

*PROSTATE PATIENT  
POSITIONING WITH ULTRASOUND  
BEFORE EACH FRACTION  
IN TELETHERAPY*

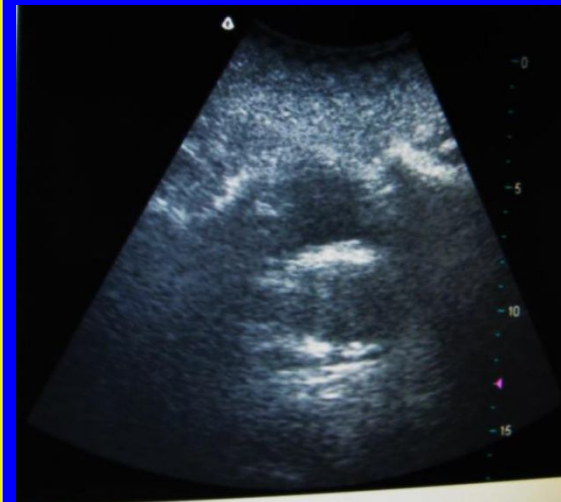
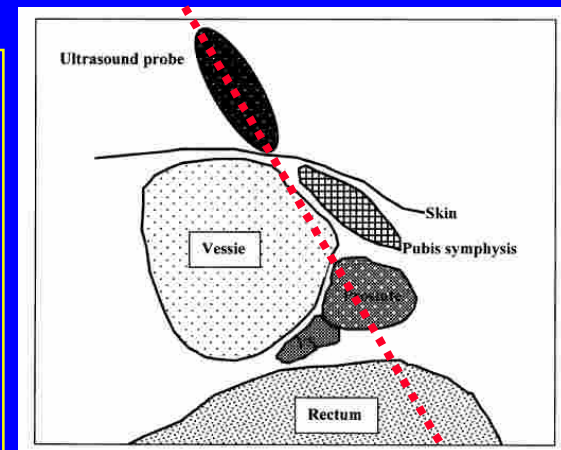
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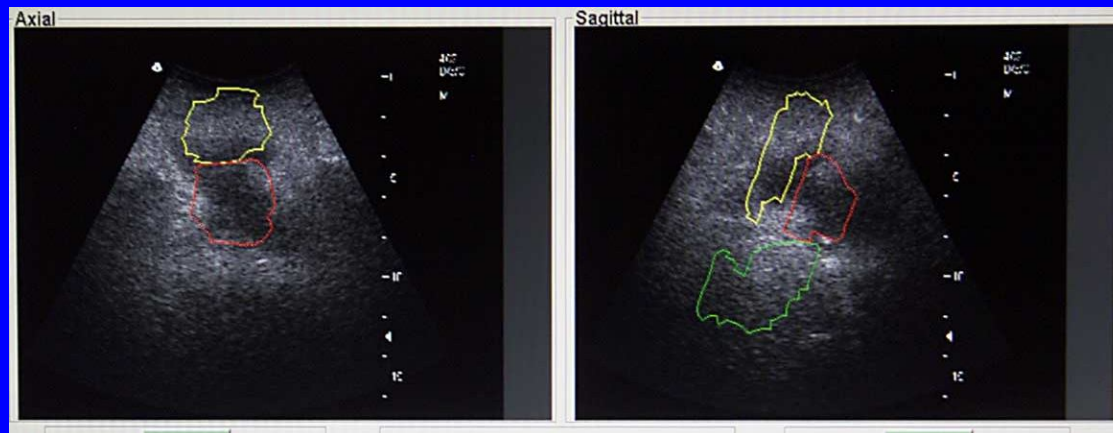
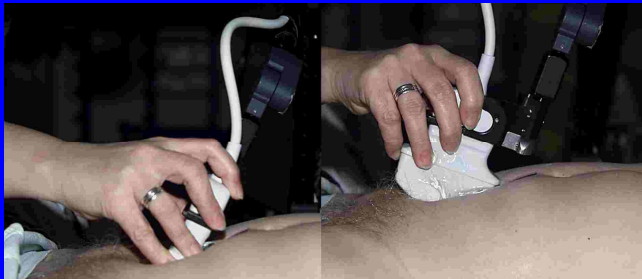
- „History“ with BAT-System
- Change to and setting up the CLARITY-system (ELEKTA)
- Experiences since 2013
- Outlook




