Depth – dose volume – target volume in IOeRT

Markus Stana, Klarissa Ellmauer, Sara Vockner, Ivan Messner, Gerd Fastner, Christoph Gaisberger and Falk Röder

Department of Radiation Therapy and Radiation Oncology, Paracelsus Medical University, Müllner Hauptstrasse 48, 5020 Salzburg, Austria

1. Purpose/Objective

According to the DEGRO practical guideline for partial-breast irradiation 2020 the target volume for APBI with IOeRT has to encompass at least 20mm in any direction with the exception of the skin and the chest wall and the relevant target volume thickness is to be assessed at one or more representative points [1]. A similar proceeding, irradiating 2cm of tissue around the tumor considering resection margins, could be appropriate for all entities treatable with IORT. Even though defining the exact geometry of an estimated tumor bed is not feasible in the IORT workflow, it is possible to calculate the size of the target volume dependent on the tumor size. This, in turn is comparable to the size of a certain isodose volume (i.e. the 90% isodose). Different approaches can be made to calculate this isodose volume, which depend on measurements of tissue depth information.

2. Material/Methods

A recent master thesis [2] compared different ways to obtain tissue depth information in the IOeRT setting. Established methods like needle probe and intraoperative ultrasound as well as measurements on selected slices obtained with a mobile cone beam CT were compared. Additionally these measurements were checked against the results of a specifically designed algorithm analyzing all relevant depths in the entire 3D dataset provided by the CBCT.

Different ways of determining the tissue volume encompassed by the 90% isodose, including preliminary dose calculations on CBCT datasets were compared for 117 patients treated with IOeRT Mamma Boost. Simple geometrical considerations were undertaken to find the target volume for different tumor sizes.

3. Results

Tissue depth considerations are often strongly influenced by the distance to the limiting organ at risk. A preliminary analysis of ten patients revealed that different measurement methods lead to differences in the identification of tissue depth information relevant to dose planning [2].

Simple geometrical calculations can rule out certain setups for IOeRT, i.e. small tube diameters, as the tissue volume encompassed by a certain isodose has to be at least as large as the ideal target volume.

4. Conclusion

Even though it is not yet possible to use CBCT data to generate a 3D voxel based patient model for dose planning as in other fields of radiotherapy due to remaining uncertainties, the geometrical information attained is very valuable. This is not only true for tube placement but also for the determination of target volume and respectively for dose planning.

The size of the target volume and the size of the tissue volume encompassed by a certain isodose should be considered as vital parameters for dose planning.

5. References

[1] Strnad, V., Krug, D., Sedlmayer, F. et al. DEGRO practical guideline for partial-breast irradiation. Strahlenther Onkol 196, 749–763 (2020). https://doi.org/10.1007/s00066-020-01613-z

[2] Ellmauer K. (2024) Assessing the Benefits of 3D Imaging for Intraoperative Electron Radiotherapy (IOERT): A Quantitative Comparison of Geometrical Information in Breast Cancer Treatment