MR-Guided Breast Radiotherapy and the Magnetic Field's Impact on Skin Dose

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BACKGROUND

Electron Streaming Effect: Electrons leaving the patient are redirected by the magnetic field, altering the dose distribution outside the target.

Electron Return Effect: At tissue–air and chest wall–lung interfaces, electrons spiral back into the tissue, increasing the local dose

Clinical Implication: Higher skin dose leads to more acute skin reactions.

OBJECTIVE

PRIMARY OBJECTIVE

To Evaluate the Impact of A 1.5 T Magnetic Field on Skin Dose during Whole-breast Irradiation (WBI)

SECONDARY OBJECTIVES

PTV

95% of PTV received 95% dose

Ipsilateral lung

V8 Gy less than 15%

Heart

V1·5 Gy less than 30%

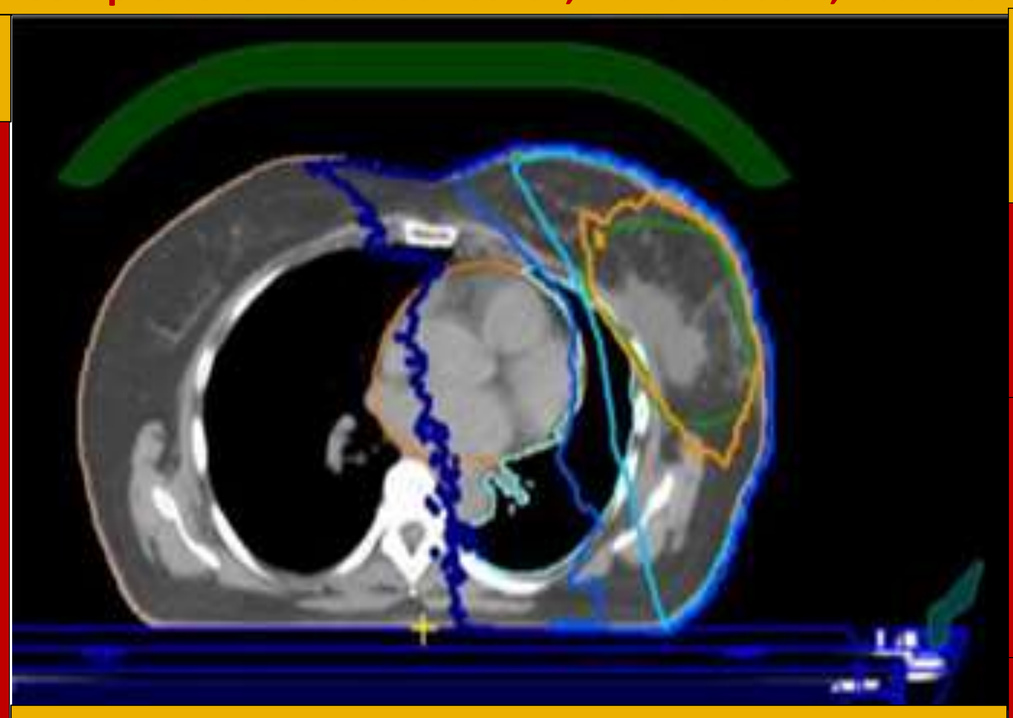
V7 Gy less than 5%

Acute Skin Toxicity

Grade 1 Dermatitis

METHODOLOGY

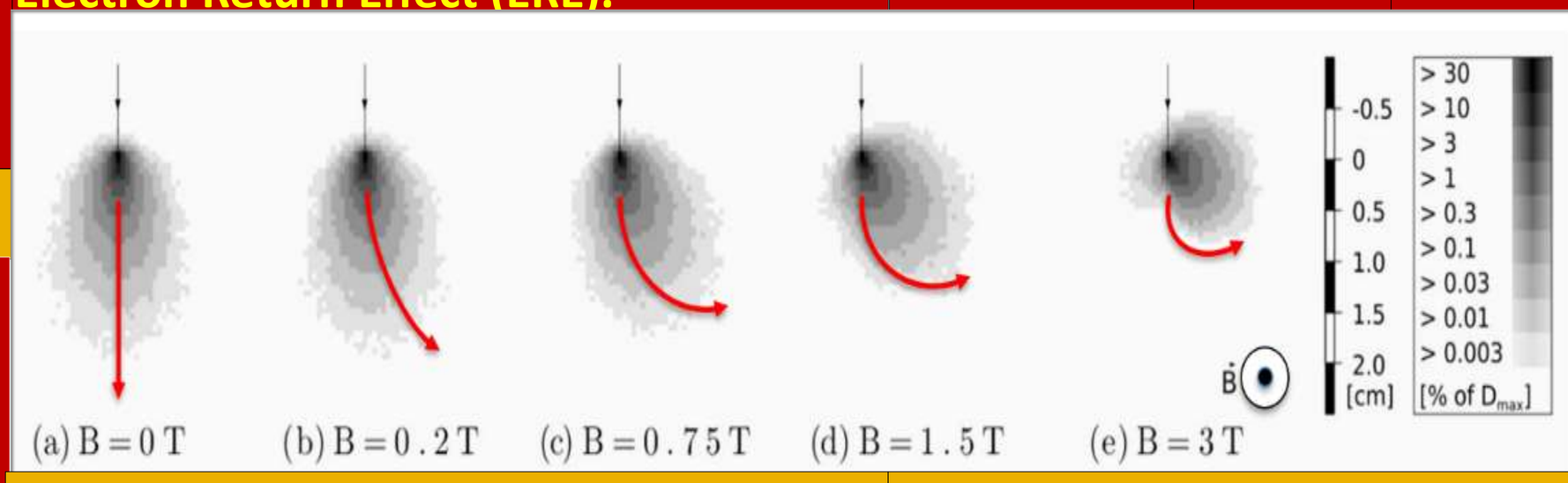
This was a retrospective study which involved 50 WBI plans diagnosed with Ca Breast. The treatment planning was performed using a Monte Carlo–based MR-LINAC treatment planning system. An ultra-hypofractionation schedule was used, delivering a total dose of 2600 cGy in 5 fractions at 520 cGy per fraction. For planning, the skin structure was defined as the first 5 mm beneath the surface, and dose measurements were taken with and without the MR field. Statistical analysis was carried out using a paired t-test to compare dosimetric results on and off the MR field. Inclusion criteria included patients who had undergone breast-conserving surgery, with T1–T2 tumour size and N0 nodal involvement. Exclusion criteria included patients who received regional nodal irradiation, those who underwent mastectomy, and patients with metal implants or devices causing MRI artifacts.



RESULTS

A comparison of whole breast irradiation (WBI) plans was performed between 0T and 1.5T magnetic field settings.Target coverage (PTV) was comparable between both settings.The ipsilateral lung dose remained similar at 1.5T, and heart dose showed minimal, clinically insignificant changes.The contralateral breast dose remained stable across both settings. However, the skin dose was noticeably higher at 1.5T, which was attributed to the Electron Return Effect (ERE).

Dose	0 T	1.5 T
PTV	95.9%	96.1
I.Lung V10Gy %	36	36.6
Heart V25Gy %	3.4	3.2
Cl Breast Mean	3.3	3.2
Skin Mean Gy	27.9	29.8
Skin D2cc	43.3	45.6



CONCLUSION

The 1.5 T magnetic field significantly increases skin dose, but PTV coverage and OAR doses remain within acceptable limits. Importantly, no acute skin toxicity was observed, supporting the safety and feasibility of treatment under magnetic fields. So, in planning on Mr-linac the factor of ERE should always be accounted for Planning to avoid excessive dose delivered to Skin.

References

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