

## Customer Perspective

# An efficient tangential VMAT technique for whole breast irradiation

Tangential VMAT (tVMAT) for whole breast irradiation (WBI) ensures fast treatment delivery and target dose homogeneity, while sparing the heart and lungs

## Contributor

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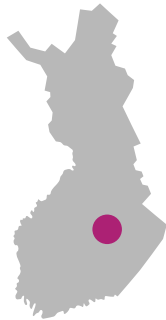
# About

## Kuopio University Hospital



### Location

Kuopio, Finland



### Staff

- 4 Radiation Oncologists
- 6 Medical Physicists
- 24 Radiotherapists
- 2 Service Engineers



### Equipment

- 1 Siemens SOMATOM Definition AS CT scanner
  - C-RAD optical surface imaging
- 1 GE Signa™ Artist 1.5T MRI scanner
- 3 Elekta Infinity™ linear accelerators
  - Agility™ MLC
  - XVI
  - C-RAD optical surface imaging
- 1 CyberKnife®
- 1 Flexitron® brachytherapy system
  - MIM auto-contouring software
  - Monaco® v 5.51 TPS (6 workstations)
  - MultiPlan TPS (4 workstations)
  - Oncentra® Brachy TPS (2 workstations)
  - MOSAIQ® OIS v 2.81



### Patients

- 1,450 new RT patients per year
- 300 breast cancer patients per year



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## Challenges of WBI

Kuopio University Hospital (KUH) is one of Finland's five university hospitals, serving a population of approximately 250,000 and with special national centers of excellence in neurology, cardiology and oncology. Situated in the Kuopio Science Park, the hospital is ideally located to collaborate with research centers and the University of Eastern Finland. The radiotherapy department specializes in treating cancer patients using stereotactic radiotherapy, brachytherapy and VMAT techniques, all relying on daily image guidance.

Radiotherapy for breast cancer patients represents around 20% of the department's case load. Adjuvant

radiotherapy following breast conserving surgery is known to decrease the rate of recurrence and to increase overall survival.<sup>1</sup> Before installing Elekta linear accelerators, breast radiotherapy at KUH was performed using a 3D-CRT field-in-field technique, and planar MV imaging for image guidance integrated on the treatment machine. This technique presented challenges for whole breast irradiation (WBI).

"With the field-in-field technique, planning limitations for WBI were related to hot and cold spots in the planning target volume [PTV]," explains Chief Physicist Jan Seppälä. "Also, in some cases, target coverage was compromised due to heart or lung dose constraints."

## Implementing breast tVMAT

When the department acquired Elekta linear accelerators and Monaco treatment planning system in 2013, it began using tangential volumetric modulated arc therapy (tVMAT) with daily CBCT to treat most cases, including breast cancer patients.

**"We began using tVMAT for breast radiotherapy almost straight away, having performed some planning simulations beforehand, comparing VMAT to 3D-CRT."**

