



# IGRT'de USG Kullanımı

Medikal Fizik Uzmanı  
**Dr. Öğr. Üyesi İ. Faruk DURMUŞ**

Yeni Yüzyıl Üniversitesi Özel Gaziosmanpaşa Hastanesi Radyasyon Onkolojisi Bölümü

# ULTRASOUND

Probların içinde çok sayıda piezo elektrik kristali adı verilen quartz kristal bulunur. Kristale pulslar halinde uygulanan voltaj ile dipol boyutlarının deęişmesine baęlı olarak titreşen kristal ses dalgaları üretir.



Doku veya ortama gönderilen ses dalgaları, her ara kesitten dönen ekolar kristalde basınç deęişikliği yaparak dipollerin yönlerinin deęişmesine neden olur.

Tipik olarak bir ultrasound probunda yaklaşık 300 kristal bulunur. Bu kristaller birbirlerinden bağımsız olarak ses dalgası üretir ve kendilerine ulaşan yansımaları elektrik akımına çevirirler.

Sonuçta saniyede yaklaşık 30 görüntü elde edilir ve bu 30 görüntü monitörde hareketli film gibi izlenir.



Akustik hız: ses hareketinin ortamdaki hızını tanımlamaktadır. Belirli bir ortamda ultrason hızı sabittir.

Yağ: 1450 m/sn Su: 1480 m/sn Yumuşak doku: 1540 m/sn Kemik: 4100 m/sn Hava: 330 m/sn

# RADYOTERAPİDE IGRT İÇİN KULLANILAN USG'LER



BATCAM  
[www.nomos.com](http://www.nomos.com)



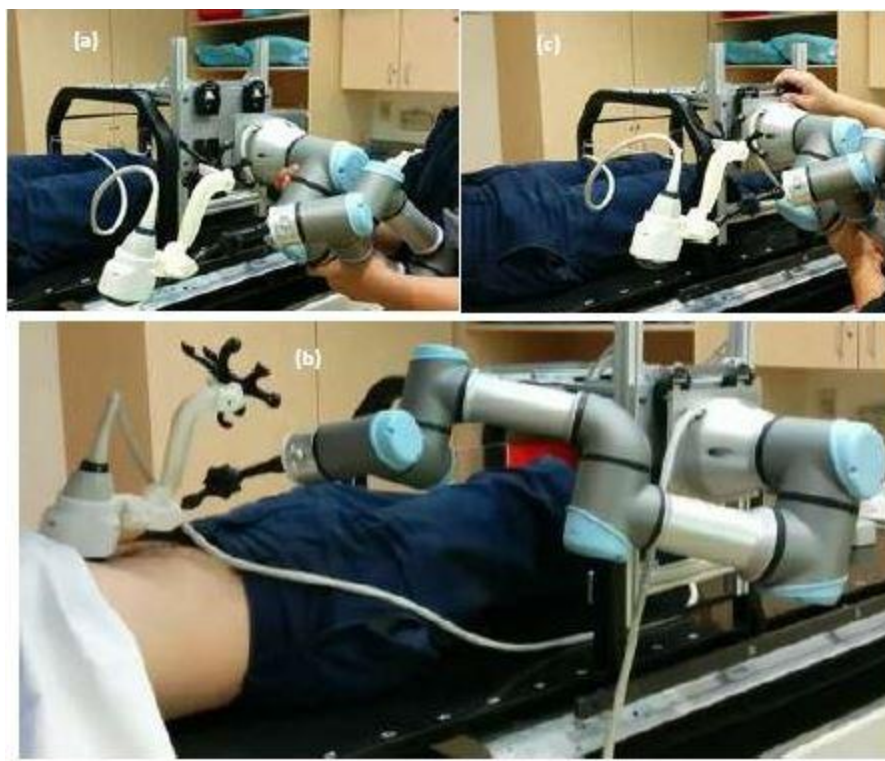
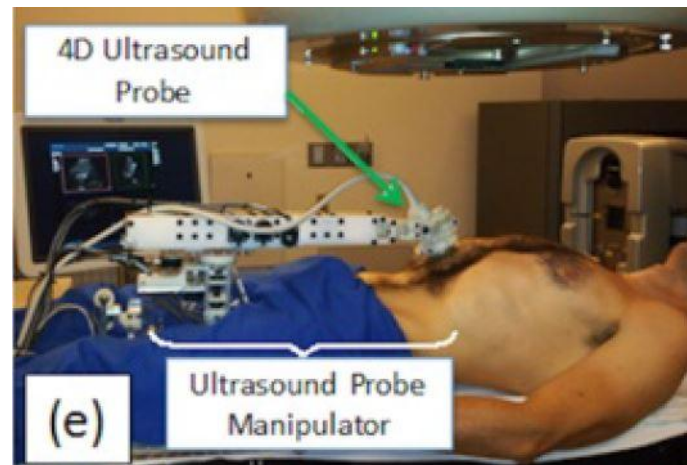
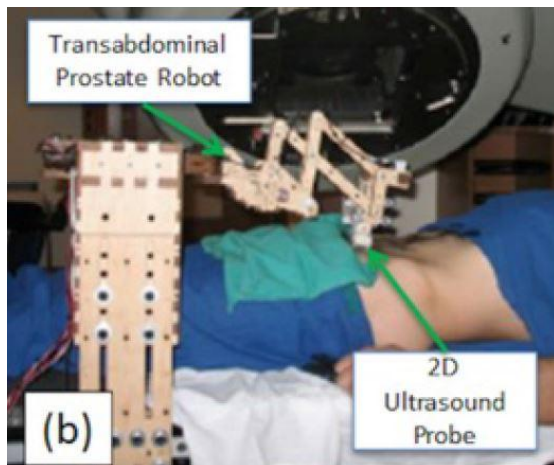
SonArray  
[www.varian.com](http://www.varian.com)



I-Beam  
[www.cmsrtp.com](http://www.cmsrtp.com)



Clarity  
[www.elekta.com](http://www.elekta.com)





