

Reducing the Orbital, Intracranial, and Overall Radiation Dose in Breast Cancer Patients Undergoing Staging CT

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Introduction

RCR guidance states that CT staging in breast cancer should include the supraclavicular fossa [1]. To ensure this, the original protocol at our centre commenced from the skull base, the level of which was estimated by the radiographers. We realised this was leading to unnecessary radiation to the orbits and brain, and potentially increasing the dose length product (DLP). After discussion with the consultants and CT radiographers, we amended the vetting protocol to include a lateral topogram, with use of C2 as a landmark for the superior extent of the scan range. Our goals were to eliminate radiation to the orbits and brain, and reduce the DLP.

Method

We audited the CT NCAPs performed for breast cancer staging in May 2025 at our trust, which were performed over three sites, and yielded 37 patients. The images were reviewed to assess the superior extent of the scan range, and the DLP was obtained from Sectra PACS.

Initial Results (Figure 1)

Of the 37 scans reviewed, 32 (86%) included the orbits, and 34 (92%) included part of the brain. The average DLP was 511. Two scans exceeded the national diagnostic reference level (NDRL) DLP of 850 mGy cm [2].

Change implemented

The results of the audit were discussed with the breast radiology consultants. After obtaining feedback, and discussion with the CT radiographer superintendent, the protocol was amended on Soliton to commence from C2 following lateral topogram, rather than from the estimated skull base. The new protocol was disseminated to all three sites by the lead CT radiographer, and a departmental email was sent to inform vetting radiologists of the change.

AUDIT

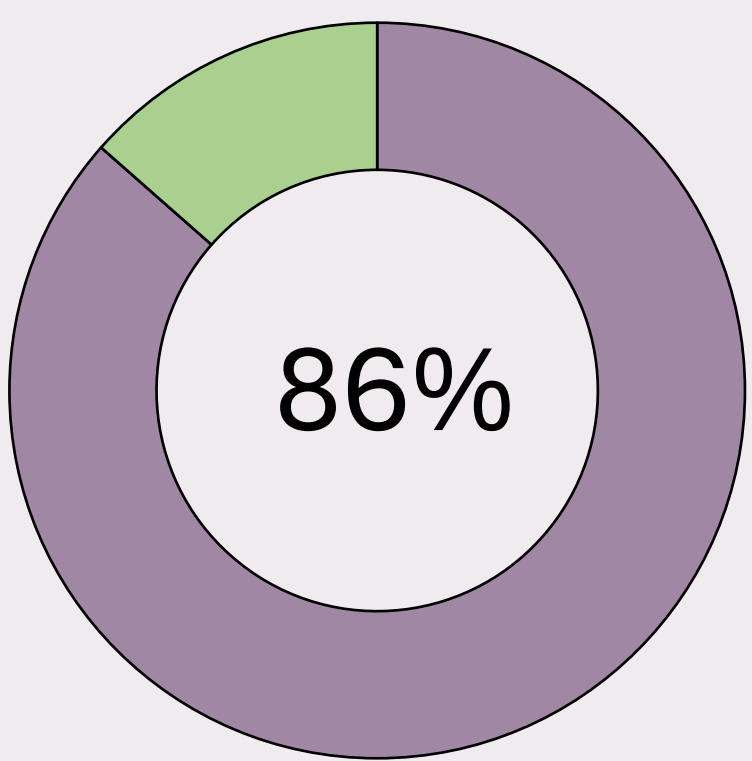
Figure 1. Pre-intervention results

Total number of scans reviewed	37
Number of scans > National DLP	2
Average dose	511
Orbits included	32 (86%)
Brain included	34 (92%)

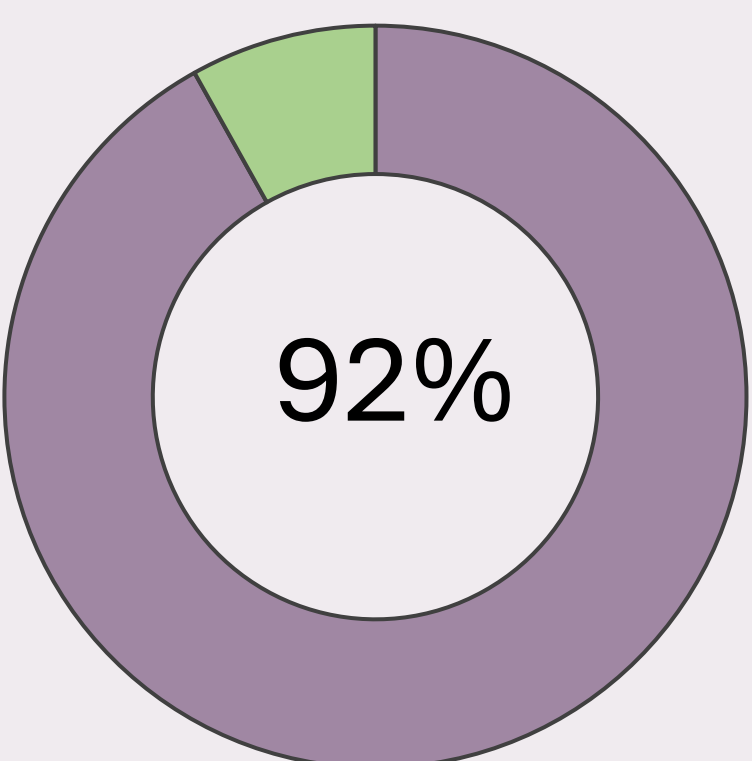
Figure 3. Pre-Intervention CT NCAP Doses