# *Why Ultrasound?*

- You can „see“ prostate, bladder, rectum,...
- Fast, not much training necessary, (rather) cheap,...
- → US offers the possibility of daily controls – necessary because of organ mobility
- US is routine in many other disciplines
- Combination US/CT, US/MR, US/planning no problem anymore



# *BAT-system (NOMOS); in use 2004-2011*



Required Couch Movements	
RIGHT	
	0.50 cm
DOWN	
	0.38 cm
OUT	
	0.25 cm

Not really 3D – but the idea transferred to Clarity  
 Important: Overlaying of US, CT and planned contours  
 Deviation of structures (in x,y,z) is given → table movement

# *Some experiences*

## Patient movement depending on room orientation

	re	li	ant	post	cran	caud
<b>Summe</b>	877	852	779	950	1246	483
<b>≤ 1cm</b>	839	811	627	702	1065	474
<b>%</b>	<b>95.7</b>	<b>95.2</b>	<b>80.5</b>	<b>73.9</b>	<b>85.5</b>	<b>98.1</b>
<b>durchschn. Abw. (mm)</b>	<b>3.2</b>	<b>3.2</b>	<b>5.9</b>	<b>7.3</b>	<b>5.4</b>	<b>3.0</b>

**Maximum deviations registered:**  
**35mm ant/post**  
**26mm other directions**

**/1/ Futschek, T. et al:** Positioning of prostate patients by IGRT using the BAT-US system.  
 RadiotherOncol (2006), Vol 81, Suppl 1, S435

# *Resonant Clarity taken over by ELEKTA*

- 2011 BAT went out of service, no European distributor; communication with US was „challenging“
- Look for a new system – Clarity (ELEKTA), in 2012 appr. 80 systems installed worldwide



**RESONANT CLARITY (2008)**  
New:IR-guidance

# *Some challenges when setting up*

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- Setting up the system was “not easy”!
- Main reason was the system’s integration into the existing hospital networks
  - image handling (incl. long storage)
  - communication with treatment planning system (XIO, ELEKTA)
  - Due to legal requirements, rules for server security and patient data protection had to be observed.
- ~months necessary until system was really integrated into the institute’s network; also including problems after shutdowns for testing emergency power supply



# *CT, Lasers and Clarity*

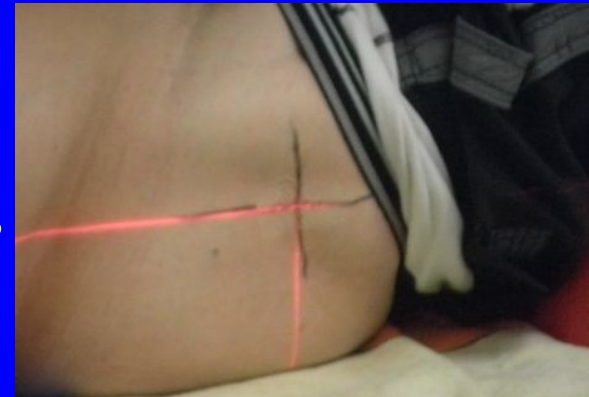


TOSHIBA Aquilion CT-simulator  
1...infrared positioning, 2...CLARITY US-system



## *Patient's way at CT*

- Patient is marked at the CT-simulator with tattoos and set into reference position
  - US is performed
  - CT-markers are fixed on the tattoos
  - CTs are taken
- CTs sent to TPS (XIO; CMS) and outlined, sent to Clarity (ELEKTA), matched with US, sent back to XIO, organs contoured there, treatment planning is performed and sent back to Clarity → complicated because of problems in sending CTs + contours!



# *Data management*

## *Clarity – TPS - LANTIS*

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- Plan sent to LANTIS verification system
- Plan + US-data sent to Clarity server
- Problem: we only have one mobile unit, which has to be transferred between CT and linac. Exact patient coordination is necessary that no patients are at linac and CT at the same time!
- Before starting US on a patient, portal images are taken at the linac during the first fraction (legal reasons for field documentation)

# *Patient's way at the linac (I)*



First patient  
setup with lasers



Additional  
control for  
table  
movement



Patient scanning  
one arc with probe!

Room for improvement: start/stop  
button for acquisition on the probe!