# Clarity USG

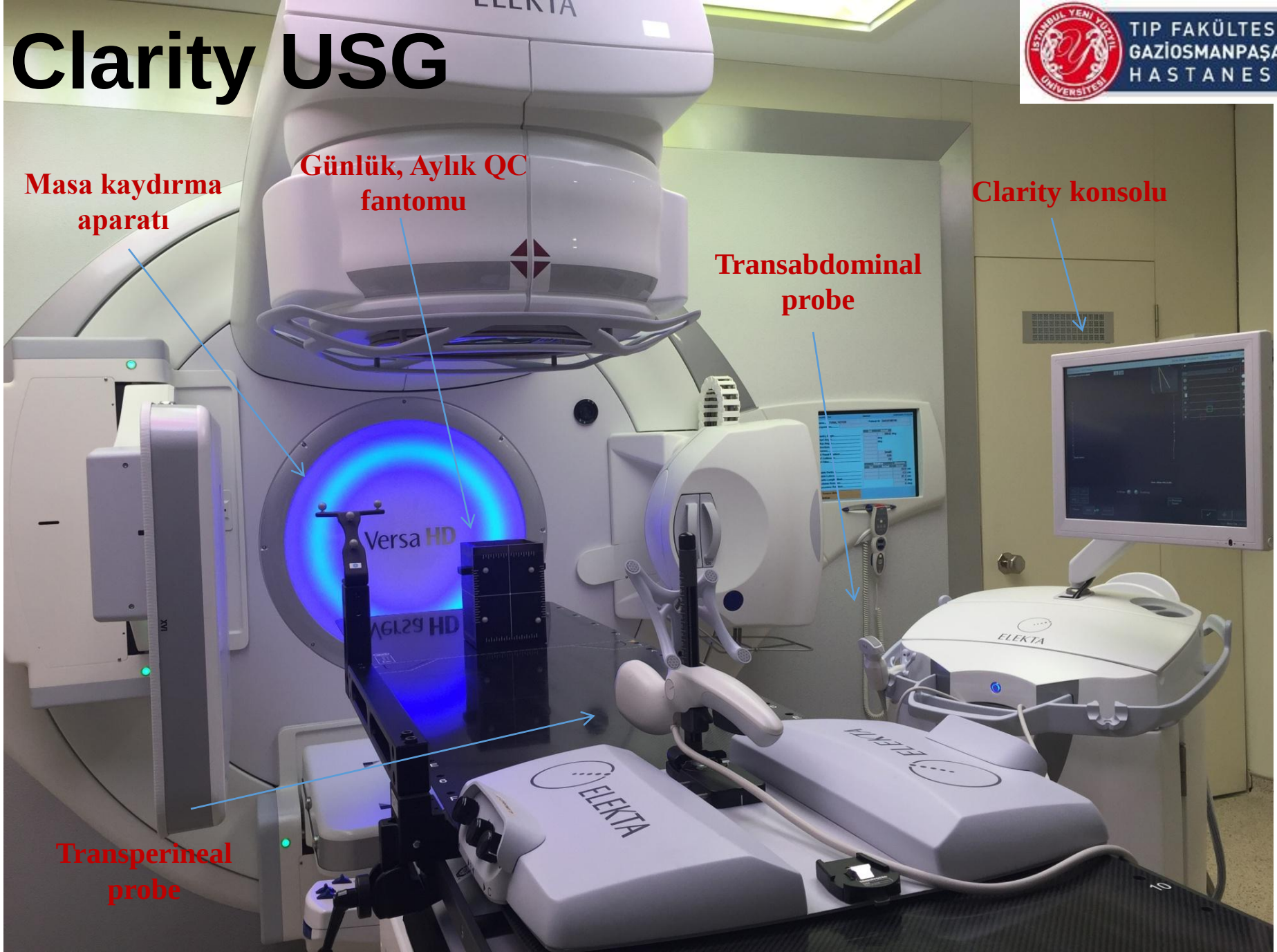
Masa kaydırma  
aparatu

Günlük, Aylık QC  
fantomu

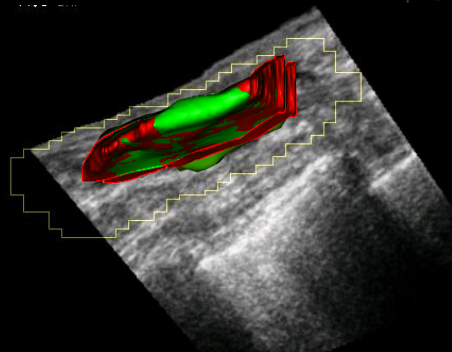
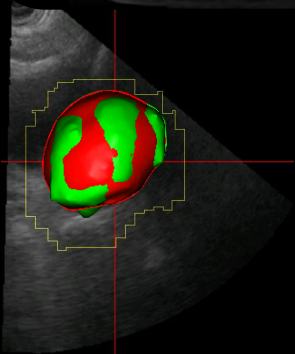
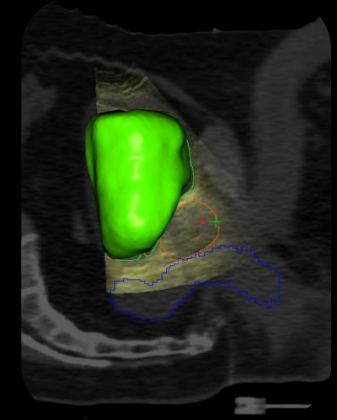
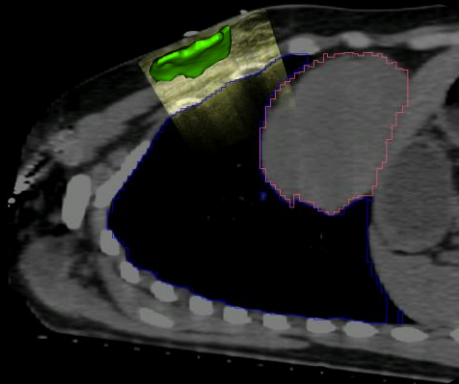
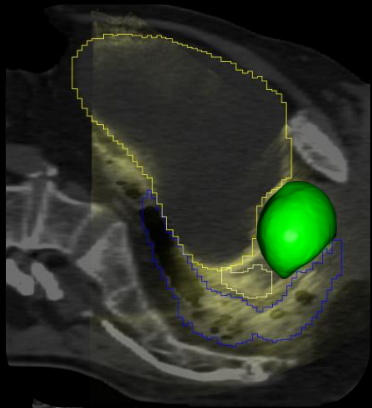
Transabdominal  
probe

