Implementing optimal patient immobilisation in abdominothoracic MR-guided SABR

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Introduction

Advanced motion management strategies are crucial for the safe delivery of complex SABR [1]. With online adaptive re-planning and motion tracking/gating, MR-guided radiotherapy (MRgRT) can minimise the impact of intrafractional motion whilst improving plan quality [2].

Extended treatment times of adaptive MRgRT SABR may result in reduced compliance and increased re-planning [3], therefore, patient setup with arms down is common. However, with a wingboard setup, additional IMRT beams can increase the degree of freedom during treatment planning, as the arms are removed from the beam path. This approach could potentially improve SABR dose gradients and decrease treatment delivery time [4], despite reduced maximum lateral couch movement.

We assessed the feasibility of introducing the High Precision Lung Board (wingboard) (Orfit, Belgium) [5] for MRgRT abdominothoracic adaptive SABR treatments to improve plan quality whilst ensuring patient comfort and reducing treatment delivery time.

Methodology

A multidisciplinary working group was established, including physicists, radiographers, dosimetrists, and oncologists. The group identified potential inclusion criteria for the wingboard. Figure 1 outlines the testing and implementation process for the wingboard.

Figure 1: *Wingboard testing and implementation pathway*

Outcomes

Table 1 presents the inclusion criteria identified by the working group. Table 2 summarises the re-planning study, highlighting plan quality improvements with the wingboard plans. As illustrated in Figure 2, the wingboard setup highlights the potential improvement to plan conformality, especially in the isodoses <50% of prescription dose. Wingboard plans were renormalised to attain the same PTV coverage as the baseline non-wingboard plans, to aid comparison.

Patient Suitability Criteria	Wingboard	Considerations
Previous radiotherapy treatments(s)	✓	Additional beams benefit complex planning i.e., re-irradiation
Pre-existing co-morbidities that affect patient comfort	×	For example, patient compliance, age, performance score, prior surgery etc.
Collision risk with fixed bore (70cm diameter)	×	Limited on-set positional shifts and risk of arm/elbow collision with the bore
Reduced arm/shoulder flexibility	×	Often relates to patient height and arm length
Multiple areas treated	✓	Feasible, except when lateral offsets are required
Able to keep arms up for longer than 30mins	✓	Tested at MR Simulation

Table 1: *Patient criteria for evaluating the suitability of the wingboard setup*

MR simulation forms were updated, and a risk assessment was completed. MR simulation appointments were used to assess patient suitability and wingboard training was provided for all radiographers with an updated competency framework. Following clinical implementation, from April to September 2024, 36 patients have successfully been treated with this approach, without any treatment pauses or re-plans.

Plan Metrics Median +/- s. d.	No wingboard (Clinical Plan)	Re-planned with wingboard	p Value
Prescription dose spillage	1.05 +/- 0.05	1.05 +/- 0.03	**0.030**
Estimated delivery time (mins)	15.0 +/- 2.7	13.9 +/- 2.06	**< 0.001**
V10Gy Skin (cc)	629.6 +/- 491.7	452.2 +/- 331.8	**<0.001**

Table 2: *Summary of retrospective re-planning data (n=14 patients)*

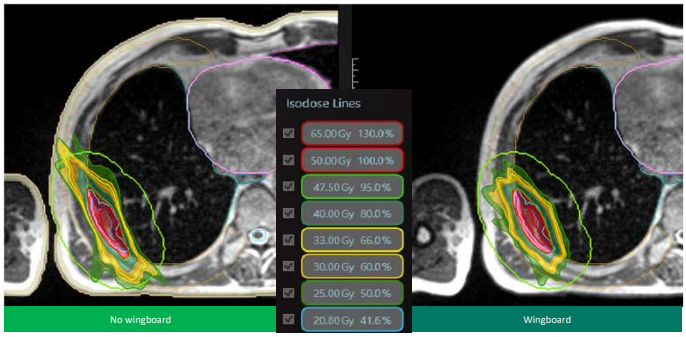

Figure 2: *Visualisation of plan conformality with and without a wingboard setup, for a laterally offset target*

Discussion

One of our main considerations for a wingboard setup in our MR-guided radiotherapy workflow was the MR coil positioning during MR simulation and treatment. The position of the coils must be reviewed and documented via positional reference points for each patient, to ensure adequate bore clearance, patient comfort and optimal coil position for MR image quality. The introduction of the wingboard to a fixed bore platform can reduce the freedom of on-set positional shifts before or during treatment. Ordinarily, where lateral patient offsets are required, a medial isocentre would be recommended with a wingboard setup to mitigate this risk.

MR simulation appointment times were extended to ensure adequate assessment of patient tolerance to the wingboard setup, which may have service and resourcing implications. We recommend that a risk assessment is completed to include an alternative workflow for patients who are unable to tolerate the wingboard setup during treatment.

Conclusion

The introduction of a wingboard allowed for improved dosimetric plan quality, despite reduced couch movement. Patient tolerability was considered acceptable as all patients have completed treatment to date. This model for implementing change was successful and will be followed for future projects within our team.

References

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