
AK IMRT Würzburg

26./27.03.2009

Roland Kramer, Conmedica GmbH, Schriesheim

CONMEDICA

High End Radiotherapy

AK IMRT Würzburg

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visionrt

- Company Background
- AlignRT®
- GateCT® and GateRT®
- International Collaboration

- Vision RT Ltd
Founded in 2001 (UK based)
- Highly innovative R&D team
Key focus: Radiation Therapy
- Clinical/Development Collaborations
Leading International Institutions
- AlignRT[®] CE marked
September 2005
- GateCT[®], GateRT[®]
Products newly released

Patient Setup

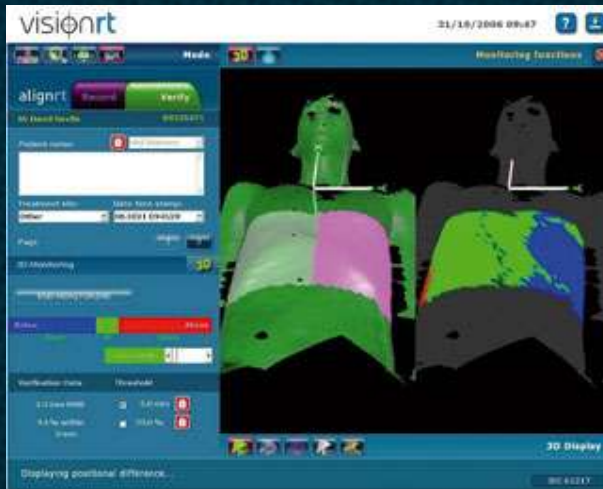


- Influence of anatomy on tumour shape
Arm position and breast
- Interdependence of adjacent targets
Head, Neck and shoulders
- Unnecessary Irradiation in certain anatomical sites
Breast

Treatment Delivery



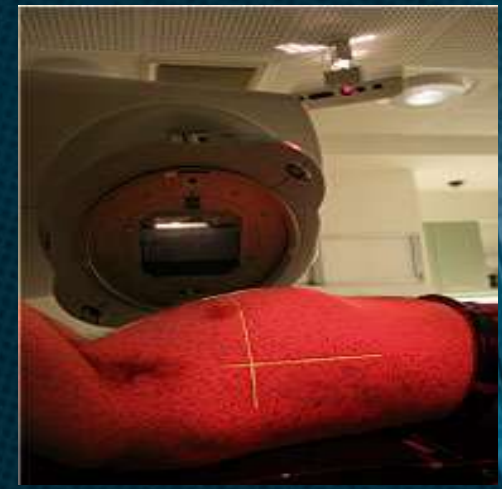
- Patient Movement
Introduction of systematic error – geographic miss
- Patient Breathing
Adjacent critical organs at risk
- Surface shape change
Critical with proton treatment - overshoots and undershoots



