Materials and Methods

A total of 42 patients were retrospectively included in the study. All these 42 patients underwent the conventional MT-350 breast-treatment protocol at the Ahus breast clinic. Of these, 31 patients were treated with the MT-350 breast board called WingSTEP breast board.

Patients were scanned in the supine position using a 16-slice Philips MX 8000 IDT Computer Tomograph (CT); the scans were reconstructed with 2.0-mm slices without additional filtration.

The clinical target volume (CTV) was the palpable breast volume. Before CT scanning a copper wire was placed marking the circumference of the breast. This wire was used as a help defining the CTV. The radiologic guidelines define the dorsal limit as the fascia over the thoracic wall and the ventral limit as 1 cm under the surface of the skin. There was no planning target volume (PTV) defined, but this volume is taken into account according to CTV field edge margin. The clinical target volume was divided by 2 for the CTV for the field edges of the mandible and bone towards the lung. There should also be an additional anterior field block of more than 2 cm underneath the breast.

All patients were placed in supine position in a mean dose of 0.8 to 1.5 giờ before treatment. Patients were immobilized using an inhouse technique with marked and fixed anatomical landmarks. Patients were treated with both MV and CBCT.

The department of the Ahus breast clinic operates two Elekta linear accelerators, one with a Synergy and one with a Precise linac. The Synergy linac is equipped with a slice-wise cone-beam computed tomography (CBCT) system XPLOR. All patients performed a cone beam scan in the Synergy treatment machine prior to the first treatment. Electronic portal images (EPIS) were taken during the CBCT fraction and further once a week, and a total of 25 images were analyzed.

Translations in the crano-caudal (CC) and anterior-posterior (AP) direction between the beam’s eye view digitally reconstructed radiograph (DRR) and the EPID image were used for calculation of intra-fraction motion and margins. In addition rotation around the gantry angle deviation with respect to the vertical will yield the correct value.

Since the imaged fields are oblique, and making the assumption that most of the motion is in the AP-direction, less in the LR-direction, and minor in the CC-direction, less than 0.5 mm, this assumption is probably valid. Translations in the cranio-caudal (CC) and anterior-posterior (AP) direction between the beam’s eye view digitally reconstructed radiograph (DRR) and the EPID image were used for calculation of intra-fraction motion and margins. In addition rotation around the gantry angle deviation with respect to the vertical will yield the correct value.

Patient setup deviations can be a random component related to patient motion, and a systematic component due to the setup process.

The setup variability of the body anatomy, in most cases therefore, will be calculated. The setup variability of the thoracic wall is a good estimate of the CTV-variability in most cases, but breast tissue is non-rigid and can deform and move with respect to the thoracic wall. We calculated the group mean (m), systematic error (S), and standard deviation (SD) using the framework of van Herk et al. [5].

The run-back at each margins target coverage of the CTV for 99% of the patients with the 95% confidence for a Determination Margin is 2.12 ± 0.73 cm, where t 0.2 is the standard deviation (SD) of the patient means, t 0.29 the correction factor (systematic uncertainty), and t 0.29 the SD of the execution (random error).

In addition margins were calculated with the requirement of a minimum dose to the CTV of 95% for 95% of the patients. This requirement yields the margin to

\[
\text{Margin} = 3.05 \times \text{SD} + \text{SE}
\]

where \(\text{t 0.2} \) is the standard deviation of the population mean. We can also calculate a PTV margin taking into account the intrafraction displacement in the AP direction found from the internal motion of 10 patients. Similarly adding the mean intrafraction displacement of 1.2 mm yields the margin in the AP direction of t 0.2 ± 1.2 mm. Since the WingSTEP CBCT and the MT-350 CBCT were used in tangential breast irradiation, we have to take into account the CTV-to-field edge margin. A secondary aim was to investigate the adequate CTV to PTV margin for both breast boards. An invasive was also to check the WingSTEP costs around 80% of a conventional breast board.

The radiation therapy technologists prefer the WingSTEP breast board due to its lower weight and easier setup. There are major baseline shifts for some patients possibly due to the patient being tense during setup, but relaxes during the treatment session. One has to keep in mind that these margins are calculated on portal images early in the treatment session, and does not account for the small baseline shifts that occur between the portal images as seen for some patients. For both conventional and EPID-based treatment planning the normal margin to account for interfraction motion will be a systematic uncertainty and the technique margin yields the margin to account for interfraction motion.

The margins are calculated from matching body-structure in the digitized images, which is a good estimate for the CTV localization. The margin does not include rotational errors or shape deformations, and are considered on a breast level.

### Results

The WingSTEP breast board offers minimal individual set-ups, but all patients included were able to perform the immobilization and minimal set-up procedure.

The results of the EPID setup verification are shown in Table 1. There are no issues on the systematic mean group in the AP direction for both breast boards. This also holds for the correction direction for the WingSTEP breast board, but there is a small systematic group mean towards the caudal direction for the MT-350 breast board. This is probably due to a standard 5° inclination for this breast board.

In addition margins were calculated with the requirement of a minimum dose to the CTV of 95% for 95% of the patients. This requirement yields the margin to

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### Conclusions

There is no group mean difference in the AP direction between the two breast boards.

The MT-350 breast board has a small CTV group mean displacement possibly due to the board inclination and patients slipping down caudally.

There are no significant CTV-PTV margin differences between the two breast boards.

Rotations around the LR-axis from CBCT-scans performed at first treatment session show no statistical differences.

There are major baseline shifts for some patients possibly due to the patient being tense during setup, but relaxes during the treatment session. Intrafraction displacement does not seem significant in intrafraction motion.

The radiotherapy technicians prefer the WingSTEP breast board due to its lower weight and easier setup.

### References

(1) Česka Medická Výuka – Lat., http://www.ceska-cvuka.cz/
(2) IFU Multimedicus GMBH – http://www.ifu.de

Table 1: Group means, systematic and random errors for the two breast boards.

<table>
<thead>
<tr>
<th>Group</th>
<th>AP [mm]</th>
<th>CC [mm]</th>
<th>Rot [°]</th>
<th>S</th>
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<td>1.69</td>
<td>0.62</td>
<td>0.62</td>
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</table>

Table 2: The margins needed to account for interfraction translations were calculated for each breast board, and are shown in Table 2. There are no significant differences in the margins needed to account for interfraction motion for the two breast boards.

One has to keep in mind that these margins are calculated from portal images early in the treatment session, and does not account for the small baseline shifts that occur between the portal images as seen for some patients. For both conventional and EPID-based treatment planning the normal margin to account for interfraction motion will be a systematic uncertainty and the technique margin yields the margin to account for interfraction motion.

The margins are calculated from matching body-structure in the digitized images, which is a good estimate for the CTV localization. The margin does not include rotational errors or shape deformations, and are considered on a breast level.

Figure 1: Baseline shift during treatment session. Distance measured with a Digital LED-Cube laser distance sensor pointing to symmetry.

Table 3: The patients needed to account for interfraction translations were calculated in the AP and CC directions. All values in mm.

<table>
<thead>
<tr>
<th>Group</th>
<th>AP [mm]</th>
<th>CC [mm]</th>
<th>Rot [°]</th>
<th>S</th>
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<td>7.08</td>
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