REFLECT: Radiomic Evaluation For the Localisation of the Excision Cavity using Tomography

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Introduction

In breast-conserving radiotherapy planning, accurate delineation of the surgical cavity is critical but challenging due to poor contrast between the cavity and surrounding breast tissue on CT. Manual contouring remains the standard, but it is time-consuming and subject to interobserver variability. Automated segmentation using deep learning could improve both efficiency and consistency.

Methods and Materials

We retrospectively analyzed 63 patients with axial CT scans (1.5 mm slice thickness) after lumpectomy. Data were split into training (60%) and validation (40%). We implemented a 3D U-Net with attention blocks and deep supervision, trained with a combined loss and extensive data augmentation. Voxels corresponding to surgical clips were excluded during training to reduce metal artifacts. As a baseline, a radiomics-based method using intensity thresholds and texture features was developed. Performance was evaluated against manual contours (ground truth) using Dice similarity coefficient (DSC) and 95th percentile Hausdorff distance (HD95).

General Pipeline Architecture

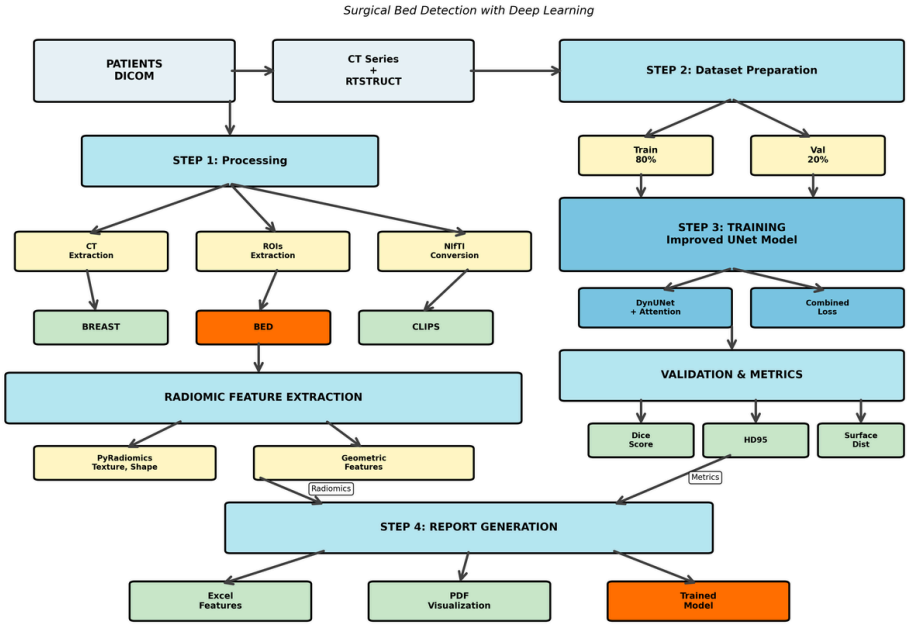


Figure 1. General pipeline architecture

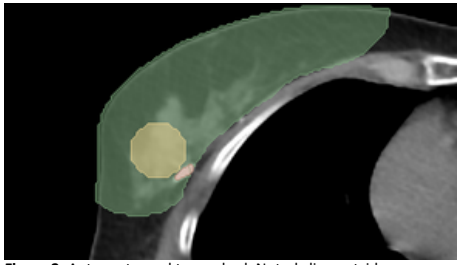


Figure 2. Autocontoured tumor bed. Noted clips outside.

Results

The deep learning model achieved a mean DSC of 0.80 ± 0.07 (range 0.70–0.90), significantly higher than the radiomics approach (0.68 ± 0.09; p = 0.01). The mean HD95 was 9.8 mm, with outliers up to 15 mm, compared to 13.5 mm for the radiomics baseline (p = 0.04). Qualitatively, the neural network performed better in irregular and poorly defined cavities, showing closer agreement with expert delineations.

Conclusions

The achieved Dice scores (~0.8) are consistent with state-of-the-art reports. Although further optimization and larger multicenter validation are required, the method shows clear potential to accelerate radiotherapy planning and reduce interobserver variability.

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