

EVIDENCE TO GUIDE DAY-TO-DAY PRACTICE OF CONE-BEAM COMPUTER TOMOGRAPHY (CBCT) RE-IMAGING

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Background:

- CBCT imaging is an integral part of patient positioning prior to the delivery of radiation treatment to ensure required PTV coverage.
- At our centre, when required shifts exceed site-specific tolerances, re-imaging is required to ensure PTV is in the treatment position (Fig.1).

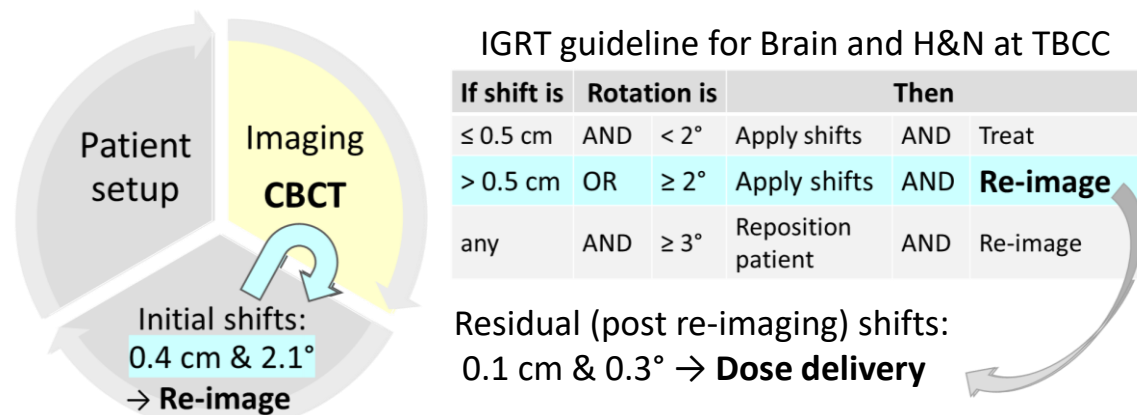


Fig.1. CBCT re-imaging workflow based on internal IGRT guidelines.

Purpose:

- To collaboratively revisit our existing re-imaging policies.
- To determine the frequency of CBCT re-imaging & better understand reasons to re-image (overall & site-specific).
- To evaluate the additional residual shifts required after re-imaging.

Materials and Methods:

- Prospective two-week study
- Only included fractions where applied shifts > site-specific tolerances after CBCT
- Recorded applied couch shifts translations (T) & rotations (R) post re-imaging
- fx population shown in Fig.2.; Brain and Head and Neck (HN) fractions < 30% of all fx
- For Brain (excluded SRS) and HN - all fx included beyond initial observation window.

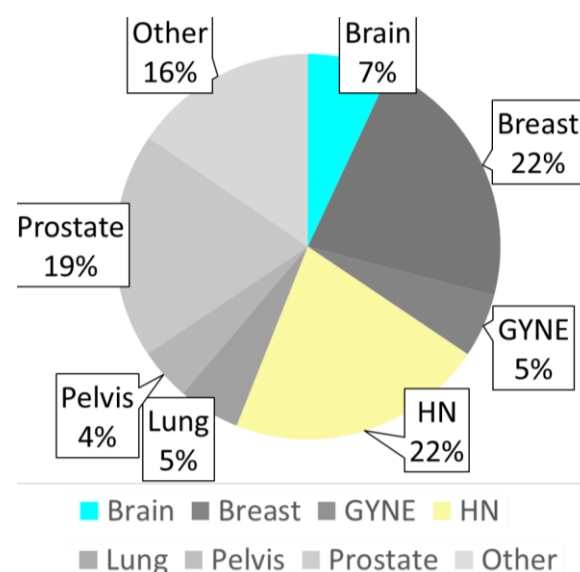


Fig.2. Percentage of fractions by tumour site at TBCC: Jan 31 – Feb 10, 2023.