### Jan Seppälä

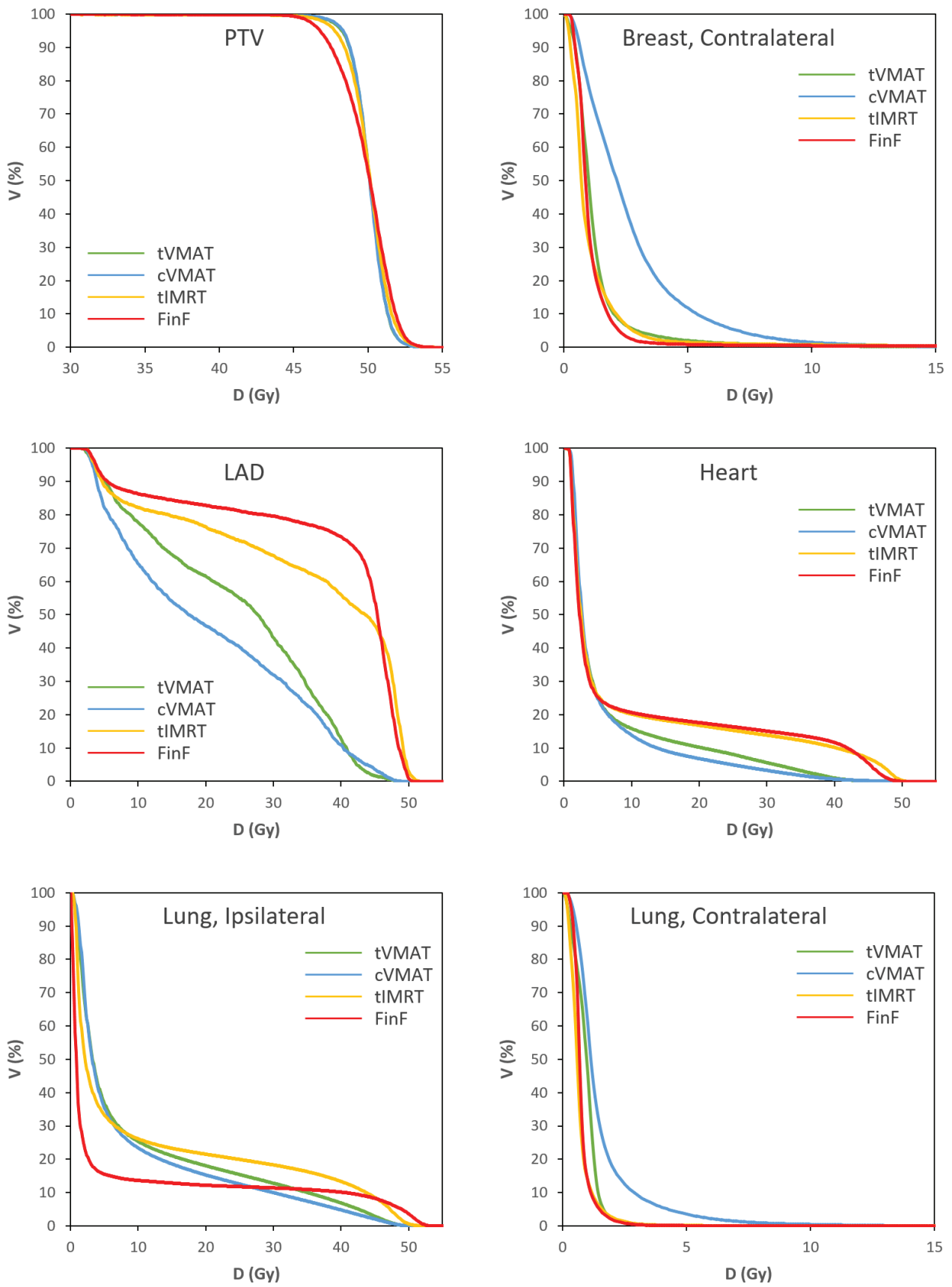
Chief Physicist, Centre of Oncology, Kuopio University Hospital

"We have since performed several investigations looking at different techniques for breast cancer radiotherapy.<sup>1-6</sup> Our main findings have been that, with proper optimization constraints and beam setup in the treatment planning system, VMAT can reduce doses to the heart and ipsilateral lung. The technique enhances dose distributions greatly, reducing hotspots, improving target volume dose

coverage and avoiding high dose irradiation of healthy tissue. Lastly, a low dose bath can be avoided."

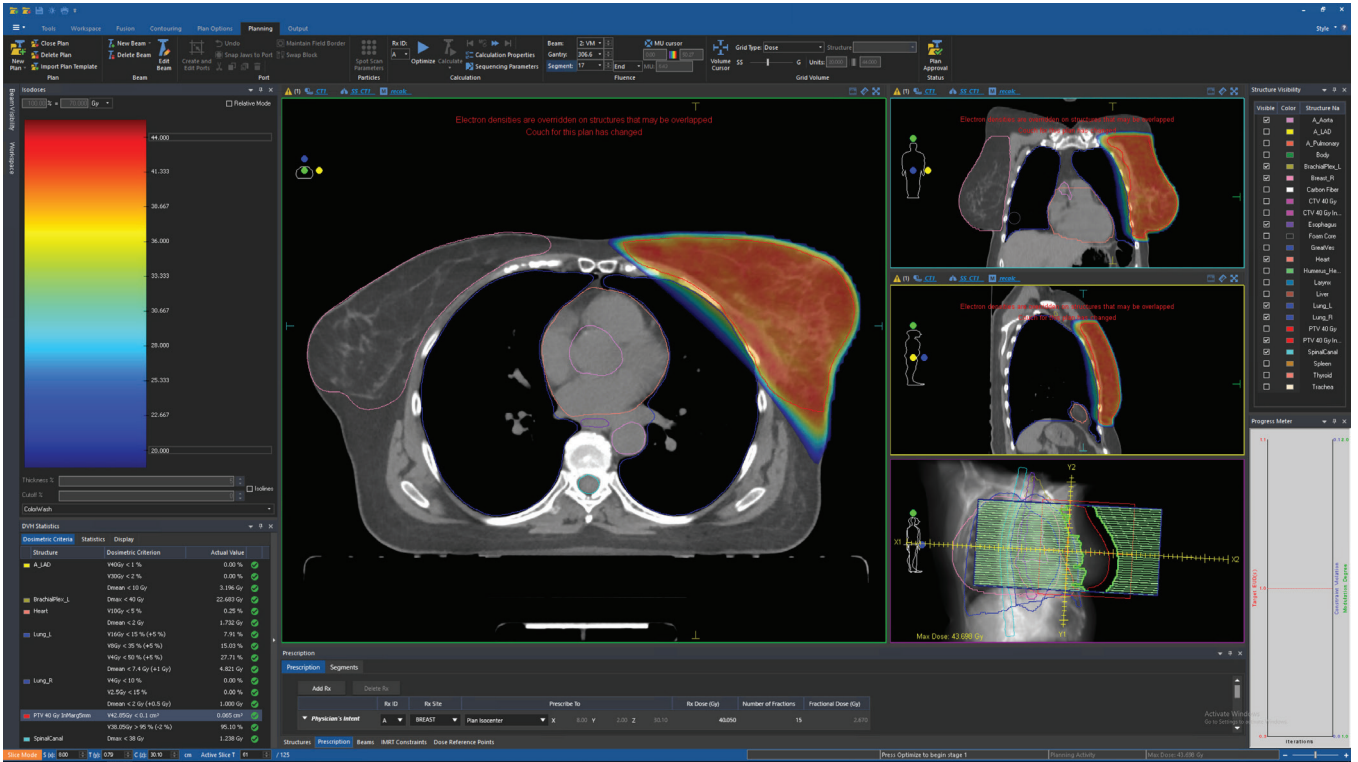
In a study of 10 left-sided breast cancer patients at KUH, tangential VMAT (tVMAT) with two dual arcs of 50–60° was compared to a standard tangential field-in-field technique (FinF), tangential intensity modulated radiotherapy (tIMRT) and continuous VMAT (cVMAT) with a dual arc of 240°. <sup>2</sup>