alignrt®



gatect®



gatert®

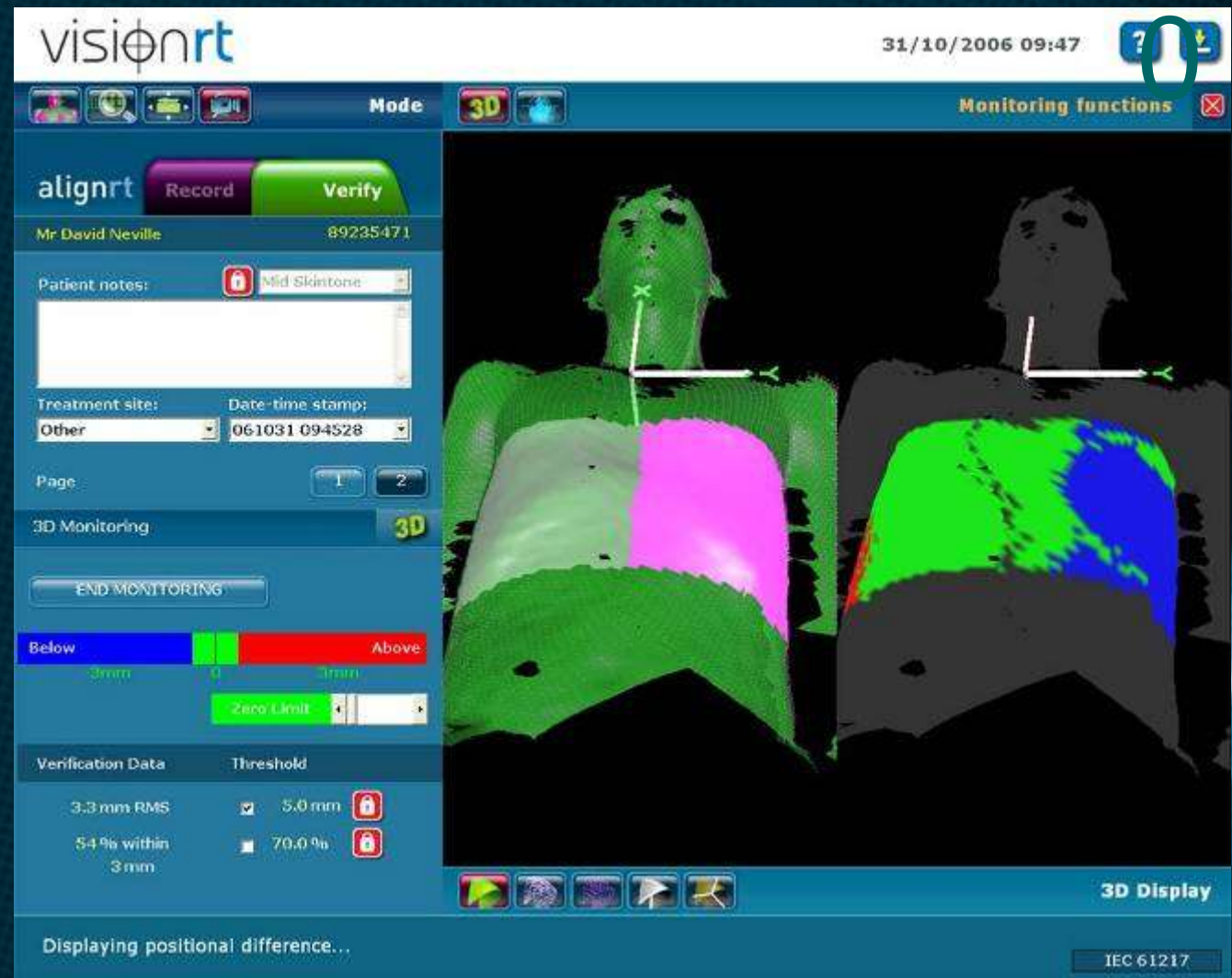
STATE OF THE ART IN 3D PATIENT TRACKING







- Patient Setup
- Surveillance



