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# Identifying predictors of implant loss in immediate breast reconstruction: integrating surgical and dosimetric factors in a large-scale study

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**Objective:** This study aimed to identify surgical and dosimetric predictors of implant loss and establish safety constraints for patients undergoing immediate implant-based breast reconstruction with postoperative radiotherapy. **Methods:** This retrospective cohort study included 292 patients who underwent immediate implant-based breast reconstruction followed by postoperative radiotherapy between 2010 and 2022. Surgical techniques and radiotherapy protocols were assessed. Radiotherapy dosimetry focused on dose distribution within a 1 cm annular volume around the implant inside the Clinical Target Volume. Statistical analysis included chi-square, log-rank, and multivariate tests. **Results:** All patients received postoperative radiotherapy at 50 Gy in 25 fractions. The implant loss rate was 13%. Univariate analysis showed a significant association between implant loss and postoperative complications, surgical reintervention, and clinical N staging ( $p=0.016$ ). Logistic regression identified postoperative complications (odds ratio [OR] 2.46;  $p=0.012$ ) and surgical reintervention (OR 3.51;  $p=0.007$ ) as independent predictors of implant loss. Among complications, seroma was significant (OR 2.71;  $p=0.042$ ). Anatomical placement significantly impacted loss rates, with 26% failure in prepectoral *vs.* 12% in subpectoral placement (OR 2.46;  $p=0.035$ ). Dosimetric analysis showed correlation between implant loss and prosthesis volume receiving  $\geq 108\%$  of the prescribed dose ( $p=0.048$ ) and the 1 cm periprosthetic annular volume receiving  $\geq 108\%$  ( $p=0.004$ ). Receiver operating characteristic (ROC) curve analysis identified a threshold of 4.57 cc for V108% in the annular region (area under the ROC curve=0.6459, sensitivity=0.70, specificity=0.57). Spearman's correlation showed a strong positive correlation between V108% in the prosthesis and the annular region ( $\rho=0.682$ ). **Conclusion:** Postoperative complications, surgical reintervention, and implant anatomical placement were independent predictors of implant failure. Dosimetric analysis showed that a V108% in the periprosthetic ring exceeding 4.57 cc increased the risk of implant loss, suggesting this as a valuable dosimetric constraint. These findings support more effective and safer treatment strategies, potentially transforming clinical practice.

**Keywords:** breast reconstruction; breast implants; radiotherapy, adjuvant.