Reproducibility of the lung anatomy under Active Breathing Coordinator control: Dosimetric consequences for scanned proton treatments.
den Otter, Lydia; Kierkels, Roel G J; Kaza, E; Meijers, Arturs; Leach, M.O.; Collins, D.J.; Langendijk, J.A.; Knopf, Antje

IMPORTANT NOTE: You are advised to consult the publisher's version (publisher's PDF) if you wish to cite from it. Please check the document version below.

Publication date:
2017

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):

Copyright
Other than for strictly personal use, it is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license (like Creative Commons).

Take-down policy
If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Downloaded from the University of Groningen/UMCG research database (Pure): http://www.rug.nl/research/portal. For technical reasons the number of authors shown on this cover page is limited to 10 maximum.
Reproducibility of the lung anatomy under Active Breathing Coordinator control: Dosimetric consequences for scanned proton treatments

Lydia A. den Otter1, Roel G.J. Kerkels2, Allia Kaza2, Arturs Meijers1, Martin O. Leach2, David J. Collins2, Johannes A. Langendijk1, Antje C. Knot1

1: Department of Radiation Oncology, University Medical Center Groningen, University of Groningen, The Netherlands
2: CR-UK Cancer Imaging Centre, The Institute of Cancer Research and The Royal Marsden Hospital, London, UK.

INTRODUCTION

Pencil beam scanning (PBS) is a highly conformal technology to treat cancer. The time structure of PBS makes the treatment of moving tumours challenging due to the interplay effect. For motion mitigation, an Active Breathing Coordinator (ABC) can be used to assist with breath-holding. As the treatment is delivered over several fractions with delivery times extending a feasible breath-hold duration, high reproducibility of ABC breath-holding is required. We evaluated the robustness of scanned proton therapy against anatomical reproducibility uncertainties when treating lung patients during ABC controlled breath-hold.

RESULTS

Dosimetric evaluation of the recalculated treatment plans showed <2% V95% target coverage loss for 19/24 cases (Figure 2). Simulated tumours in the caudal regions showed a loss of V95% up to 6.1%. Organs at risk doses differed little compared to the planned doses (V5%<1% for the heart and the lungs, D2.10<1.4 Gy to the spinal cord and esophagus). For one sample case (Figure 3), the planned and recalculated dose distribution is shown. The loss of CTV coverage is depicted by the dose heterogeneities shown in Figure 3(b).

CONCLUSION

When treating under ABC controlled breath-hold, robustly optimized IMPT plans lack robustness to caudally located lung tumours. For most other cases anatomical variations between repeated ABC breath-holds have limited dosimetric consequences.