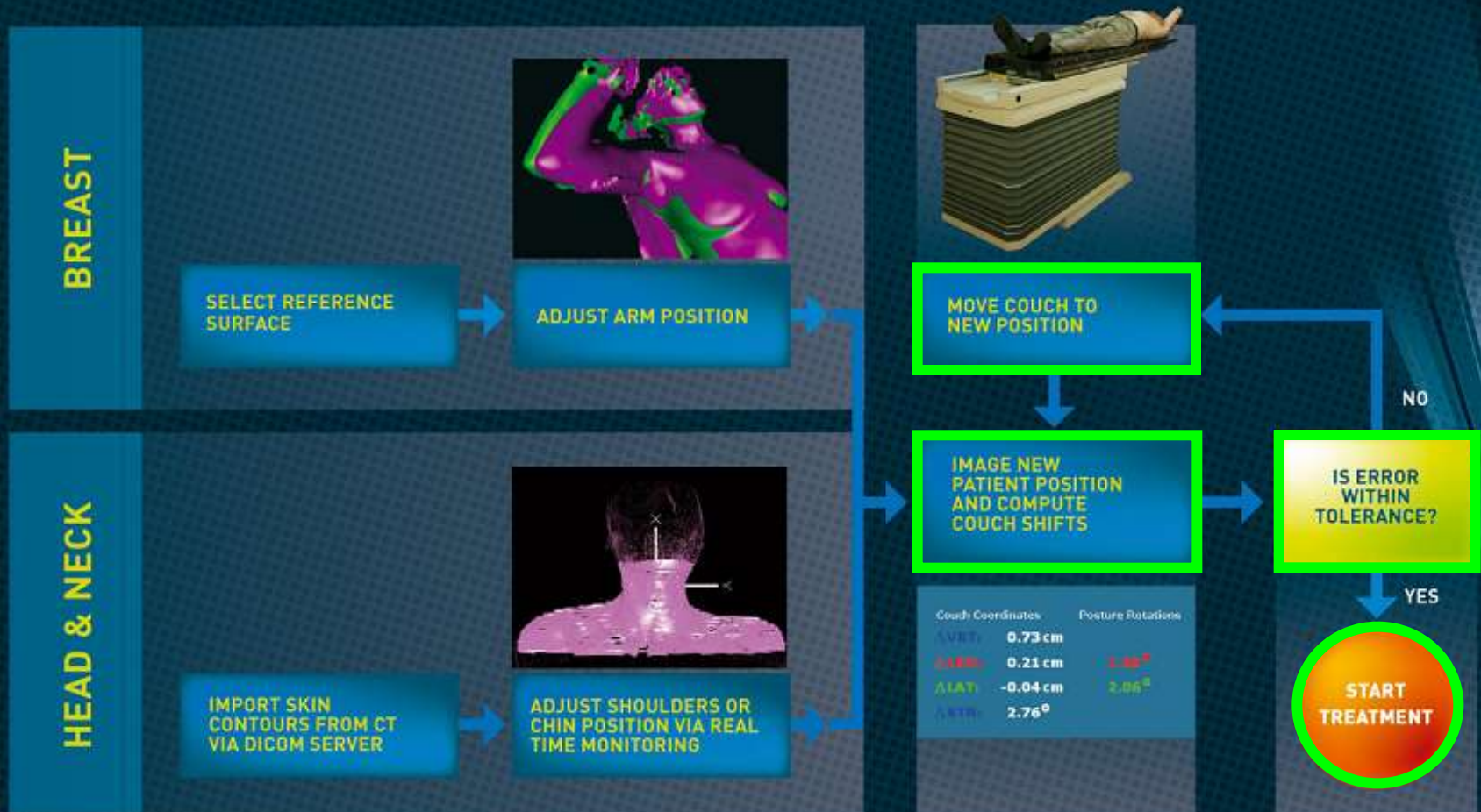
PATIENT SETUP



SURVEILLANCE



alignrt® PATIENT SETUP: CLINICAL WORKFLOW 13





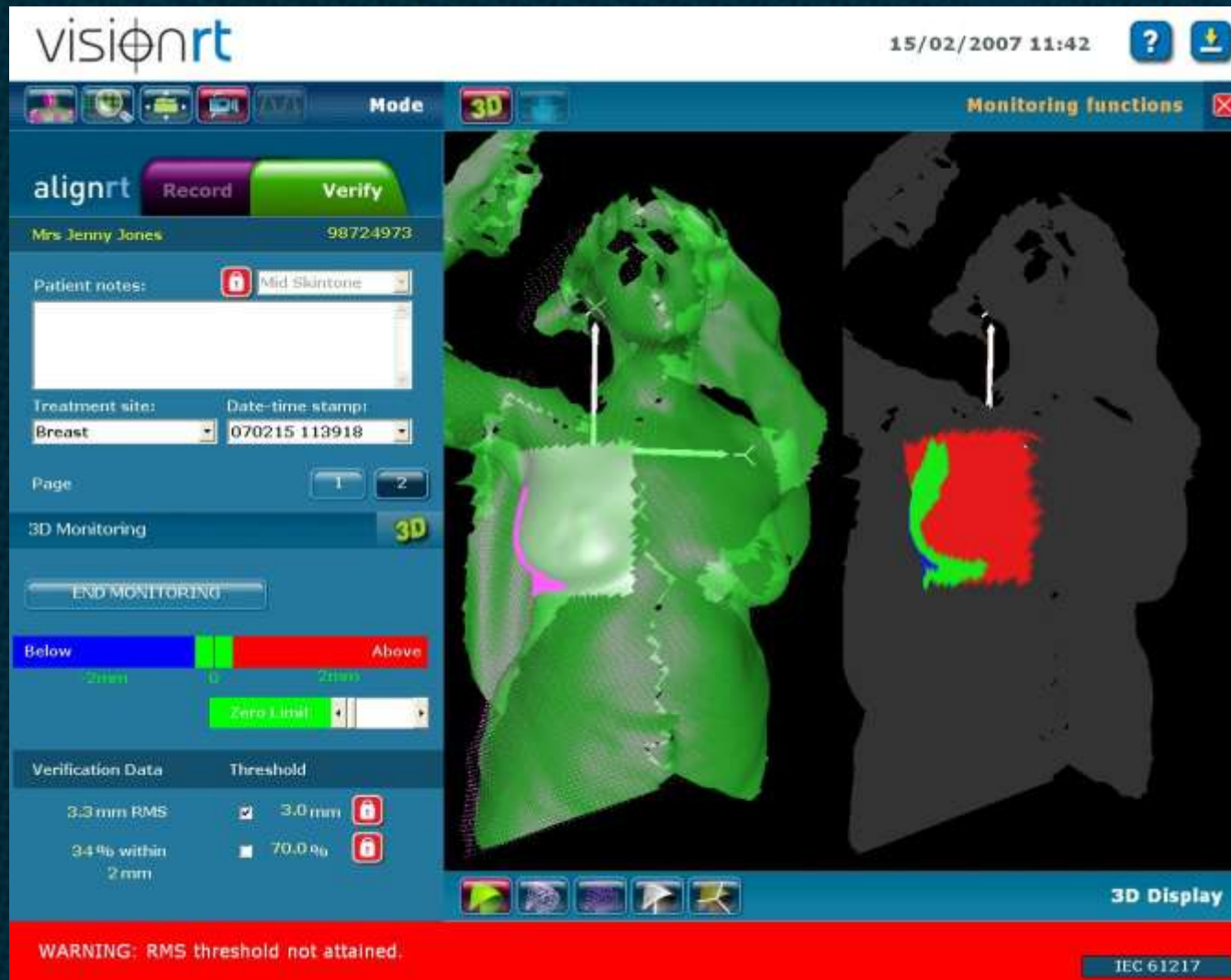
Where is the patient?