Clarity konsolu

Transperineal  
probe



# Structure based IGRT

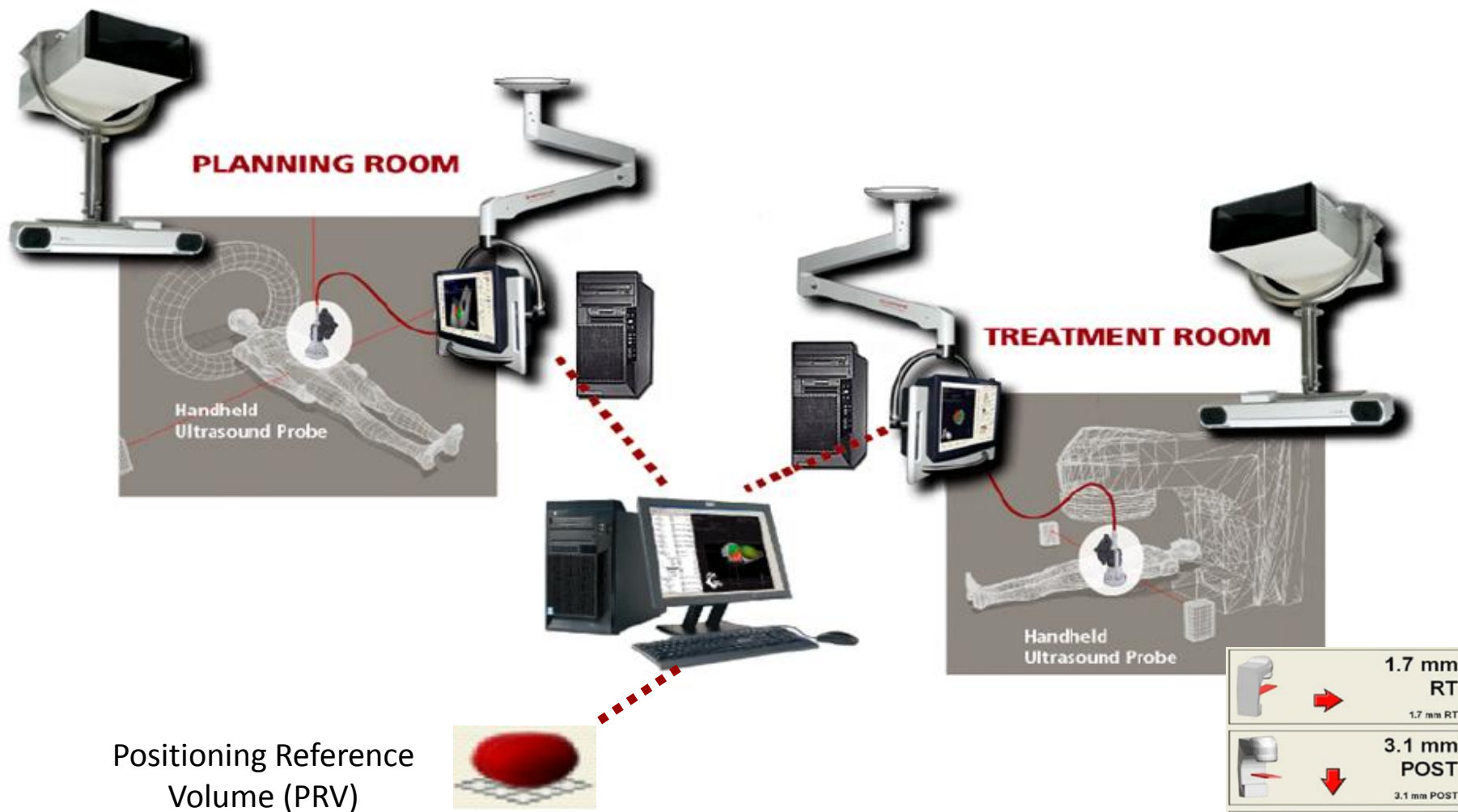


Prostat

Meme

Mesane

# Clarity sistemi





CT



Clarity USG tarama



Monaco 5.11 TPS  
Kontur+Planlama

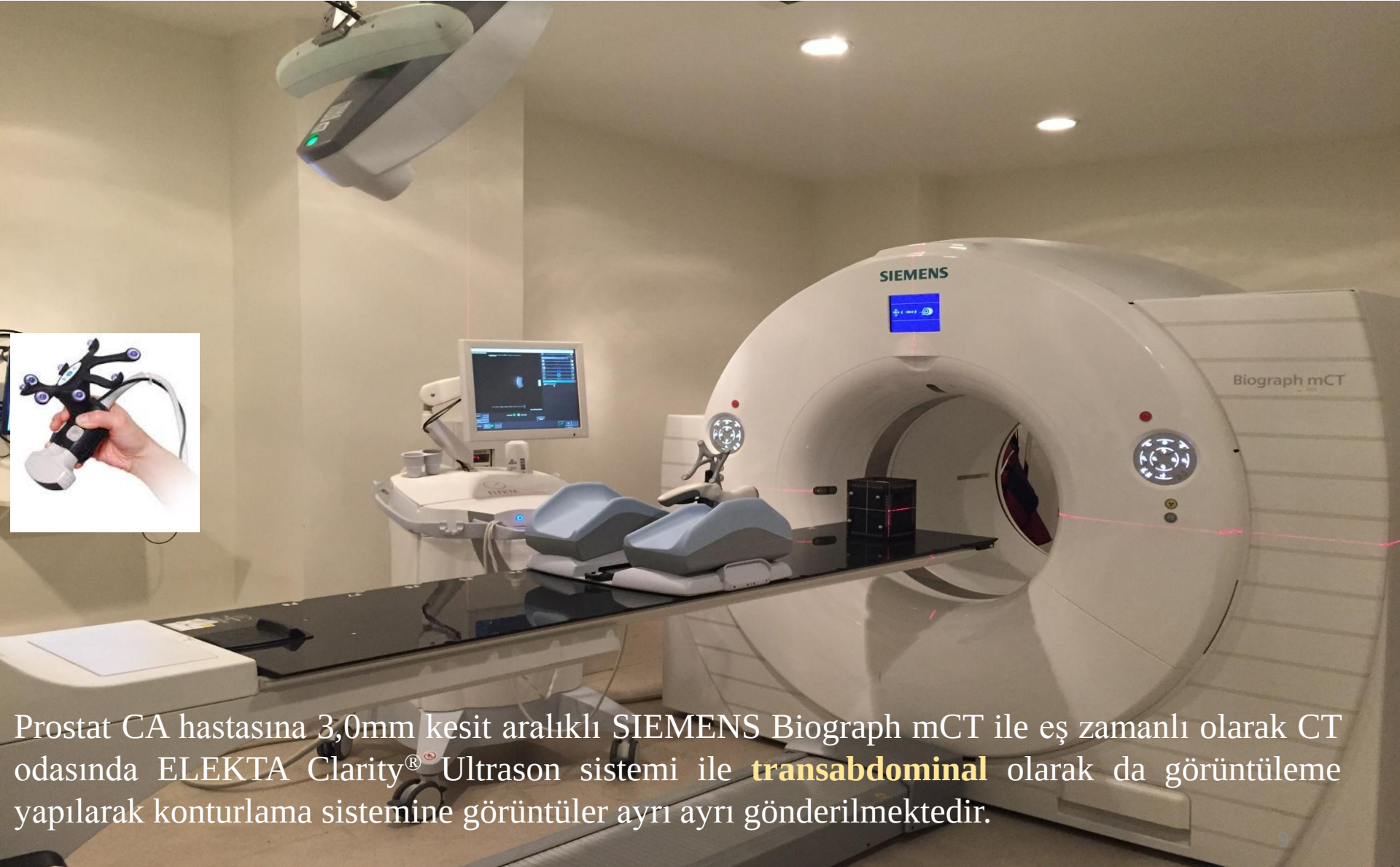


Clarity Workstation  
Füzyon

CT taraması  
USG taraması  
Kontur ve planlama  
Clarity Workstation da CT/USG füzyon  
Referans volüm belirlenir (PRV)

