MRI Delineation of Tumour Bed for Partial Breast Irradiation: Fusion/Comparison with CT/Titanium Clip-based Method

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Introduction: A standard method of tumour bed (TB) delineation for partial-breast irradiation (PBI) involves outlining titanium clips and architectural abnormalities on CT images. Uncertainties remain regarding delineation of TB/normal tissue interface between clips. MRI offers greater soft-tissue contrast. We investigated whether MRI adds information leading to changes in CT/clip-defined target volumes, and evaluated the clinical significance of differences.

Methods: 30 women with breast invasive ductal carcinoma/DCIS underwent lumpectomy during which 6e12 titanium clips were secured in the four radial, anterior and deep excision margins of the TB. Patients underwent CT imaging and MRI in the same prone position. 3D-MRI datasets (T1-weighted [standard and fat-suppressed] and T2-weighted) were co-registered with CT data (matched using clips). TB was delineated separately on CT, MR, and fused MR-CT datasets. Clinical (CTV) (TB + 15 mm) and planning target volumes (PTV) (CTV + 10 mm) were generated. The primary endpoint was conformity index (CI) between CT and fused-MRCT TB (volume of agreement divided by total delineated volume [volumetotal]). DiscordanceCT was defined as percentage of volumetotal missed by CT, and discordanceMRCT as percentage of volumetotal missed by MRCT. Partial-breast dose distributions were generated for CT/clip-CTV, and percentage of MRCT-CTV receiving 095% of isocentre dose.

Results: Median CT/clip and MRCT-TB volumes were 5.7 cm3 and 9.7 cm3, respectively (mean percentage volume increase ¼ 55.1%). Mean CIs for CT vs MR were 0.54 (TB), 0.84 (CTV) and 0.89 (PTV). For CT vs MRCT TB, discordanceCT (i.e. geographical miss of seroma/haemorrhage seen on MR) was 37.1%. DiscordanceMRCT (i.e. inappropriate inclusion of normal breast tissue on CT) was 9.2%. Median coverage of CT/clip-CTV by 95% isodose was 97.1% (30/30 CTV covered). Median coverage of MRCT-CTV was 96.5%. 4/30 MRCT-CTV were inadequately covered (worst coverage ¼ 89.0%).

Conclusions: Addition of MR to CT/clip data increases TB volume by identifying additional seroma/haemorrhage. TB discordance rarely translates into clinically significant differences in CTV/PTV. CT/clip-based PBI plans adequately cover MRCT-defined target volumes in most cases. CT/clip-based TB delineation should remain the current standard for PBI.