

Fiducial marker guided liver SABR - feasibility, utility and migration rates

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Background

- SABR is an established focal treatment for primary and oligometastatic liver tumours.
- Poor tumour visibility on CBCT
- Use of surrogates such as fiducial markers, external liver contours, surgical clips, and ablation cavities crucial for safe delivery

Study aims

To evaluate the feasibility and utility of FMs in select patients by

1. Comparing differences in translational shifts on 3D CBCT between FM match and external liver contours match
2. Assessing FM migration rate
3. Assessing adverse events from FM insertion

Methods

- Retrospective review of 9 patients identified for FM insertion through our SABR MDT
- **Comparing translational shifts:**
 - Online match was performed using FMs.
 - 3D CBCTs were rematched offline using external liver contours.
 - Differences in translational shifts were recorded by three independent radiographers.

Methods

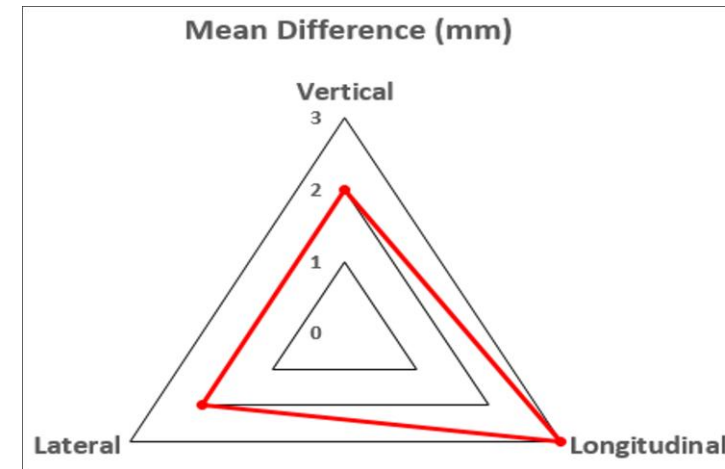
- **Migration rate assessment:**
 - X,Y,Z coordinates measured on CT planning scan and on each online matched CBCT and displacement recorded for comparison
- **Adverse events**
 - Assessed by retrospectively reviewing patients' medical records from the period immediately after the procedure until completion of RT course

Results

- FMs used as primary surrogate for image matching in 8/9 patients.
- 1/9 had FMs inserted at a location deemed unsuitable for primary surrogate matching.
 - Likely due to the lesion being difficult to visualise on ultrasound at the time of FM insertion.
- One patient had two lesions treated with separate isocentres so was counted as 2.
- A total of 45 3DCBCTs were reviewed offline.

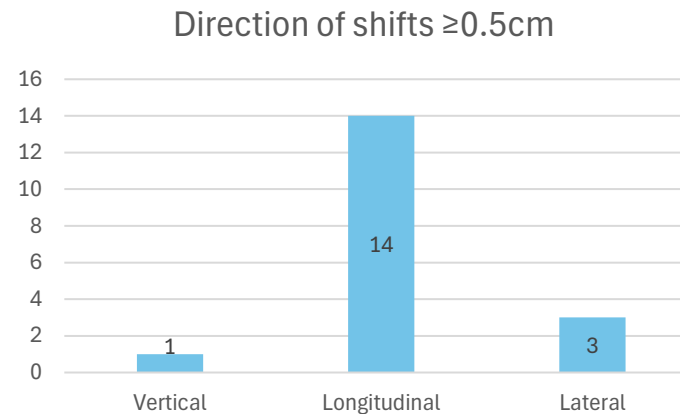
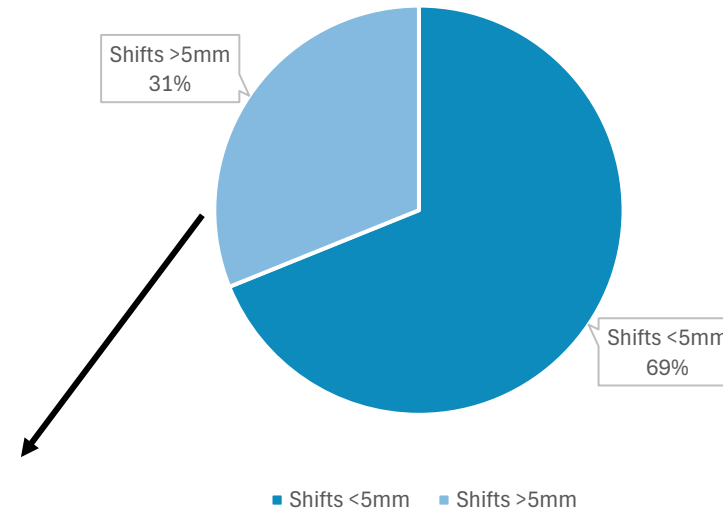
Results – translational shifts

- Largest mean difference in translational shifts between FM and external liver contour match was 3mm (0-11mm) in the longitudinal direction

