Analyze field in field complexity
- Possibly employ perturbed dose along with port films to quantify unexpected skin side effects.

 jmetzger@EMHS.org