During Imaging

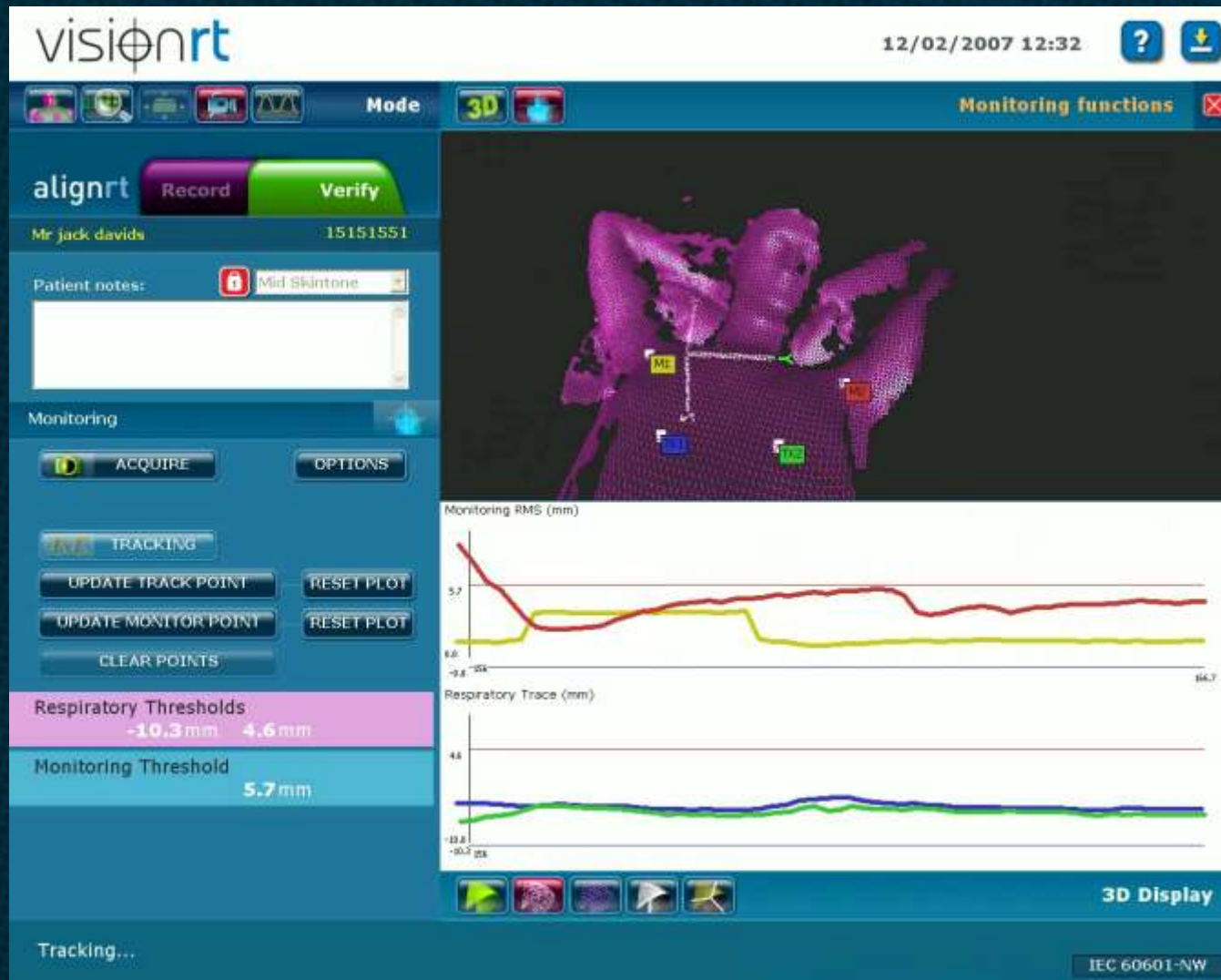
During Treatment Delivery

alignrt® SURVEILLANCE : COLOUR MAPPING

15



alignrt® DECOUPLING BREATHING AND MOVEMENT 16





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PHYSICS CONTRIBUTION

CLINICAL EXPERIENCE WITH A 3D SURFACE PATIENT SETUP SYSTEM FOR ALIGNMENT OF PARTIAL-BREAST IRRADIATION PATIENTS

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Purpose: To assess the utility of surface imaging on patient setup for accelerated partial-breast irradiation (APBI).

Methods and Material: A photogrammetry system was used in parallel to APBI setup by laser and portal imaging. Surface data were acquired after laser and port-film setup for 9 patients. Surfaces were analyzed in comparison to a reference