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Intraoperative radiotherapy (IORT) as a boost for breast cancer: Evaluation of the Radiance® Planning System and correlation of clinical data for fibrosis

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Breast conserving surgery (BCS) and sentinel lymph node biopsy (SLN) have been the major surgical management of early breast cancer recently. Postoperative breast radiotherapy to the breast and the tumour bed is regarded as an essential adjuvant therapy to BCS and cannot be safely omitted. Intraoperative radiotherapy (IORT) is a convenient and effective treatment for some breast cancer patients. IORT as a boost followed by conventional external radiotherapy has less radiation-induced fibrosis than whole breast radiotherapy, but the percentage of higher-grade fibrosis (II°-III°) still ranges between 25 -38% after IORT as a boost. Currently, it is not possible to plan the radiation therapy process beforehand for IORT. Radiance® planning System is a new simulation and planning tool for IORT. It can be used as a treatment-simulation tool for dosimetry estimations, dose distribution and documentation of the treatment of patients with breast cancer. The purpose of this project is to validate the planning software Radiance® System for IORT boost patients by creating dose-volumehistograms for the skin at risk and to find the affecting factors for fibrosis after IORT as a boost. 42 cases were enrolled into replanning and analysis and distributed into two groups: 14 cases with fibrosis in group A and 28 cases without fibrosis in group B. The two groups were extremely similar in basic patient characteristics ($p>0.1$). The replanning data including breast volume, seroma volume, skin volume, skin dose, applicator size and 50% dose-volume were planned successfully using Radiance® System. Univariate and multivariate analyses were done for the patients' basic characteristic, radiotherapy data and replanning data. In the univariate analysis, seroma volume and skin volume were associated with a trend towards the risk of fibrosis ($p<0.1$), whereas applicator size and 50% dose-volume were significantly associated with higher grade fibrosis. In the multivariate analysis, the independent prognostic factor for fibrosis was the applicator size ($p=0.0565$, OR 3.85, 95%CI 0.963 -15.384). Therefore, an increase of the applicator size of 1cm increased the risk of fibrosis 3.85 times. The results suggest that excessive expansion of the clear margin during breast conserving surgery will obviously increase the risk for fibrosis after intraoperative radiotherapy. Secondly, the planning software Radiance® system was validated and can be used as an evaluation and documentation tool for post-planning of IORT for breast cancer.