Evaluation of the use of Average Intensity Projection for the localisation of mobile lung tumours treated using Stereotactic Ablative Body Radiotherapy (SABR)

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Objective

To investigate if Average IP is a valid dataset to use when matching to CBCT
Background

- 4DCT – 13 datasets available

Inhalation

Exhalation

2nd couch position

3rd couch position

50% MIP MIN AVE IP

Beacon Hospital
Average IP

- Average pixel densities among all the phases
- Target is dependent on time spent at each position
Phantom

- Phantom
  - 39 Datasets

Respiratory and Tumour motion Simulator Phantom showing spherical target

1cm 3 seconds
Procedure used for phantom measurements

4DCT → Ave IP → Aperture

CBCT/Fluoro Motion → Static CBCT
Analysis - Phantom

• Automatic registration for high density regions for phantom datasets

• Motion on CBCT(A) and AVE IP (B)

Figure 2: 3.5cm excursion & 4second rate (A) Ave IP, (B) CBCT and (C) auto match overlay
Results – Phantom Automatch

Automatch on high density, most shifts were less than 2mm
Measured spherical target length including motion for a range of excursion lengths and rates

Breathing Period in Seconds

Both AVE IP and CBCT underestimate target motion
Dependent on time spent at maximum inhalation and exhalation.
Analysis - Retrospective Patients

Retrospective matching of AVE IP dataset with CBCT
- Bony Match
- Soft Tissue Ave IP with CBCT
- Compared with fluoro moves applied before treatment

<table>
<thead>
<tr>
<th>Moves on CBCT vs AveIP match</th>
<th>ANT</th>
<th>SUP</th>
<th>LEFT/RIGHT</th>
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<tbody>
<tr>
<td></td>
<td>0.5</td>
<td>0.2</td>
<td>0</td>
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RESULTS – Fluoro vs AVE IP (103 fractions)

Moves required for Fluoro vs Average CBCT

- AVE (> 4mm)
- Fluoro (>4mm)
- AVE (2-4 mm)
- Fluoro (2-4 mm)
- AVE (<2mm)
- Fluoro (<2mm)

Fraction number

- LEFT/RIGHT
- SUP/INF
- ANT/POST
Clinical Example

- Large Tumour motion
CT 50% vs CBCT following bony match
Resulting Fluoro

GTV outside aperture
2nd Day moved to AVE IP on high density window
Fluoro following soft tissue move

GTV in aperture
Conclusions

- AVE IP is a valid dataset for matching with CBCT, looking at higher density area

- Need Fluoro to check motion and gating window
Acknowledgements