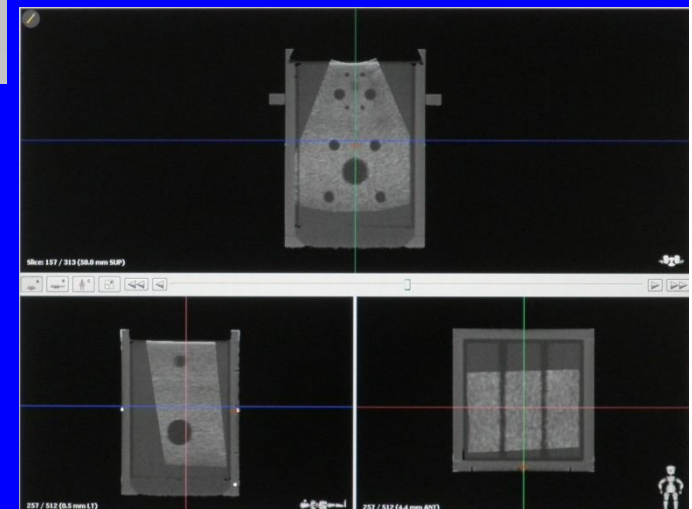
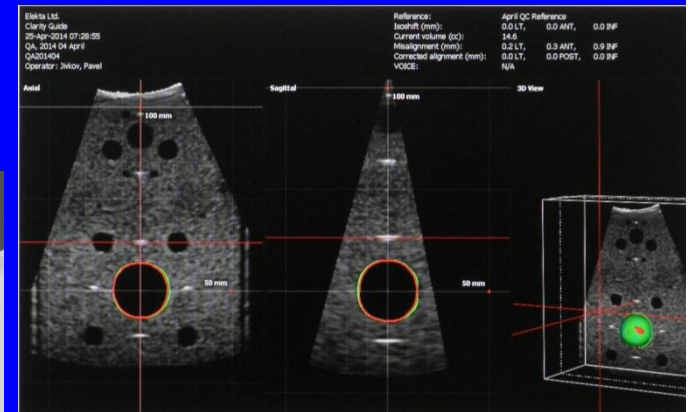


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- The monitor displays a 3D visualization of a patient's internal organs, likely the lungs, with a red crosshair indicating a specific point of interest. The interface includes various control buttons and data readouts.
- Top Left:** Three small 2D cross-sectional images showing different views of the patient's anatomy.
- Top Right:** A table of measurements and orientations:
- | Measurement | Value | Orientation |
|-------------|-------|-------------|
| 0.4 mm      | LT    | 1.0 mm LT   |
| 5.6 mm      | POST  | 0.3 mm POST |
| 4.2 mm      | SUP   | 4.3 mm SUP  |
- Bottom Left:** A table of patient data:
- | Parameter              | Value | Unit  |
|------------------------|-------|-------|
| Weight (kg)            | 65.0  | kg    |
| Height (cm)            | 170.0 | cm    |
| Body Mass Index (BMI)  | 22.6  | kg/m² |
| Heart Rate (bpm)       | 65    | bpm   |
| Respiratory Rate (bpm) | 12    | bpm   |
| SpO2 (%)               | 98    | %     |
- Bottom Right:** A table of patient data:
- | Parameter              | Value | Unit  |
|------------------------|-------|-------|
| Weight (kg)            | 65.0  | kg    |
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| SpO2 (%)               | 98    | %     |
- Bottom Center:** A row of buttons: Patient, Scan, Segment, Setup, Position, and R&V.
- Bottom Right:** A row of icons: a green checkmark, a plus sign, and a gear icon.
- Bottom Far Right:** User information: User alexandra.sigmund, Server, and Tilt.