surface from the first treatment session by use of rigid transformations. The surface model after laser setup was used in a simulated photogrammetry setup procedure. In addition, breathing data were acquired by surface acquisition at a frame rate of 7 Hz.

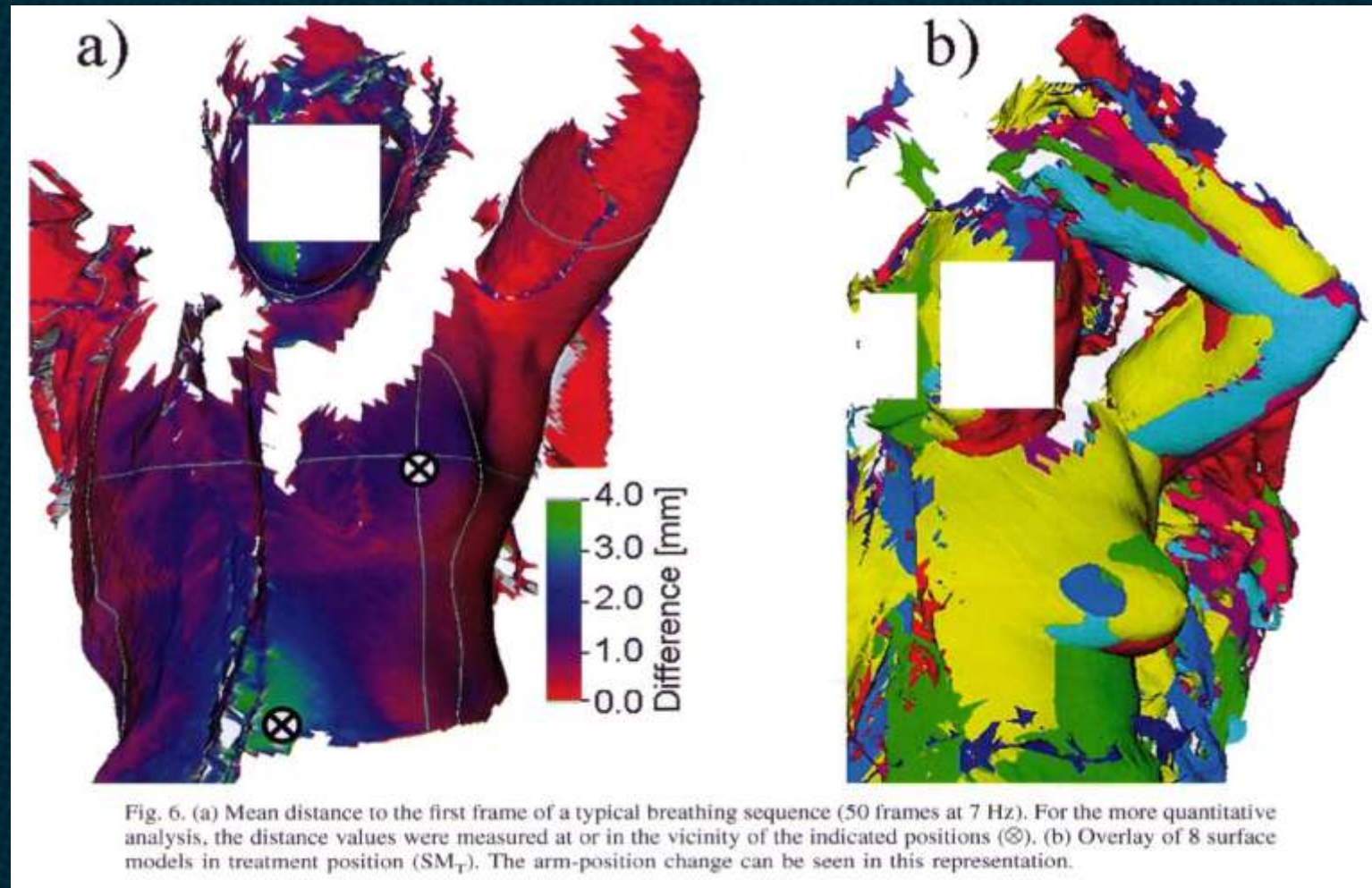
Results: Mean 3D displacement was 7.3 mm (SD, 4.4 mm) and 7.6 mm (SD, 4.2 mm) for laser and port film, respectively. Simulated setup with the photogrammetry system yielded mean displacement of 1 mm (SD, 1.2 mm). Distance analysis resulted in mean distances of 3.7 mm (SD, 4.9 mm), 4.3 mm (SD, 5.6 mm), and 1.6 mm (SD, 2.4 mm) for laser, port film, and photogrammetry, respectively. Breathing motion at isocenter was smaller than 3.7 mm, with a mean of 1.9 mm (SD, 1.1 mm).