Pre-Intervention Orbit Inclusion



Pre-Intervention Brain Inclusion

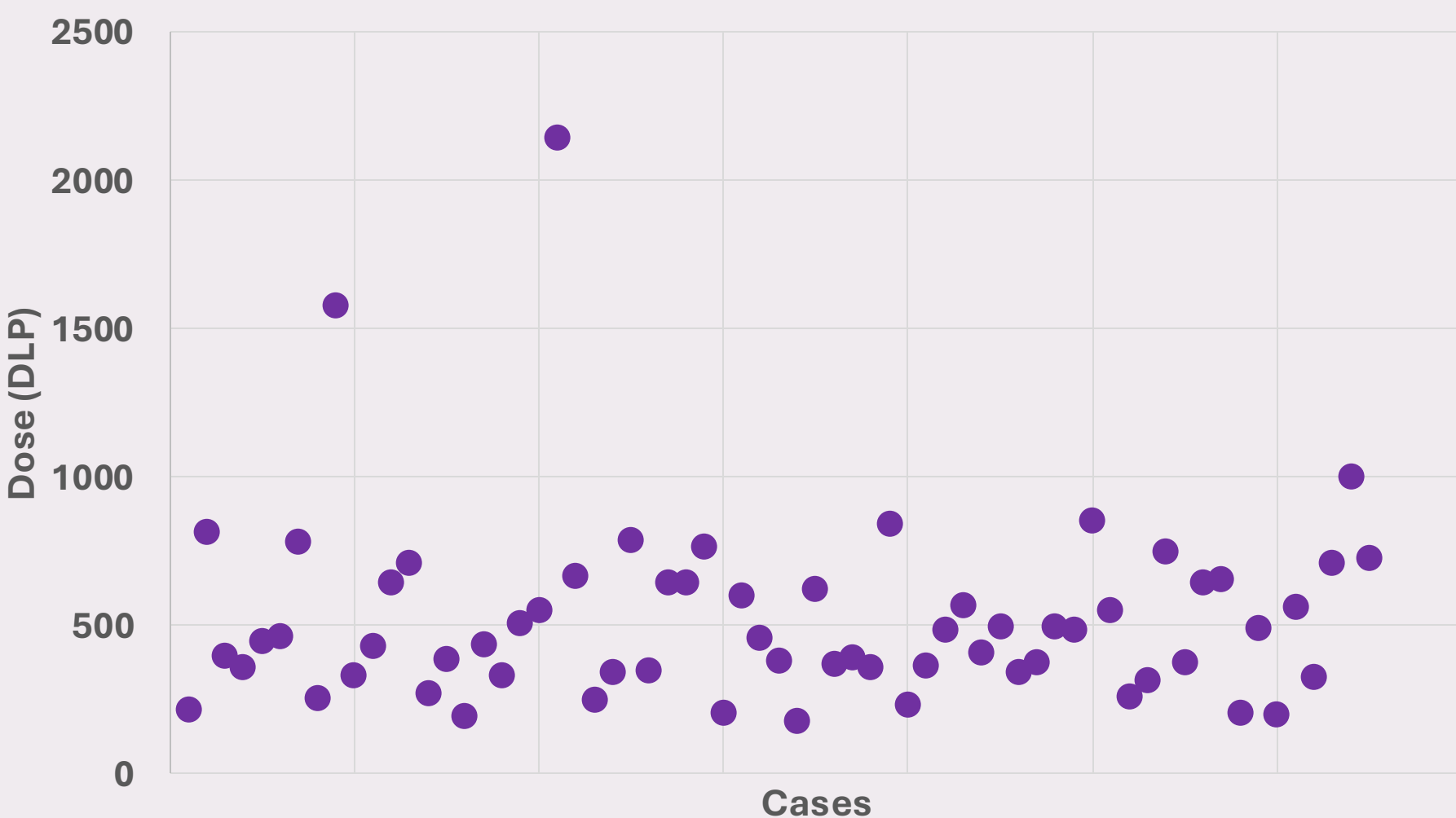


RE-AUDIT

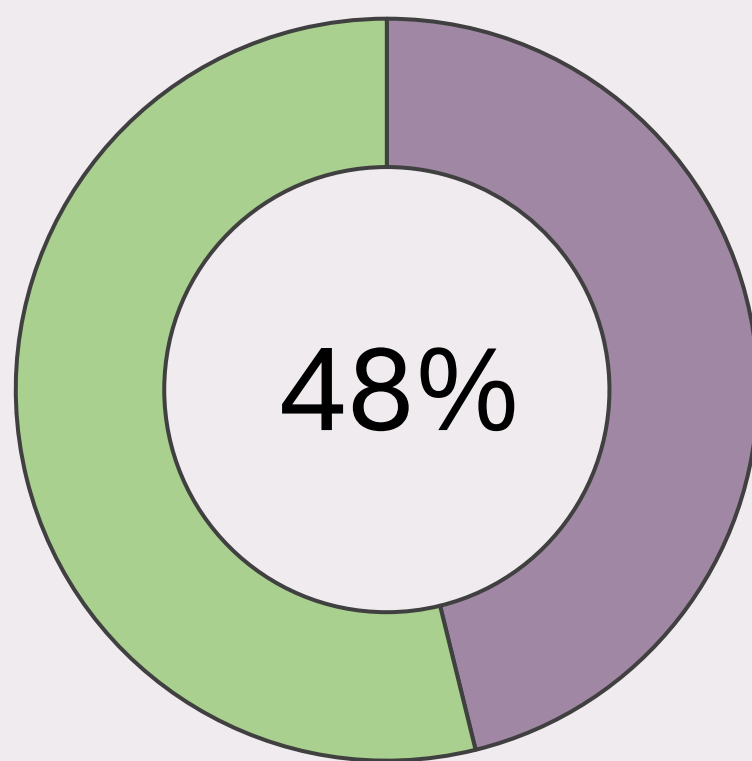
Figure 2. Post-intervention results

Total number of scans reviewed	65
Number of scans > National DLP	4
Average dose	525
Average dose excluding 2 outliers	483
Orbits included	31 (48%)
Brain included	30 (46%)

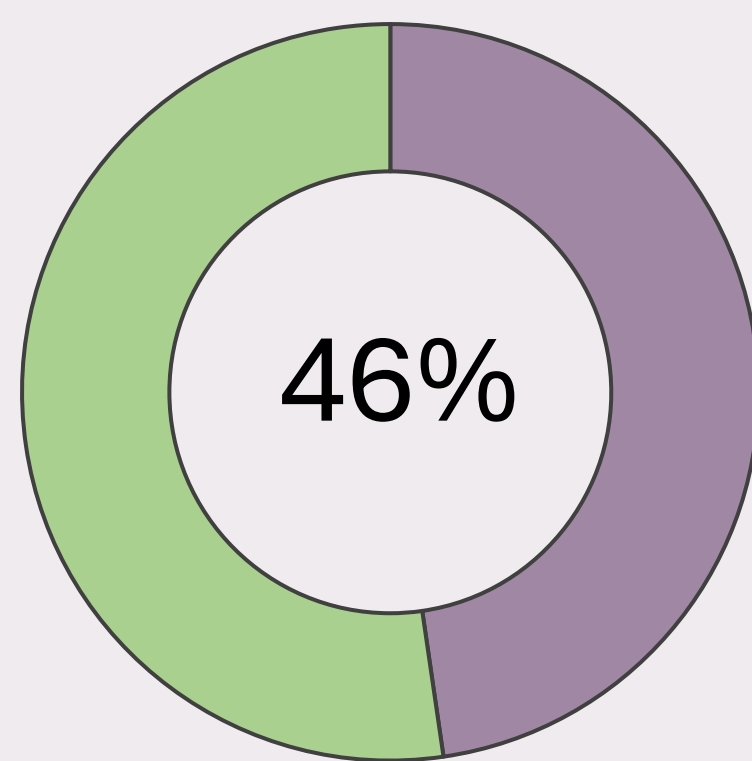
Figure 4. Post-Intervention CT NCAP Doses



Post-Intervention Brain Inclusion



Post-Intervention Orbit Inclusion



Re-audit Method and Results (Figure 2)

Post-intervention, the 65 CT NCAPs performed for breast cancer staging from 29/06/2025 - 28/08/2025 were reviewed as per the initial method. The results demonstrate that we halved the incidence of inclusion of the brain (from 92% to 46%) and almost halved the incidence of orbital radiation (from 86% to 48%) .

Due to two outlying results, the DLP was increased on re-audit (fig. 4). When the two outliers are excluded, the average DLP is slightly reduced compared to the initial results, from 511 to 483. Four scans exceeded the NDRL.

Conclusion

Although there was an improvement, we did not meet our target of eliminating orbital and intracranial radiation. On review of the post-intervention CT images, the reason for this is due to incomplete compliance with the new protocol. Further training for the CT radiographers is required to ensure that lateral topogram and use of C2 as a landmark becomes standard practise, and we will re-audit to ensure that standards continue to improve.

The results of the average DLP show that adding the lateral topogram has not increased the DLP. We believe that once there is complete compliance with the new protocol the average DLP, and the incidence of scans exceeding the NDRL, will reduce.

As radiologists and radiographers, we should endeavour to reduce unnecessary radiation to patients under our care. This is especially pertinent in breast cancer patients, who are likely to undergo multiple irradiating imaging examinations and may also receive radiation therapy.

References

- [1] RCR Publications Recommendations For Cross Sectional Imaging In Cancer Management Second Edition26. Breast Cancer April 2022. S Barter, P Britton
- [2] <https://www.gov.uk/government/publications/diagnostic-radiology-national-diagnostic-reference-levels-ndrls/ndrl>