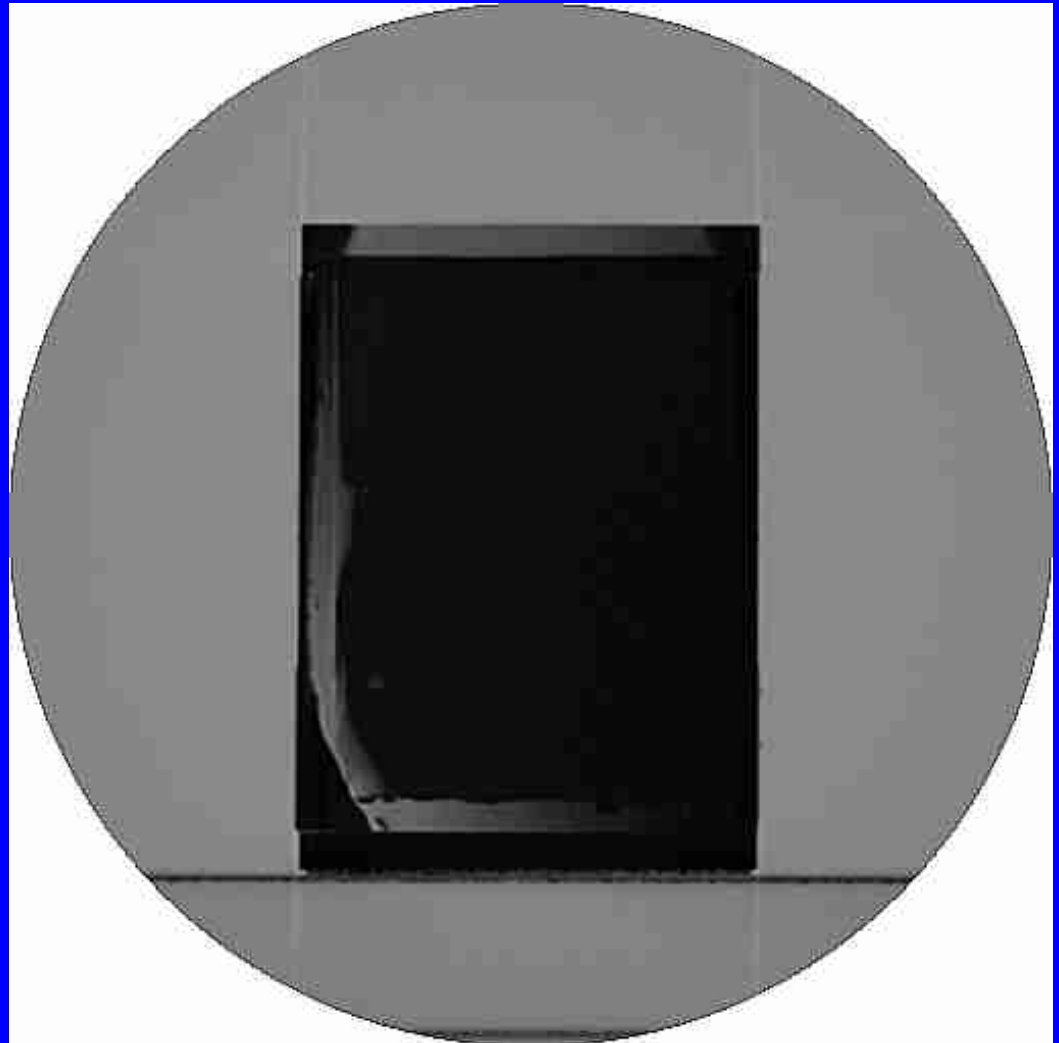
# *Daily and monthly checks*

- Daily checks at linac with US-phantom
- Monthly checks at CT – comparison CT/US
- Experiences:
  - 8 months reference point within a 1mm sphere
  - Some degrading in last time – phantom?



# *What happened last Friday...*

- Phantom fell down during daily check
- Offer (reduced) for a new phantom: 13.5K €
- Problem: gel inside may dry out and shrink – internal markers change position.





# *Some experiences with patients*

- 2014: 159 prostate cases in our department
  - 111 primary prostate cancer
    - 73 IGRT with Clarity, some with IMRT
    - 38 permanent implants (I-125)
  - 48 prostate beds
- 2015, 01-10: 60 pat. with Clarity
- 71 pat, 37fractions/pat:  $\approx 2600$  treatments/a; that means  $\approx 10$  treatments/d
- 3-5min for US: additionally  $\approx 40$ min/d in total treatment time

# *Experiences (I)*

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- The system works fine in routine
- Of great importance is the US/CT-fusion for contouring and the 3D US acquisition; this procedure needs routine (eg pressure with US-probe)
- The hardware is stable and the infrared positioning devices in treatment room and CT work well.
- Communication with the other systems and data storage is stable now.

## *Experiences (II)*

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- (Minor) problems with the daily checks – constancy of phantom?
- Software handling esp. for monthly checks could be made easier.
- Comments on image acquisition should be possible for documentation and later control

- Current version: 3.1
- User-friendliness still may be improved
  - The existing software is a combination of different software modules with different ways of navigation making it hard to work with.
  - Numbers on the screen sometimes are too small (reason is a high resolution screen for US-images).
  - Better description of daily and monthly checks.
- But: despite of these points it works fine in routine!