**Material and Methods:** After mastectomy with level II axilla dissection, IMN radiation was considered only in medial or central quadrant disease with axilla involvement.

Between June 2000 and November 2002, 203 patients receiving post surgery chest wall radiation (50 Gy/25 fractions/5 wks), were randomized (after informed consent) to: Arm I – receiving additional IMN radiation (n = 94; left breast: 43) and Arm II – no IMN radiation (n = 109; left breast: 55). All patients received 6 cycles of FAC chemotherapy.

CT-based planning was done for each patient to optimize IMN coverage. Volume of heart irradiated and the volume of heart receiving 5 Gy **(V5)** were estimated individually from integral DVH. Maximum heart distance **(MHD)** was measured for majority.

All patients were monitored with ECG, Chest X-ray, Echocardiogram at the start of radiation, on completion and then 6 monthly. TMT and 24 hr. Holter monitoring were performed in selected cases.

**Results:** After a median follow up of 72 months, 4 had chest wall recurrence – 2 of who received IMN radiation. IMN recurrence was observed in none, whether they received IMN radiation or not.

Regarding cardiac effects, 2 patients of Arm I developed constrictive pericarditis. 3 had LV dysfunction (estimated by EF < 50%) and 3 developed congestive failure – all belonged to Arm I with left sided disease. No toxicity was noted in 55 left breast cases of Arm II ($p < 0.001$). So significant late cardiac effect was observed in 8/43 left breast IMN-treated and in 0/55 left breast IMN-not treated cases ($p < 0.001$). It was absent in right breast patients, even if IMN treated. DVH analysis revealed 50% of heart volume was exposed to 22−25 Gy in Arm I vs. 8−10 Gy in Arm II with left sided disease. MHD ranged between 1.87 and 2.9 cm.

**Conclusion:** In centers without IMRT or 3DCRT facility, addition of IMN portal is not justifiable at least in left breast cancer, even with axilla positive medial quadrant disease, as it may invite fatal late cardiac toxicity without any additional gain in loco-regional control.

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**Prone position breast irradiation for women with larger or pendulous breasts: an intensity modulated radiotherapy (IMRT) planning study**

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**Background:** Supine position breast radiotherapy is most commonly used for whole breast radiotherapy in patients treated with breast-conserving therapy for early breast cancer. In women with larger and/or pendulous breasts, this technique can cause increased dose inhomogeneity and hot spots to skin fold areas, with, as a result, increased skin toxicity and impaired cosmetic outcome. In prone position, with the breast hanging free from the thoracic wall, skin folds can be eliminated and field separation could be reduced. We aimed to evaluate prone position breast radiotherapy by means of a CT planning study.

**Materials and Methods:** A pilot study was performed including 15 women with large or pendulous breasts. All women had a CT scan in supine and in prone position. The patients were treated conventionally, in supine position. Opposed tangential beam arrangements were set up in both positions. For each position, both a conventional 3D plan and an IMRT plan was developed. Breast coverage, dose homogeneity, and dose to the lung and heart were compared.

**Results:** In prone position, skin folds can be adequately eliminated. The mean field separation in supine position was 24.7 cm (range 21.5−28.2 cm); this was reduced to 20.8 cm (range 16.2−24.6 cm) in prone position. In prone position, the breast tissue could be adequately covered, but the conformal radiotherapy plan caused underdosage in the medial part of the breast, whereas with IMRT, a homogeneous dose could be obtained. The percentage of the breast receiving >95% of the dose was 93%, 95%, 89% and 96%, for supine conventional, supine IMRT, prone conventional and prone IMRT plans, respectively.

In prone position, the dose to the ipsilateral lung was reduced compared with the supine position (average dose 6.02 Gy, 6.47 Gy, 1.20 Gy, 1.53 Gy for supine conventional, supine IMRT, prone conventional and prone IMRT plans, respectively). The dose given to the heart in prone was similar to that in supine position.

**Conclusions:** Prone position breast radiotherapy is a feasible technique for women with pendulous breasts, if IMRT is used. With this technique a homogeneous dose to a larger breast can be given, and skin folds are eliminated thereby reducing the risk of epidermolysis. Also, the irradiated lung volume is reduced compared with supine breast irradiation. The dose delivered to the heart is similar in both positions due to the heart moving anteriorly in prone position.

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**Treatment position verification in tangential breast irradiation**

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**Purpose:** As part of a joint study to improve heart sparing during whole breast irradiation the Leiden University Medical Centre and Medical Centre Haaglanden have prospectively investigated inter- and intra-fraction variability during tangential breast irradiation.

An important part of this study consists of a precise registration of the 3-D variability of the treatment position verification. By correction of the patient variation we hope to determine an optimal CTV (Clinical Target Volume) – PTV (Planning Target Volume) margin.