Both VMAT techniques significantly improved cardiac avoidance, dose coverage and dose homogeneity compared to FinF or tIMRT (Figures 1–2). <sup>2</sup> VMAT also decreased high dose areas (> 20 Gy) in the ipsilateral lung. Dose coverage was greatest with cVMAT, however this technique significantly increased dose to the contralateral breast. There were no significant differences in mean dose to the contralateral breast between tVMAT, tIMRT and FinF. The authors concluded that tVMAT is an effective method for achieving homogeneous dose coverage for WBI, observing that this technique reduces doses to the heart, the left anterior descending coronary artery and the ipsilateral lung without increasing dose to the contralateral breast or lung. <sup>2</sup>



**Figure 1.**

Average cumulative DVHs (n = 10) for the four different techniques studied. PTV, contralateral breast, left anterior descending coronary artery, heart, ipsilateral lung and contralateral lung.<sup>2</sup>



**Figure 2.** A distribution for a patient planned with cVMAT on Monaco 5.51 at KUH.

## An accurate and efficient workflow

The current workflow for breast tVMAT at KUH:

### Simulation

- The planning CT scan is obtained with a slice thickness of 3 mm.
- Left-sided breast cancer patients are imaged in breath-hold, using the C-RAD surface monitoring system.

### Treatment planning

- Auto-contouring of the target volume(s) and critical organs is performed (based on a national consensus atlas).
- The oncologist fine-tunes delineation of the target volume(s) and a treatment planner (either a radiation therapist or medical physicist) fine-tunes critical organ contours.
- The treatment plan is generated in Monaco, using a Monaco template for breast VMAT.

### Treatment preparation

- Once the treatment plan is ready, it is checked by a physicist and approved by an oncologist, the

plan is then automatically exported to MOSAIQ. This also includes the reference CT and prescribed relative offsets for the iso position. The plan promotion can now be completed seamlessly.

- To support a tattooless workflow, the C-RAD reference image is also transferred to MOSAIQ.

### Treatment delivery

- The C-RAD surface imaging system is used for patient setup and for guiding patient breath-holds.
- Daily low dose (0.4 mGy) CBCT image guidance is performed.
- The VMAT treatment is delivered in two arcs.

“We’re very happy with the new simplified workflow that is now achievable with Monaco HD and MOSAIQ 2.81,” Seppälä comments. “The automated transfer of data, including patient setup shifts, imaging fields and seamless plan promotion, has made the process easy.”

The total treatment time for breast VMAT, including patient setup, CBCT imaging, image matching and treatment delivery, is approximately 10 minutes without DIBH and about 15 minutes with DIBH, with an average beam-on time of less than two minutes.



“We have also found that the use of Flattening Filter-Free (6 MV FFF) beams has the potential to speed up tVMAT delivery for deep-inspiration breath-hold treatments without degrading the treatment plan dose distributions,<sup>3</sup>” he continues.

Currently, around 95% of all external beam radiotherapy (EBRT) patients at KUH, and 100% of breast EBRT cases, are treated using VMAT. Seppälä explains how Elekta solutions help them achieve accurate and efficient VMAT deliveries:

“Monaco templates are great for enhancing efficiency and standardizing the planning process,” he says.