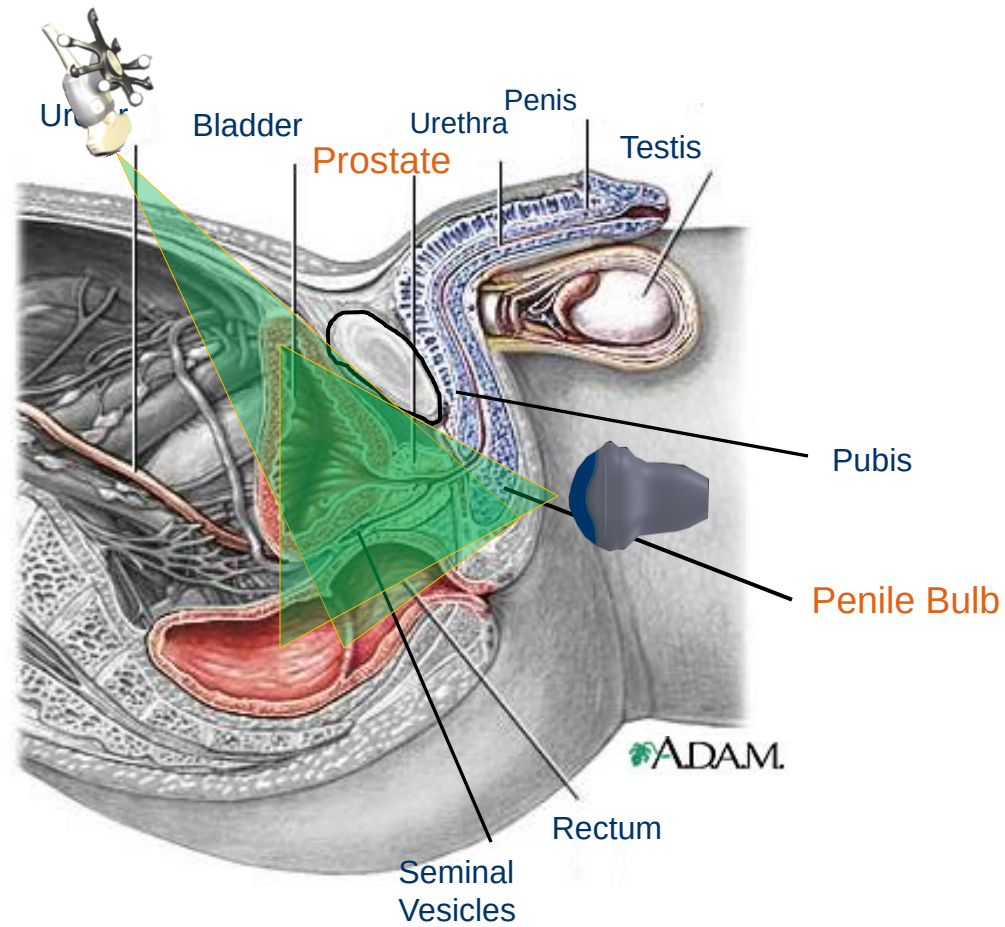


# Prostat IGRT



Prostat CA hastasına 3,0mm kesit aralıklı SIEMENS Biograph mCT ile eş zamanlı olarak CT odasında ELEKTA Clarity® Ultrason sistemi ile **transabdominal** olarak da görüntüleme yapılarak konturlama sistemine görüntüler ayrı ayrı gönderilmektedir.

# Prostat IGRT



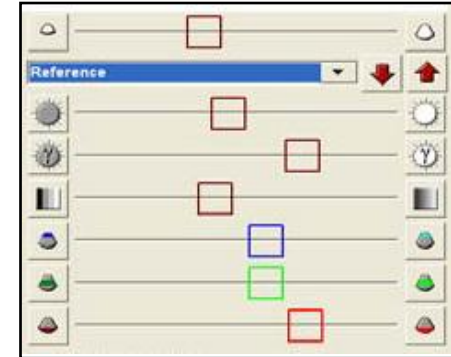
# Transabdominal Prostat Taraması



## Prostate Scan and Segment Overview

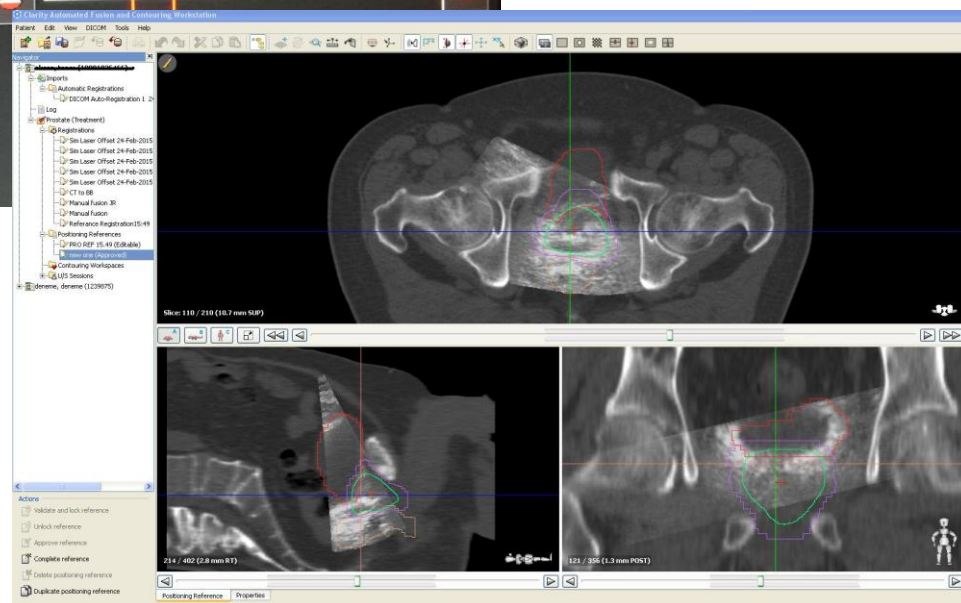
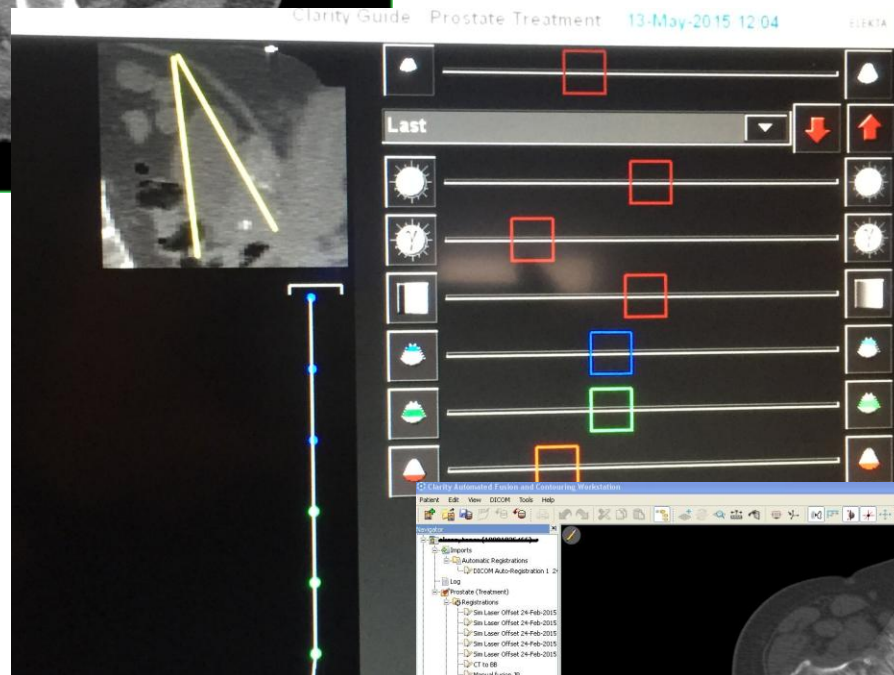
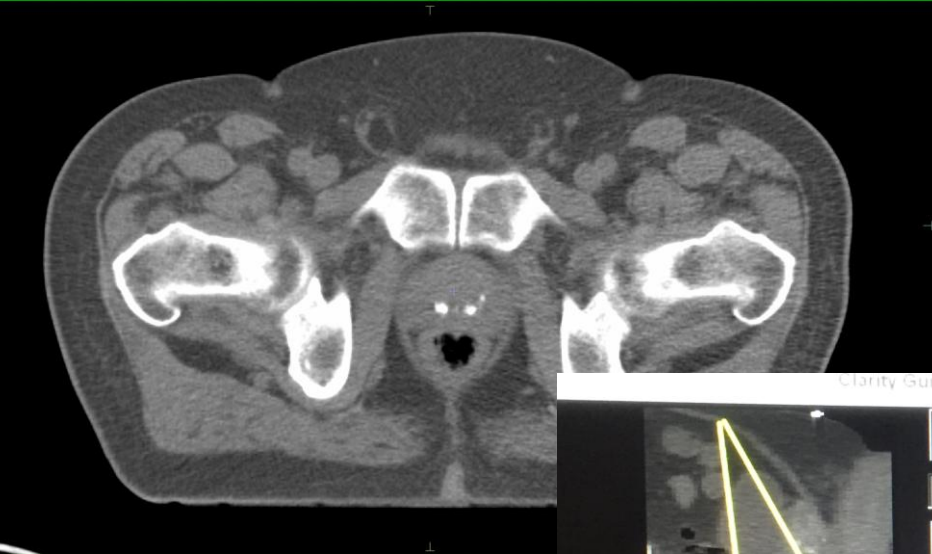
1. Probu pubisin üzerinden başlatarak mesaneye doğru tarama yapılır.
2. Daha sonra prostat tarama alanına girene kadar prob açlandırılarak tarama yapılır.
3. Tarama optimizasyonu