**Methods and Materials:** A combination of anatomical structures and 5 skin markers have prospectively been used to quantify changes in all directions. During the whole treatment period electronic portal movies of 26 patients were taken (± 4 frames) two days a week. This enabled us to quantify the degree of both intra- and interfraction variability. We also investigated changes in patients having lifted either one arm or both arms during irradiation.

**Results:** The mean value of the intrafraction variability (n = 91), for marker as well as for anatomical match, is less than 2 mm (SD 1 mm).

The interfraction variability for patients with one arm (n = 84) and two arms (n = 105) lifted is shown in the table.

| | Skin markers | | | | | | | | Anatomical structures | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Horizontal | | | | Vertical | | | | First EPI as ref. image | | | | DRR as ref. image | | | |
| | Cran | Caud | Med | Lat | Cran | Caud | Med | Lat | CLD | CCD | MHD | BD | CLD | CCD | MHD | BD |
| 1 arm | | | | | | | | | | | | | | | | |
| μ: | −1.0 | −0.8 | −2.5 | −1.9 | 0.7 | 1.7 | −1.4 | 1.7 | 0.0 | 0.1 | −0.6 | −0.6 | 2.7 | −2.3 | 2.1 | 2.6 |
| Σ: | 2.7 | 3.1 | 3.1 | 5.2 | 3.9 | 4.0 | 5.1 | 5.6 | 2.5 | 2.4 | 2.7 | 2.7 | 3.0 | 3.9 | 2.3 | 4.9 |
| σ: | 2.2 | 2.6 | 3.3 | 2.9 | 2.8 | 3.0 | 2.9 | 3.0 | 2.0 | 2.5 | 3.2 | 3.2 | 2.0 | 2.6 | 3.1 | 2.1 |
| 2 arms | | | | | | | | | | | | | | | | |
| μ: | 0.4 | 0.0 | 0.4 | −0.4 | 0.3 | 0.8 | 0.6 | −0.1 | −1.4 | −0.2 | −1.4 | 0.2 | 0.2 | −1.0 | −0.7 | 1.5 |
| Σ: | 2.2 | 2.0 | 3.0 | 3.5 | 4.0 | 3.0 | 3.3 | 6.1 | 2.2 | 2.5 | 2.8 | 1.9 | 3.5 | 2.7 | 2.0 | 4.3 |
| σ: | 2.1 | 3.2 | 2.5 | 3.7 | 2.9 | 2.0 | 2.1 | 3.4 | 2.2 | 2.1 | 2.2 | 1.8 | 2.2 | 2.2 | 2.2 | 1.8 |

μ = mean of means; Σ = SD of means; σ = mean of SD; CLD = Central Lung Distance; CCD = Cranial Caudal Distance; MHD = Max. Heart Distance; BD = Breast Depth.

**Conclusion:** Our results point out that the intrafraction variability is limited: <2 mm. For the interfraction variability a difference appears in the patient outline between the DRR and EPI, and that μ doesn't correspond.

A potential pitfall for clinical use of the marker data is the recurring diversity in marker placement from day to day. There is no correlation between the movement of the skin markers and the anatomical structures, both visualised on the EPI.

The data enabled us to analyse the patient variability and develop a position verification protocol. Thus we were able to determine the optimal CTV-PTV margin for breast irradiation in our institute.

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**Prone versus supine breast irradiation in early stage breast cancer patients**

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**Introduction:** External beam radiotherapy for breast cancer patients is necessary after breast conserving therapy. Volume of breast tissue which needs to be irradiated is close to critical structures such as lung, heart; therefore an alternative prone position could be used to improve dose homogeneity during radiotherapy. The purpose of this study was to compare dose distribution within target and normal tissue volumes between two radiotherapy plans in prone and supine position in women with large and small breasts.

**Material and Methods:** 35 early breast cancer patients in clinical stage T1−2N0 were treated with breast conserving therapy and were dedicated for further radiotherapy. Planning CT was performed in a prone and supine position and two treatment plans for each patient were developed using conventional tangents technique. Dose volume histograms were produced and plans were compared with regard to dose volumes parameters.

**Results:** The mean doses to the target volume were (50.9±0.59 Gy for supine position and 50.3±0.81 Gy for prone position), minimum dose (39.2±4.1 Gy vs. 40±5.4 Gy) and maximum dose (54.9±0.76 Gy vs. 54.3±1.0 Gy), the dose in 95% of PTV was significantly higher in supine compare to prone position (48.4±1.05 vs. 47.1±1.34). The percentage of ipsilateral lung receiving >5, 10 and 20 Gy were significantly higher in