“We have templates for right- and left-sided breast cancer patients with various dose levels [15 x 2.67 Gy, 5 x 5.2 Gy or 25 x 2 Gy] and for breast only, with lymph node involvement or for bilateral breast cancer patients (see insert and Figure 3). With Monaco optimization constraints we can minimize OAR doses quite nicely. We also find the Monaco autoflash margin option (an extension of the dose outside the body surface) very useful when planning and treating superficial targets, and we use a setting of 2 cm for every breast cancer treatment plan.

**“Our Elekta linear accelerators with Agility MLC have the precision required for highly accurate dose delivery and VMAT ensures fast treatment deliveries.”**

#### **Jan Seppälä**

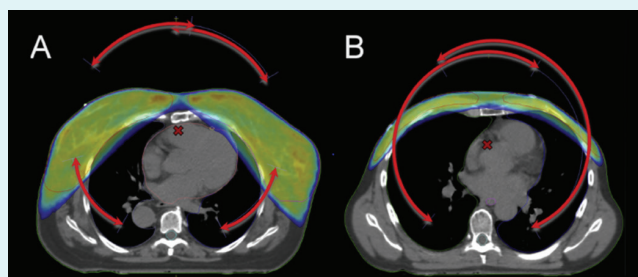
Chief Physicist, Centre of Oncology, Kuopio University Hospital

“We use daily CBCT image guidance for every patient, with the imaging dose optimized to be as low as possible for breast cancer patients. Daily soft tissue image matching allows us to use relatively small (5 mm) CTV to PTV margins. CBCT imaging complements VMAT treatments greatly, because we can see if there are any breast deformations or anatomical changes during the treatment course. If large (> 1 cm) systematic changes occur on the patient surface that would affect dose distributions, then we will replan.

“The C-RAD surface imaging system is used for positioning every breast and lung cancer patient,” he adds. “We no longer use tattoos for setting up these patients. The C-RAD system is also employed to treat left-sided breast cancer and lung patients using a deep inspiration breath-hold (DIBH) technique if the patient is capable of holding their breath. Currently, approximately 90% of left-sided breast patients and about 66% of lung patients with radical intent are treated with DIBH.”

### **Single isocenter VMAT for bilateral breast irradiation**

Traditional treatment planning for bilateral breast irradiation (BBI) is challenging because overlapping tangential fields are usually unavoidable without compromising target coverage. The team at KUH has implemented a single isocenter VMAT technique for BBI. Compared to the standard tangential field technique, clinicians have found that VMAT improves PTV dose coverage and dose homogeneity, avoiding hotspots and improving lungs and heart sparing.<sup>4</sup> Treatment time for single isocenter VMAT delivery of BBI is less than 15 minutes, including daily CBCT imaging.



**Figure 3.** VMAT field arrangements (red arcs) and axial dose distributions for two patients studied (A and B) with a dose color wash ranging from 35 Gy to 60 Gy.<sup>4</sup> The single plan isocenter is marked with a red cross.

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## Enhancing patient care

Reported side effects of breast radiotherapy include breast fibrosis, changes in breast appearance, and late pulmonary and cardiovascular complications.<sup>2</sup> Dose inhomogeneity in the treated breast is a predictor of fibrosis, erythema, moist desquamation and edema.<sup>2</sup> Consequently, methods that ensure dose homogeneity, while reducing dose to the heart, LAD and ipsilateral lung are preferable to avoid these treatment-related complications.

The experience of the KUH radiotherapy department is that tVMAT can achieve these treatment goals, and contralateral doses can be kept to low levels despite using VMAT. The radiotherapy department is currently evaluating ProKnow for clinical application and sees a lot of potential for analysis of patient outcome data, such as the correlation of cosmetic outcomes with a change in technique. Seppälä reports that cosmetic results following breast radiotherapy at KUH have been greatly improved when compared to earlier symptoms recorded with the 3D-CRT (mostly field-in-field) techniques.

“With the tVMAT technique, we have much less skin toxicity than we used to have with previous 3D-CRT techniques,” he says. “With tangential VMAT, we have the benefits of a VMAT delivery and can remain confident that there will be no low dose bath. In addition, when combining tVMAT with deep inspiration breath-hold (DIBH), patients do not have to hold their breath while the other tangential beam is loaded, and the gantry is in the correct position. This makes it more convenient for the patients.”

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“Our department is very satisfied to treat our breast patients using such a novel technique with so little toxicity. I would, and have, recommended this method to other clinics.”

**Jan Seppälä**

Chief Physicist, Centre of Oncology, Kuopio University Hospital

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## Disclaimer

This customer perspective is based on the experience and application of medical experts, and is intended as an illustration of an innovative use of Elekta solutions. It is not intended to promote or exclude any particular treatment approach to the management of a condition. Any such approach should be determined by a qualified medical practitioner.



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