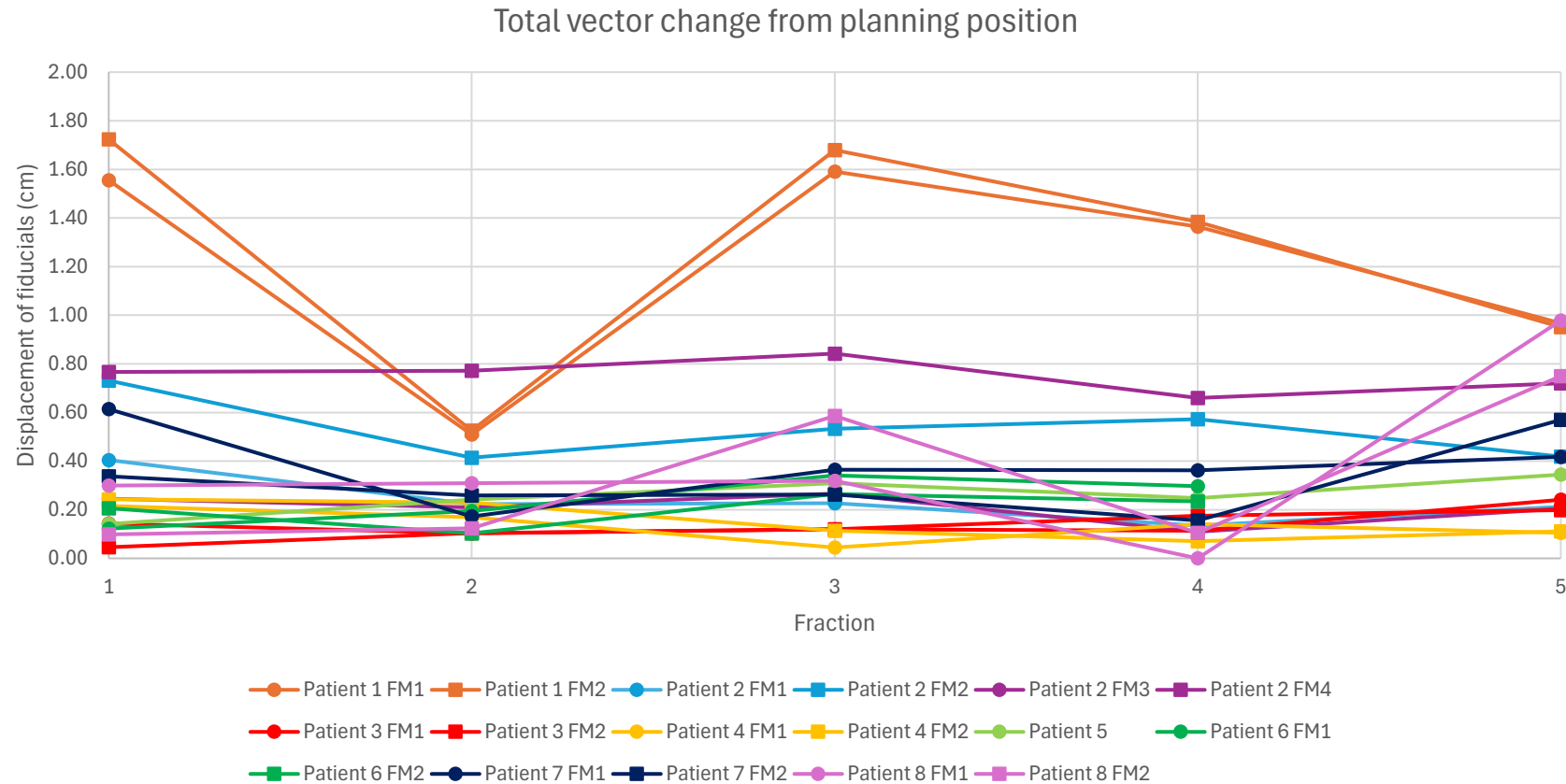


Results – translational shifts

- A total of 14 fractions out of 45 (31%) had shifts $\geq 5\text{mm}$ with the highest number being in the longitudinal direction



Results – migration rate



Graph showing displacement of the fiducials in each fraction for every patient. There are 2 outliers and without these, 73% of displacements were $\leq 0.3\text{cm}$, which is our action level and is a small enough shift to assure that there is no significant fiducial migration.

Results – migration rate

- 1st outlier – liver compressed
- 2nd outlier – 2 isocentres with one fiducial in each PTV and one in-between the PTVs. Match was more focused on the FM inside the PTV than the in-between



Results – adverse events

- None of the patients had complications immediately post insertion or by the time they finished their course of RT

Discussion

- Liver affected by gastric and bowel filling and organ deformation (compress, rotate)
- Large difference between FM and liver contour match shown in 1/3 of patients may be due to;
 - Blurriness near diaphragm/dome of liver due to breathing on 3DCBCT
 - Unclear demarcation of external liver contours caused by nearby bowel gas and artefact
- Less inter-user variability when matching to FMs

Limitations

- Offline matching of external liver contour was done on 3DCBCT which does not take any shifts from breathing into consideration.
- Migration rate – better method of determining true fiducial migration

Conclusion

- External liver contour match can be affected by bowel/gastric filling and liver deformation
- Less inter-user variability when matching to FMs suggesting it can be a more reliable IGRT surrogate
- FMs can play an important role as an IGRT surrogate in a select cohort of patients treated with SABR
- US guided FM insertion is a safe procedure



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Questions

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