- Scan depth
- Gain
- Gamma
- Contrast
- Field Gain Controls



4. Prostat tam yakalanana kadar taramaya devam edilir.

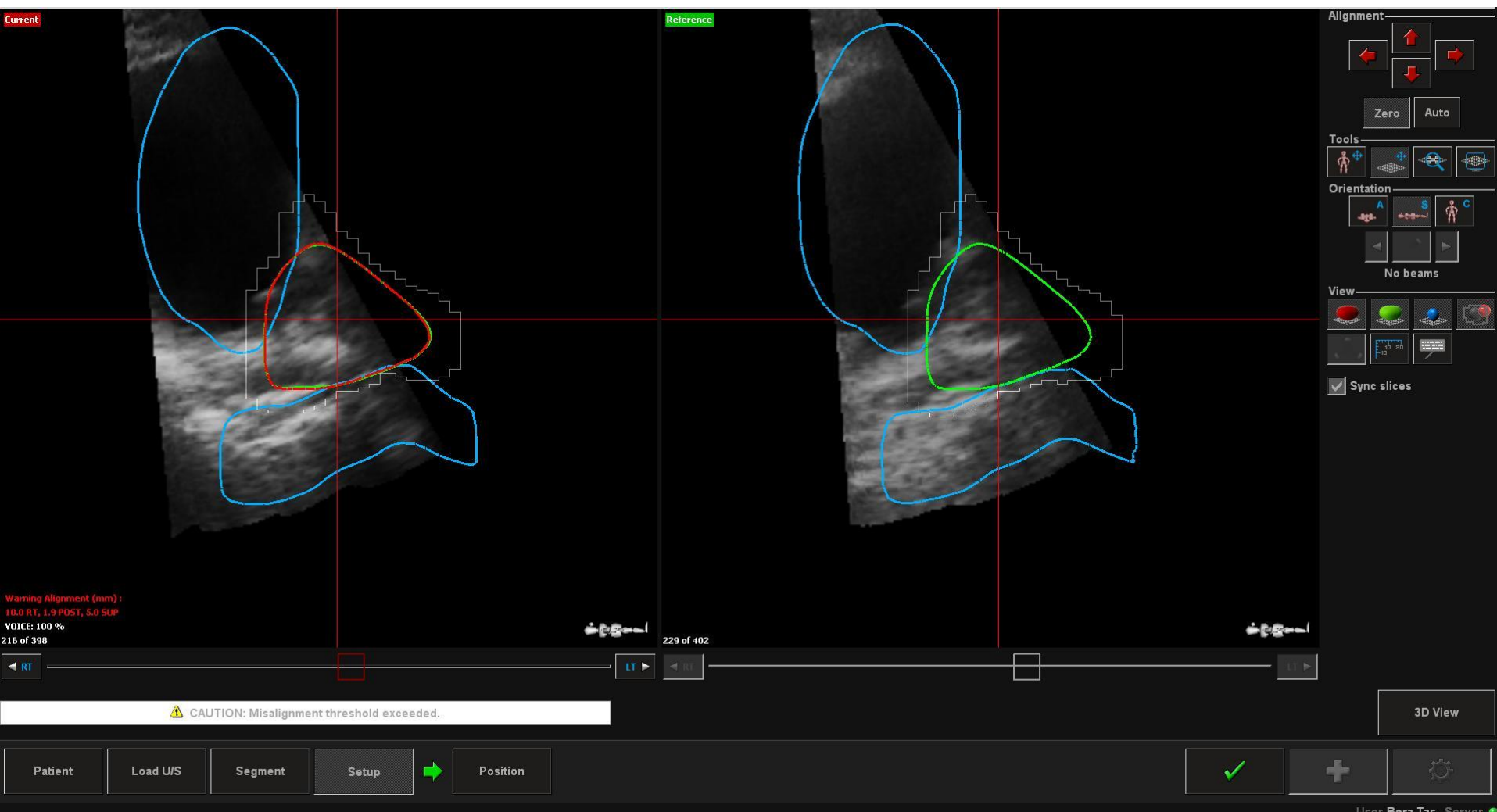










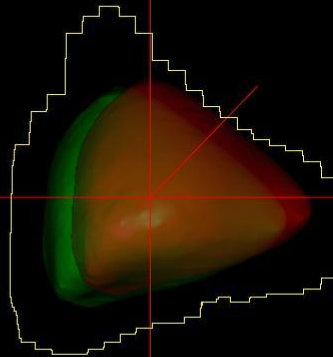






# Pozisyonlama....

Elekta Ltd.  
Clarity Guide Review  
21-Apr-2015 15:02:31  
akcan, taner  
10891836466  
Operator: Tas, Bora