Results:

- 1945 fx delivered during observation window: 10% required re-imaging
- Re-imaged fx due to initial shifts exceeded tolerance, R-only, T-only & combined R, T (Fig.3)
- Brain and HN fx consist > 80% of all re-imaged fx (Fig.4)
- Average magnitude of residual shifts applied shown in Table.1.

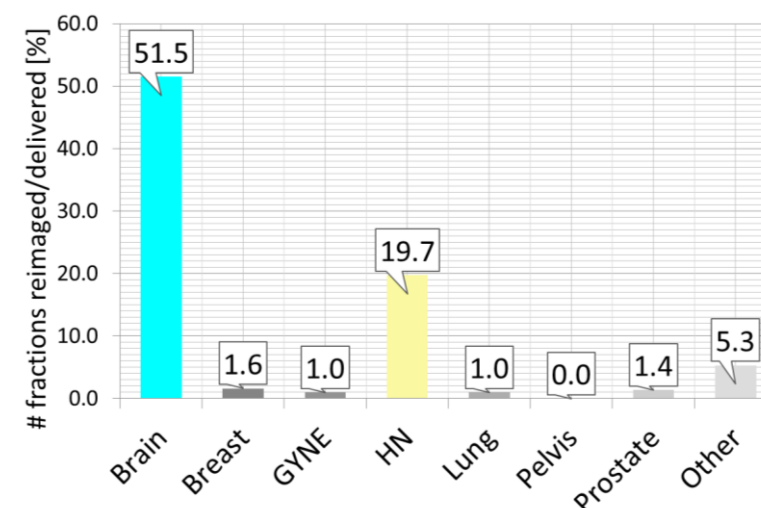


Fig.4. % of fx re-imaged vs. delivered.

No correlation between:

- types of initial shifts exceeding tolerance & residual shifts post re-imaging ($R^2 < 0.4$),
- Incidence of re-imaging and fraction through treatment (Fig.5).

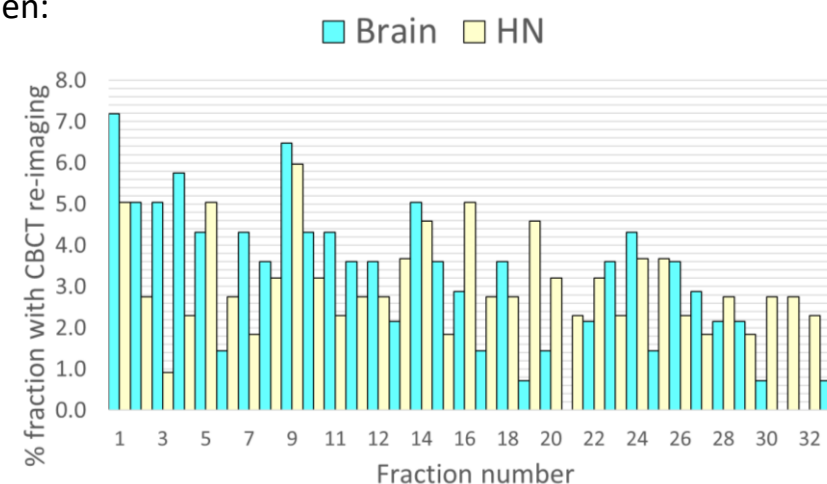


Fig.5. % Incidence of re-imaging by fx number.

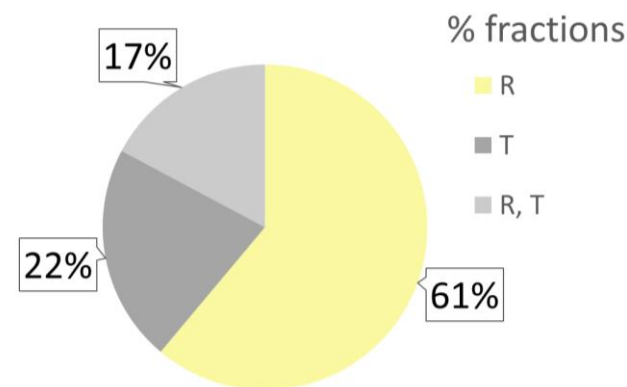


Fig.3. Initial shifts exceeding tolerance: translational vs. rotational.