Conclusions: Surface imaging for PBI setup appears promising. Alignment of the 3D breast surface achieved by stereo-photogrammetry shows greater breast topology congruence than when patients are set up by laser or portal imaging. A correlation of breast surface and CTV must be quantitatively established. © 2006 Elsevier Inc.

Partial-breast irradiation setup, Surface imaging, Radiotherapy.

INTRODUCTION

Video-based patient setup has been used for patient setup for a number of years (4–12). Multiple approaches are used



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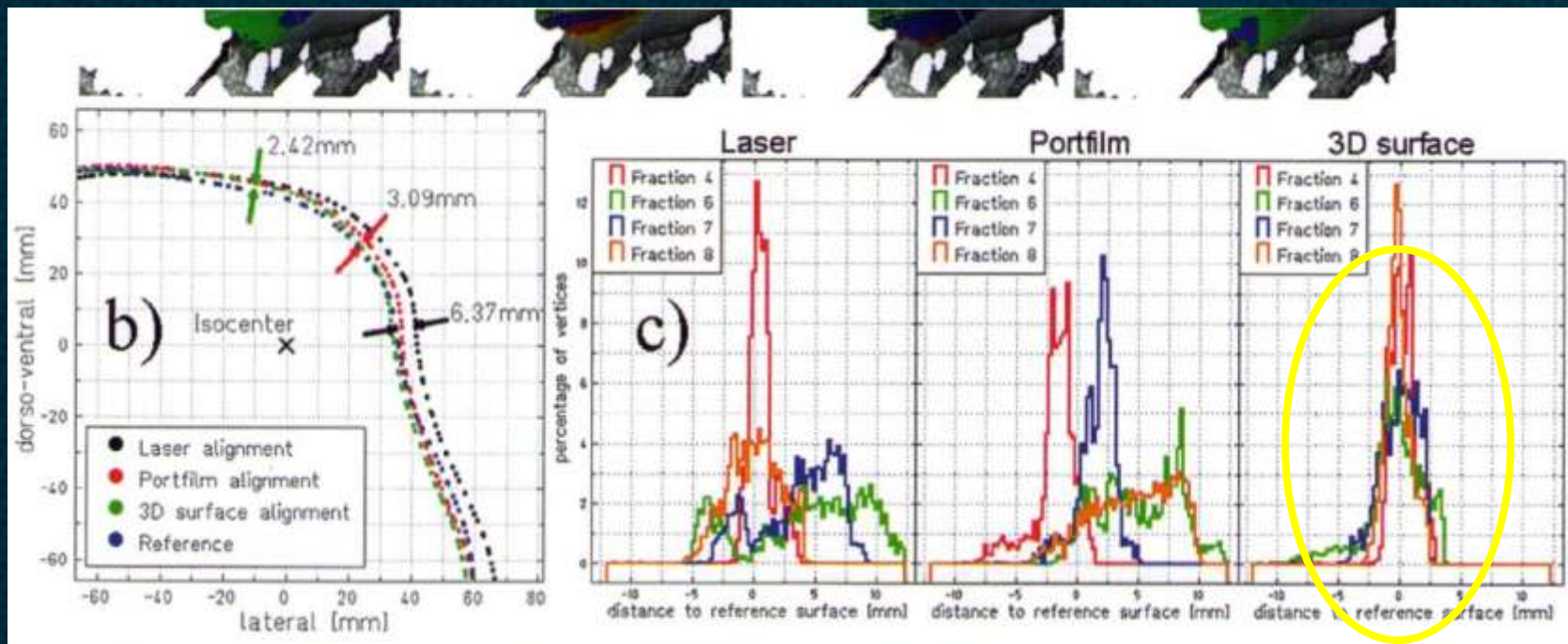


