Title

ANALYSIS OF THE EFFECTS OF DIFFERENT MATCHING CONE BEAM CT STRATEGIES ON THE DOSE DISTRIBUTION IN BREAST CANCER BY t-IMRT AND VMAT DELIVERIES.

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Background: To analyze the dosimetric deviations within IMRT plans (both tangential IMRT and fully modulated VMAT) using two different image guided positioning strategies. The strategies proposed are soft tissue/skin matching (SM) and skeletal/bone landmarks matching (BM). This evaluation aims to support the clinicians in choosing the optimal positioning strategy to be implemented in the clinical routine.

Methods: Two sets of 10 patients were selected: average sized breasts (AB) & relatively larger breasts (LB), cutoff 1300cc PTV. For each patient a weekly CBCT (five sets each) was acquired during the course of the treatment documenting the weekly variations in breast form & position. The CBCTs were manually matched to the planning-CT (PCT) without allowing for rotational corrections, once to the skin surface/soft tissue of the breast (SM) & again to the thoracic cage (BM). Electron density was corrected & used to overwrite those of both the CBCTs and PCTs thus disallowing discrepancies in dose calculations due to differences in the tissue densities in each CT. After matching, the delineated PTV & organs at risk were copied from the PCT on each CBCT then corrected for discrepancies caused by position and shape changes. Reference plans (RP) created on each PCT using t-IMRT (2 tangential beams, 3-7 segments per beam and 2.5 cm flash margin) & VMAT were then copied to each CBCT & the dose was recalculated. We

compared the dose distribution of the RP to that of each of the 5 serially acquired CBCTs after a SM, and 5 more times after the BM. Deviations in the delivered from the planned dose distributions were analysed.

Results: All values (V-parameters in %, D-parameters in cGy) are averages of the data of the 10 patients in each group. Results are shown as difference between the resultant and the original PCT.
See summary of the results in table 1.

Table 1: Summary of the results.

t-IMRT	***Average Breast***	***Large Breast***
PTV coverage	V105% in BM was +1.4% (i.e in BM was higher than the original PCT by 1.4%) (p=0.003) , while in SM was +0.76% (p= 0.012). Comparing both techniques together was also significant (p=0.006).	D50% in BM was -10.3 cGy, while in SM was -14 cGy with statistically significant p-value (p=0.033)
Heart, left lung and patient tissues	The difference between the matched CBCTs in both techniques and the PCT was small and clinically irrelevant.	
VMAT:	***Average Breast***	***Large Breast***
PTV coverage	D5% in BM was +84.5 cGy and in SM was +71 cGy with highly significant p-value<0.0001 in both techniques. Comparing both techniques together, p-value was 0.017. V105% in BM and SM were +1.8% and +1.4% respectively with highly significant p-values <0.0001 in both techniques. When comparing BM and SM together, p-value was 0.078.	D5% and V105% were also higher in the BM and SM than the PCT with significant p-values. They were also numerically higher in the BM than the SM though not statistically significant.
Heart, left lung and patient tissues	The difference between the matched plans (BM and SM) and the original PCT was small and clinically irrelevant.	

Conclusion: Minor setup errors after IGRT seem to produce minimal impact on the planned dose distribution in both the target breast and nearby organs independent of the treatment technique. Bone matching minimally but significantly increased hot spots (D5% and V105%) with VMAT in comparison to skin matching in average breast sizes.