Simultaneous boost in breast radiotherapy requires increased margins or revised match strategy

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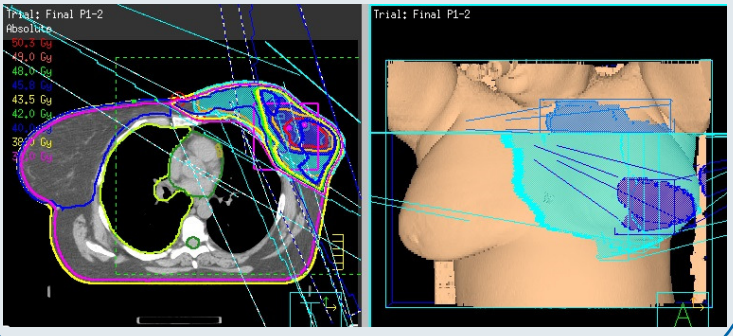
Purpose

In radiotherapy simultaneous boost compared to sequential boost allows shortening of the overall treatment time. The present study evaluated the difference between match based on boost volume and total target volume, with the specific aim to suggest margins when a single registration is used.

A case example of a forward planned breast cancer patient with lymph node involvement and simultaneous boost:



Method

In total 358 CBCTs from 55 pts were analysed:

- 250 CBCTs were performed before each fraction (16 pts) receiving radiotherapy after breast conserving surgery and with lymph node involvement at Odense University Hospital using the Elekta CBCT software
- 108 CBCTs were performed once a week (39 pts) receiving radiotherapy after breast conserving surgery without lymph node involvement at Herlev Hospital using Varian CBCT software

Two matches were performed:

1. A chest wall-match where CBCTs were auto-registered to the planning CT, lymph nodes included if relevant
2. A boost specific match using manual registration of surgical clips

Results

Systematic (Σ) and random errors (σ) between the thoracic wall and the clips based boost matches are found. The CTV-PTV margins were calculated based on the systematic and random errors using the Van Herk margin recipe (IJROBP 47: 2000). These numbers are found both using no re-matching and a re-matching if there were more than 3 mm differences between the two matches.

Results from the 250 CBCTs with lymph node involvement

	Σ [mm]	σ [mm]	CTV-PTV [mm]
No re-matching			
lateral	2,4	2,0	7,3
Longitudinal	2,7	2,3	8,4
Vertical	2,8	2,2	8,5
3-mm threshold for re-matching			
Lateral	0,7	1,1	2,6
Longitudinal	0,6	1,0	2,3
Vertical	0,7	1,1	2,6

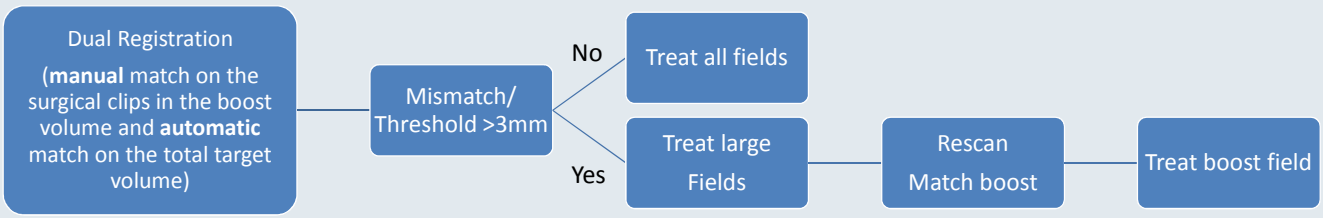
Results from the 108 CBCTs without lymph node involvement

	Σ [mm]	σ [mm]	CTV-PTV [mm]
No re-matching			
lateral	1,8	0,7	5,1
longitudinal	2,8	0,8	7,5
vertical	1,5	0,9	4,3
3-mm threshold for re-matching			
lateral	1,0	0,5	2,7
longitudinal	1,1	0,6	3,1
vertical	1,1	0,6	3,1

Conclusion

- Simultaneous boost radiotherapy requires larger CTV-to-PTV margins than the standard sequential boost margin of 5 mm
- In both data set an adaptive protocol for daily IGRT can reduce the required CTV-to-PTV margin by up to 5 mm for the boost region by re-scanning and re-matching the boost region (this match procedure is used in the clinic at Odense University Hospital)

Proposed clinical match procedure



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