Fig. 5. (a) Distance data for 4 fractions and 3 modalities in color-wash representation for a typical patient. Underneath the color wash is the textured reference surface model from the first fraction. The white lines represent virtual lasers, and the white crosses indicate positions for distance measurements obtained by use of the axial contours through isocenter shown in (b). A quick congruence check with respect to the reference surface model is possible if the distance data are presented in the form of histograms (c).

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of time at any specified surface point. Breathing motion is assessed at treatment isocenter and at a point in the abdomen (Fig. 6a). Because of missing surface patches or view obstructed by clothing, identification of the same coordinates for all treatment fractions of a specific patient frequently was not possible. In such cases, the closest possible point was chosen.

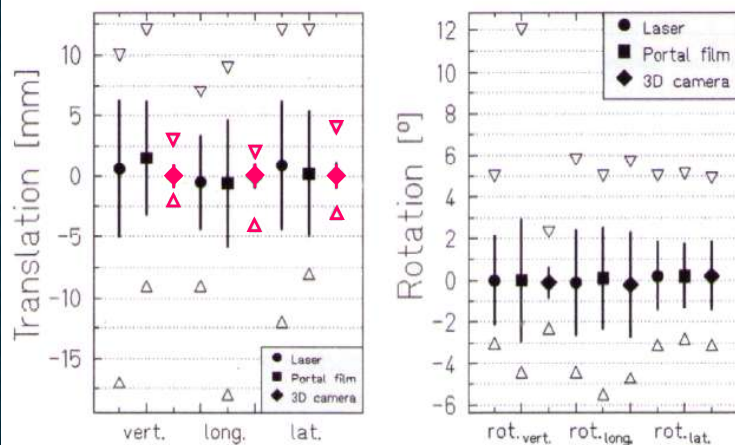


Fig. 7. Mean \pm standard deviation with minimum (Δ) and maximum (∇) of the couch shift required to bring the corresponding surface model back to reference. Data are from 9 patients, and 44 fractions were analyzed.

RESULTS

Recommended couch shifts

The patient-alignment procedure provides the therapist with couch shifts to bring the surfaces in an ROI into alignment. These shifts are based on a rigid-body transformation that minimizes the distance between the SM acquired for setup and the SM_R . In off-line analysis, recommended shifts were calculated for all SM_L , SM_T , and SM_V acquisitions. Data from 9 patients and 44 fractions (plus 9 as reference) are combined in Fig. 7. For each degree of freedom, the mean, standard deviation, maximum, and minimum of recommended shift are plotted. The resulting 3D displacements are summarized in Table 1.

Table 1. Three-dimensional displacement (in mm) as recommended by the alignment procedure

Surface model	Mean	Standard deviation	Minimum	Maximum
Laser	7.3	4.4	1	17.6
Treatment	7.6	4.2	1.7	19.3
Virtual 3D alignment	1	1.2	0	4.2

C. Bert et al. Clinical experience with a 3D surface patient setup system for alignment of partial-breast irradiation patients. International J. of Radiation Oncology Biology Physics: 64(4), pp. 1265-1274, March

