Dosimetric impact of an MR-suitable breast tissue expander for breast radiotherapy

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Einleitung

Breast tissue expanders (TE) are used to prepare breast cancer patients for a reconstruction with an implant after mastectomy. TEs have typically access ports with a dense magnetic base (used for TE location) to allow for gradual volume expansion. When radiotherapy is indicated after mastectomy, the high-density structures within the TE are unfavourable for radiotherapy dose calculation. In this work, we investigated the dosimetric impact of an MR-suitable (i.e. conditional) TE with a radiofrequency identification (RFID) port.

Material und Methode

The TE (Motiva Flora, Establishment Labs) consists of a silicone shell, a port of polyetheretherketone (PEEK), and the RFID of copper wire [1]. The TE (345cm3) was filled with 313cm3 of NaCl-solution, placed on the chest of an Alderson Rando phantom and covered with a 5mm bolus (Superflab, GS Plastics). A CT scan was performed with the clinical protocol for breast (120kV, 3mm slice thickness) and metal artefact reduction (iMAR, pace maker) on a Siemens Somatom go.Open Pro. A tangent plan with 6MV fields and physical wedges was created in Varian Eclipse 15.6 (AAA 15.6) using an extended CT calibration curve without overwriting the dense areas inside the expander. For the dose measurements MOSFETs (mobileMOSFET, BEST Medical Canada) were placed in seven different locations, where we would expect an impact of the TE:
1) mammilla level above the port,
2) medial at the mamilla and port level,
3) medial at the mamilla and port level of the densest material,
4) lateral at the mamilla and port level,
5) lateral at the mamilla and port level of the densest material,

6) lateral at the maximum expansion of the TE all underneath the bolus and at the
7) chest wall centrally underneath the TE.
The phantom was set up with a CBCT at the Varian Truebeam linear accelerator. The CBCT and the planning CT were registered. The doses calculated at the points of the MOSFETS and measured doses were compared to evaluate the dosimetric impact of the TE.

Resultate

The measured doses were 1.1%, 1.7%, 7.0%, 2.2%, 4.2% and 5.0% higher than the planned doses at the 1) mammilla level above the port, 2) medial at the mamilla and port level, 3) medial at the mamilla and port level of the densest material, 4) lateral at the mamilla and port level, 5) lateral at the mamilla and port level of the densest material, 6) lateral at the maximum expansion of the TE, respectively. At the 7) chest wall centrally underneath the TE the measured dose was 3.0% lower than the planned dose.

Diskussion

We found that the impact of the TE is acceptable for breast tangent radiotherapy. The densest material within the expander (i.e. the port's base) is surrounded by sufficient material of the expander itself and does not alter the dose to a clinically significant level. Limitations of this study are the finite number of measurement points and the measurements in the build-up region underneath the bolus, where we decided for a realistic tissue thickness.

[1] Breast Tissue Expander With Radiofrequency Identification Port: Assessment of MRI Issues. M Bayasgalan, A M Munhoz, and F G Shellock, American Journal of Roentgenology 2020 215:1, 159-164