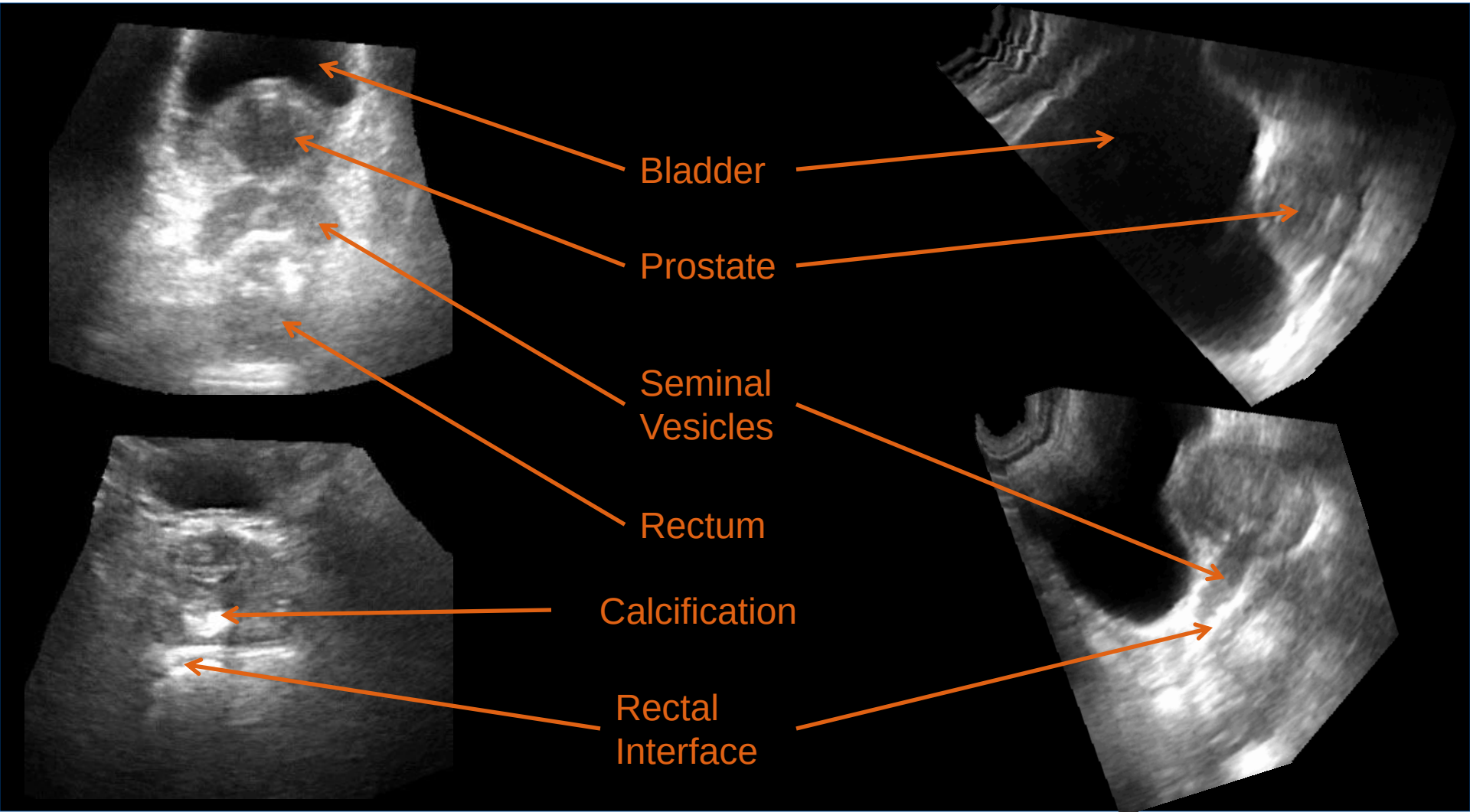
Reference: new one  
Isoshift (mm): 0.0 LT, 0.0 ANT, 0.0 INF  
Current volume (cc): 40.4  
Misalignment (mm): 10.0 RT, 1.9 POST, 5.0 SUP  
Corrected alignment (mm): 10.0 RT, 1.9 POST, 5.0 SUP  
VOICE: 100 %

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User Bora Tas Server

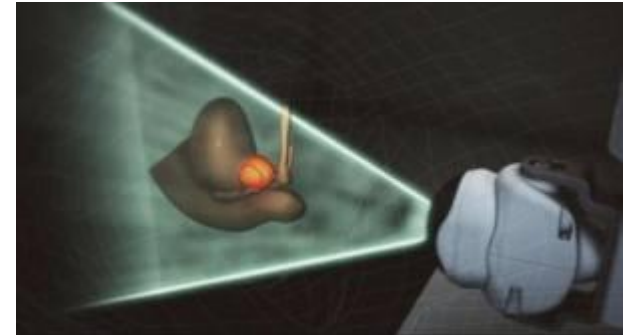
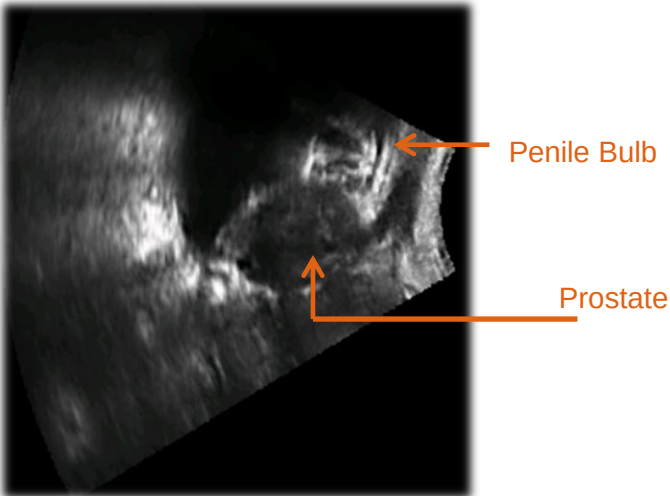
# USG ile Görebildiklerimiz (*Transabdominal*)



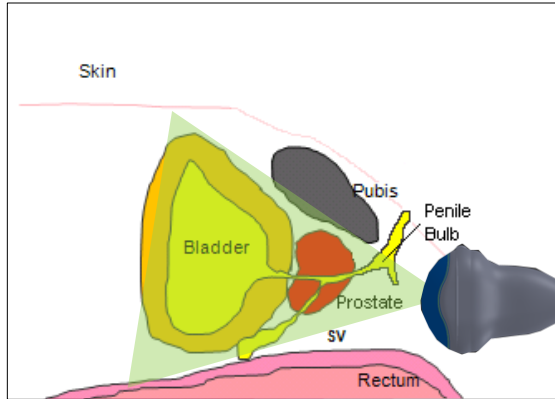
# TransPerineal Prostat Taraması



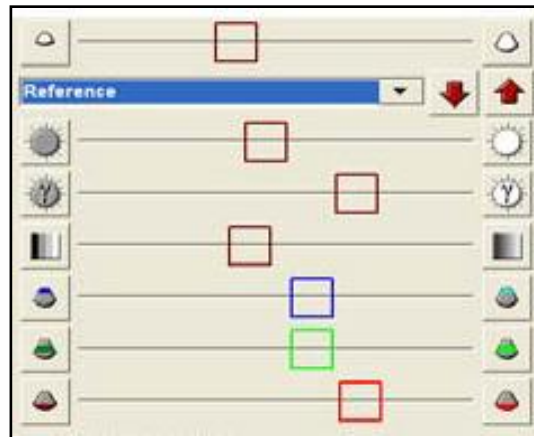
- 1) Hastanın bacak arasına prob aparatı takılır
- 2) Prob tabana yerleştirilir daha sonra tam temas etmesi için yukarıya doğru açlandırılarak perine ile temas sağlanır
- 3) Penis bulb ve prostatın tarama alanında olacak şekilde prob ayarlanır. Bu şekilde FOV alanı ortalanmış olacaktır



# *TransPerineal Prostat Taraması*



Prob yerleştirildikten sonra prostatın en iyi görüntülendiği, parametreler ayarlanmalıdır

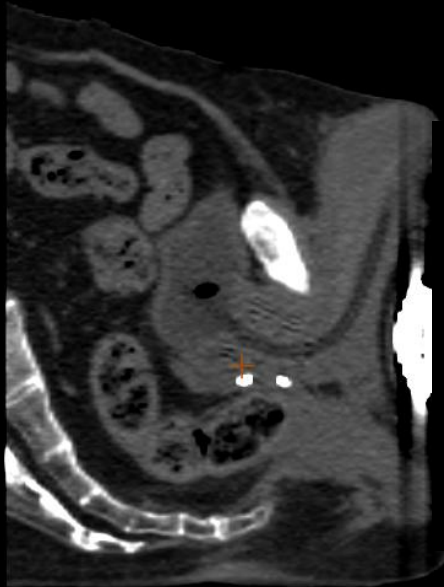


- Scan depth
- Pre-set scan settings
- Image Gain
- Image Gamma
- Dynamic Range “Image Contrast”
- Near, Middle and Far Field Gain controls