SURFACE TRACKING FOR 4D CT RECONSTRUCTION



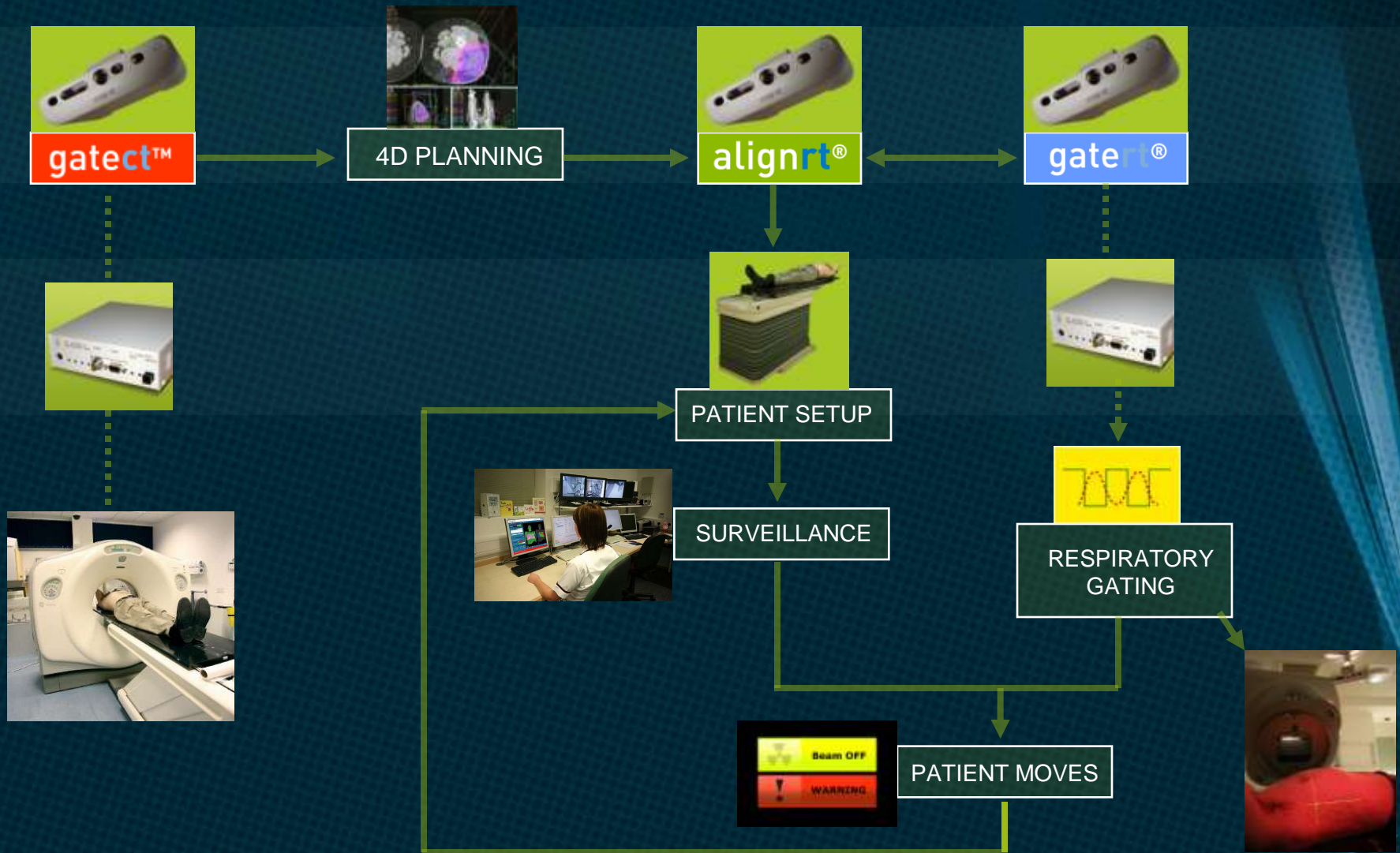
REAL TIME, MARKERLESS, RESPIRATORY GATING



THE POTENTIAL

- 3D surface provides reference for repositioning;
- Multiple points or a region of surface may be tracked
- Points/region for tracking may be selected remotely, and repeatedly from fraction to fraction
- Multiple parameters may be derived from real time surface data from which phase and amplitude may be extracted
- Provides the potential for more precise modelling of internal motion

Works in progress.





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TECHNICAL ADVANTAGES

- Markerless and non-invasive
- Can be used online and remotely
- Images entire 3D surface
- Analysis of multiple regions of interest
- Auto patient correction
- No ionizing radiation

CLINICAL ADVANTAGES

- Enables 4D CT reconstruction
- Allows interactive correction of non rigid anatomy
- Real time surveillance
- Respiratory gated imaging and delivery
- Real time surface tracking

-
- Vielen Dank für Ihre Aufmerksamkeit.
-



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