Table.1..Residual (post re-imaging) shifts.

Magnitude (< 0.2 cm, < 0.5°)

Shift	Mean	STD _s
Vrt [cm]	0.10	0.15
Lng [cm]	0.12	0.17
Lat [cm]	0.14	0.20
Pitch [°]	0.32	0.48
Roll [°]	0.42	0.85
Rtn [°]	0.39	0.57

Results (continued):

- Rotation is the most frequently occurring residual shift in Brain patients.
- Pitch is the most frequently occurring residual shift in HN patients (Fig.6).

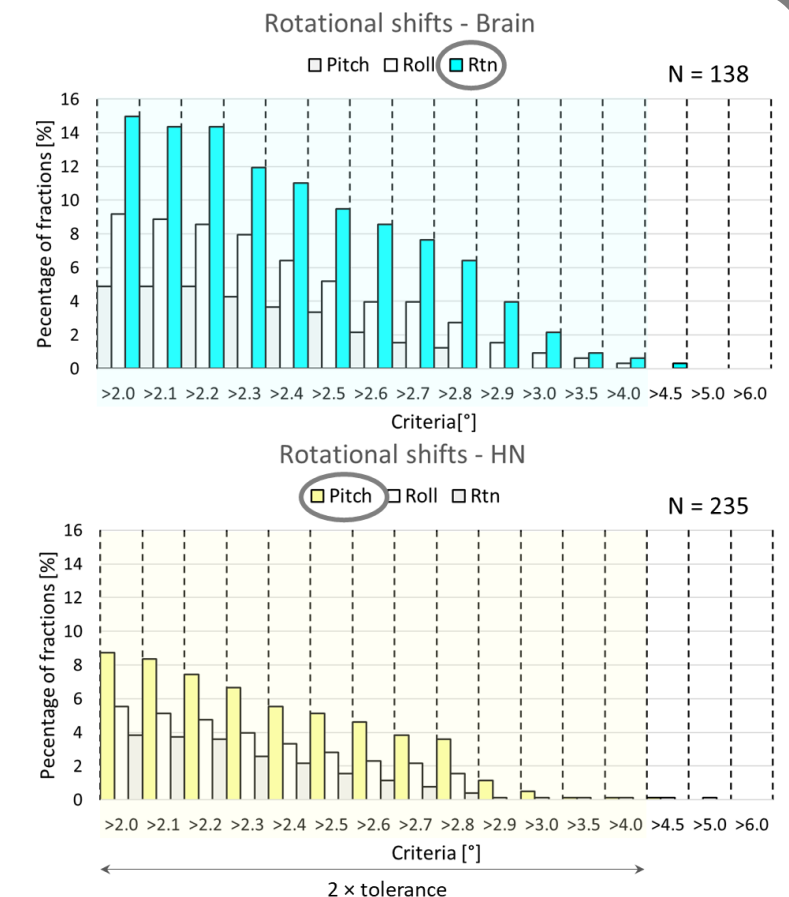


Fig. 6. Residual shift magnitude distribution for Brain and HN tumour sites.

Conclusions:

- Frequency of CBCT re-imaging highest for Brain and HN sites
- Frequency higher for sites using six couch degree of freedom (6DoF)
- Magnitude of the residual shifts validates our re-imaging protocols
- Rotations are the most frequent reason (~2/3 fx) to re-image
- Rotational residual shifts are the largest for Rtn (Brain) and Pitch (HN).

Fig.7. Benefits and costs of CBCT re-imaging.

Future work:

- Establish more standardized use of kV image pairs in Brain protocol.
- Further improve patient set-up via immobilization.
- Early detect patients with more re-imaging via offline imaging review.
- Continue to foster interprofessional collaboration to improve clinical practice & to improve patient's experience & treatment accuracy (Fig.7).