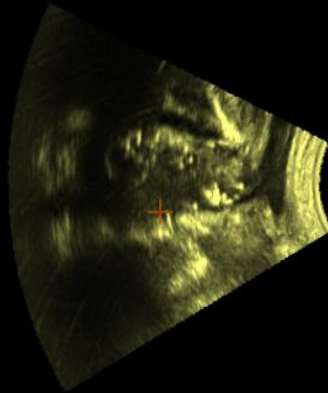


# *TransPerineal Prostat Taraması*

CT



USG



Fusion



CT & USG Contour

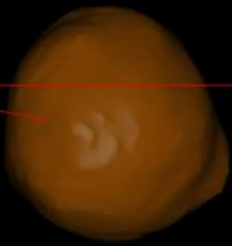


# Pozisyonlama....

Prostate, Patient 13 ( TPUS\_LDR\_Seeds )

Elekta Ltd.  
Clarity Guide Review  
06-Mar-2012 10:43:08  
Prostate, Patient 13  
TPUS\_LDR\_Seeds  
Operator: Maintenance, Document

Clarity Guide Review Prostate Treatment 16-Oct-2014 8:45 ELEKTA



0.3 mm RT  
7.7 mm LT

0.0 mm POST  
5.5 mm POST

0.0 mm INF  
0.0 mm INF

Couch in range

View Orientation

No beams

Reference:  
Isoshift (mm): ref  
Current volume (cc): 48.3  
Misalignment (mm): 7.7 LT, 5.5 POST, 0.0 INF  
Corrected alignment (mm): 0.3 RT, 0.0 POST, 0.0 INF  
VOICE: 100 %

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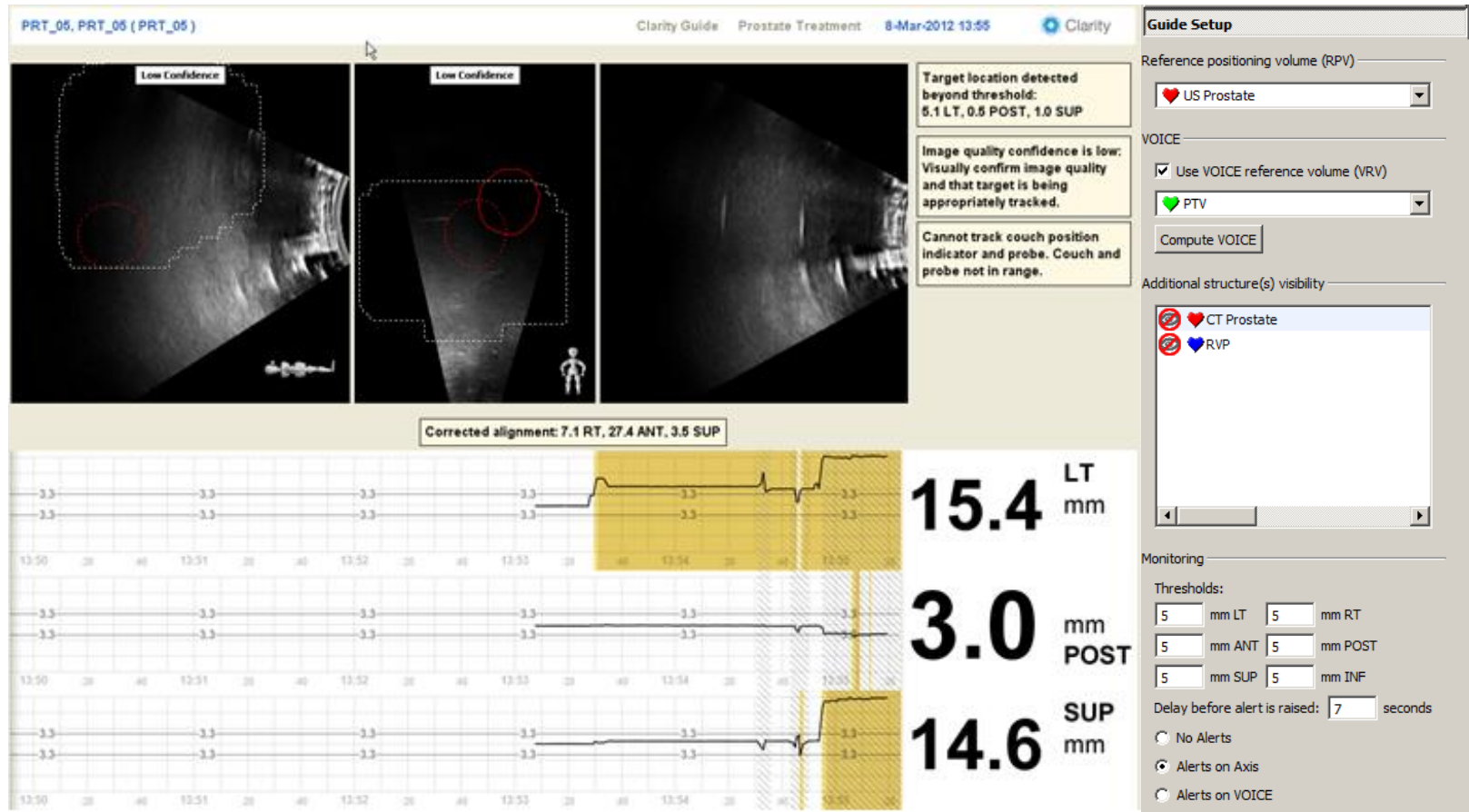
Patient Load U/S Segment Setup Position R&V

User Document Maintenance Server

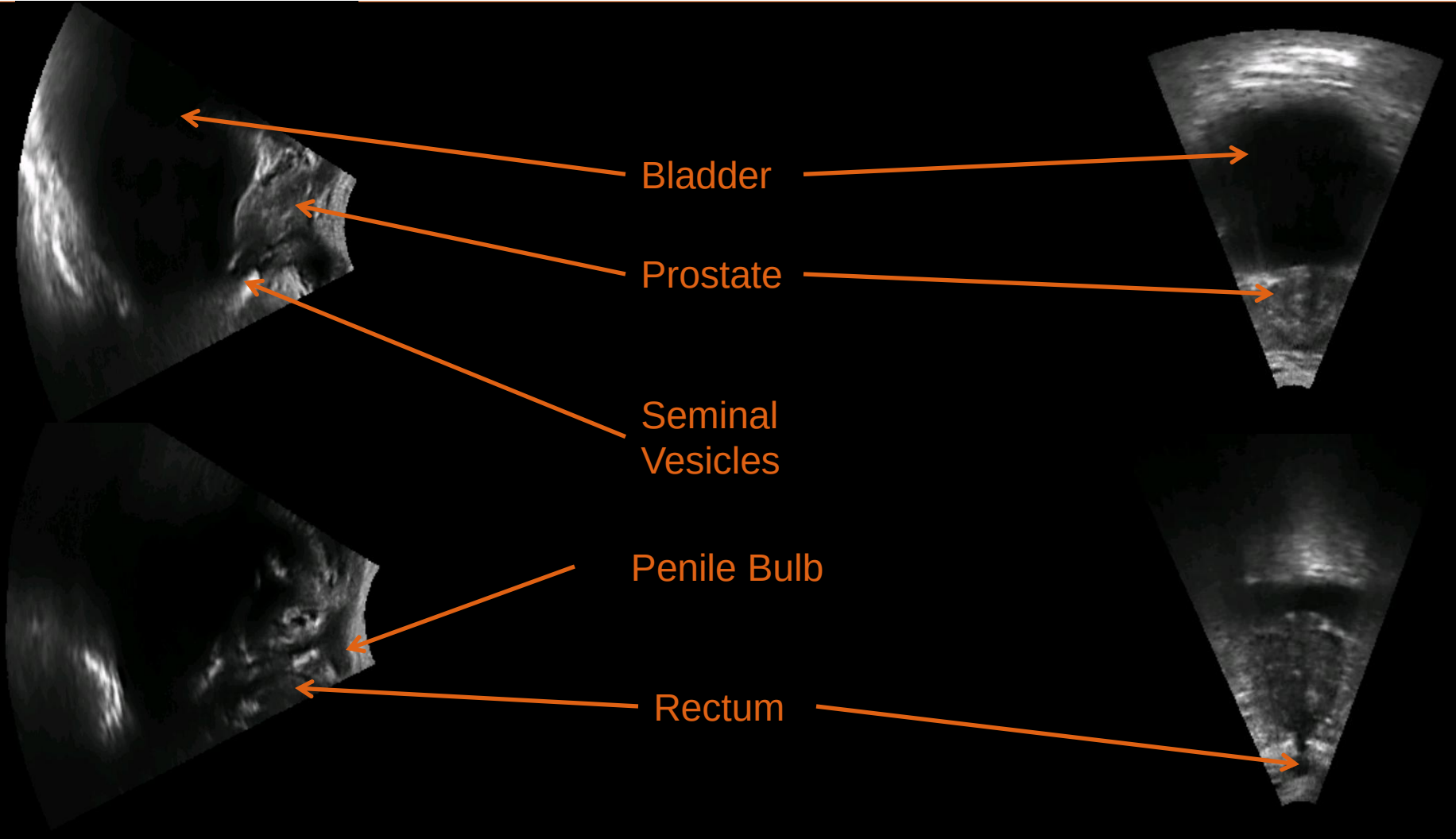
# Gerçek zamanlı takip....



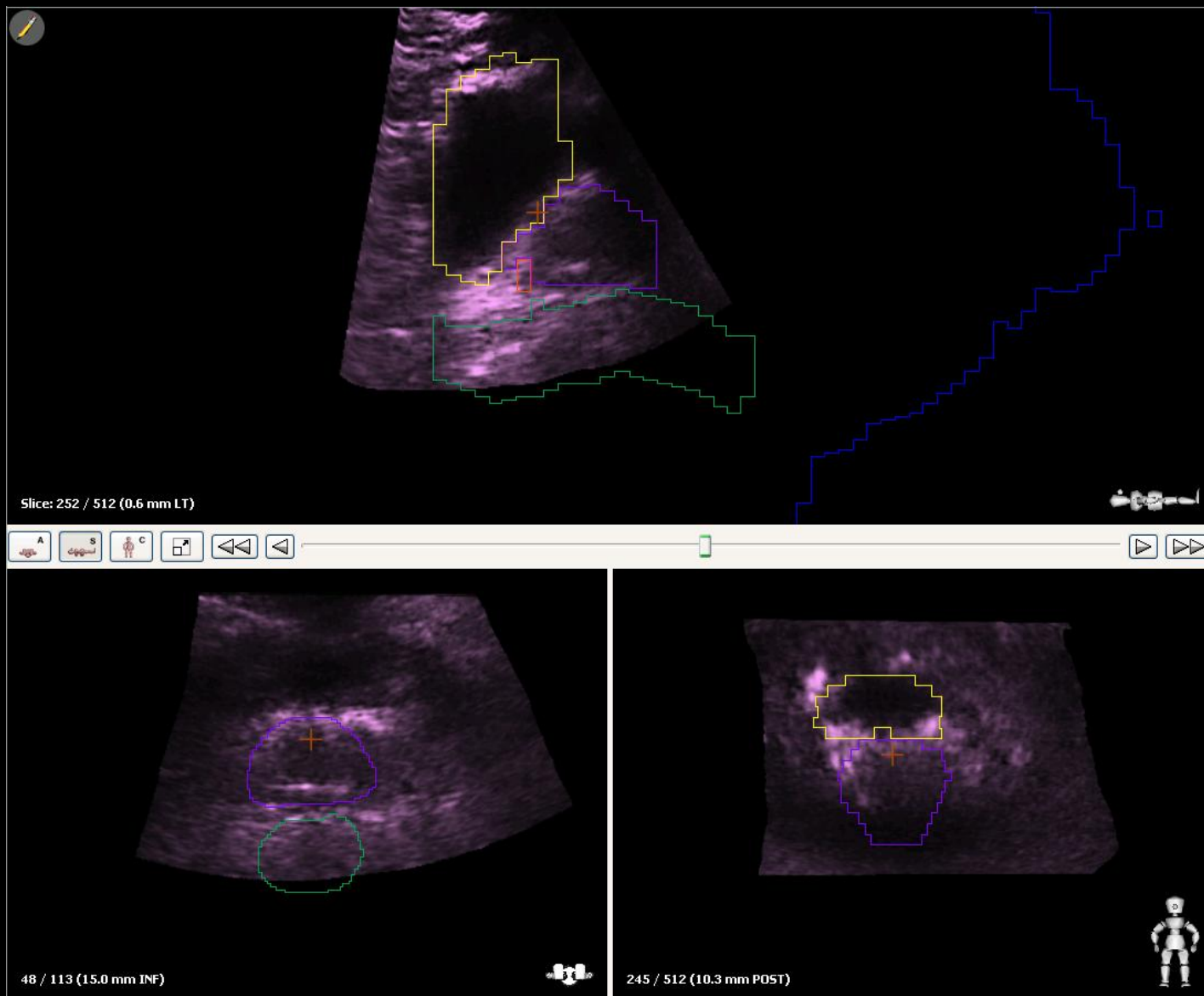
# TransPerineal Prostat Taraması



# USG ile Görebildiklerimiz (*TransPerineal*)







| Structures |                  |
|------------|------------------|
|            | Bladder          |
|            | External         |
|            | Prostate         |
|            | Rectum           |
|            | Seminal Vesicles |

5 Clicks

# MESANE KONTROLÜ

Sessions:

| e              | Data Set ID     |
|----------------|-----------------|
| Apr-2015 15:02 | 101427889720625 |
| Apr-2015 15:04 | 101427976285765 |
| Apr-2015 12:43 | 101428054236500 |
| Apr-2015 14:23 | 101428319415625 |
| Apr-2015 14:25 | 101428405946078 |
| Apr-2015 14:51 | 101428493870843 |
| Apr-2015 14:25 | 101428665152671 |
| Apr-2015 15:06 | 101428926798156 |
| Apr-2015 15:45 | 101429015544046 |
| Apr-2015 15:11 | 101429099875125 |
| Apr-2015 15:33 | 101429187621906 |
| Apr-2015 15:17 | 101429273045328 |
| Apr-2015 15:42 | 101429533746640 |
| Apr-2015 15:02 | 101429617751062 |

Review  
Session

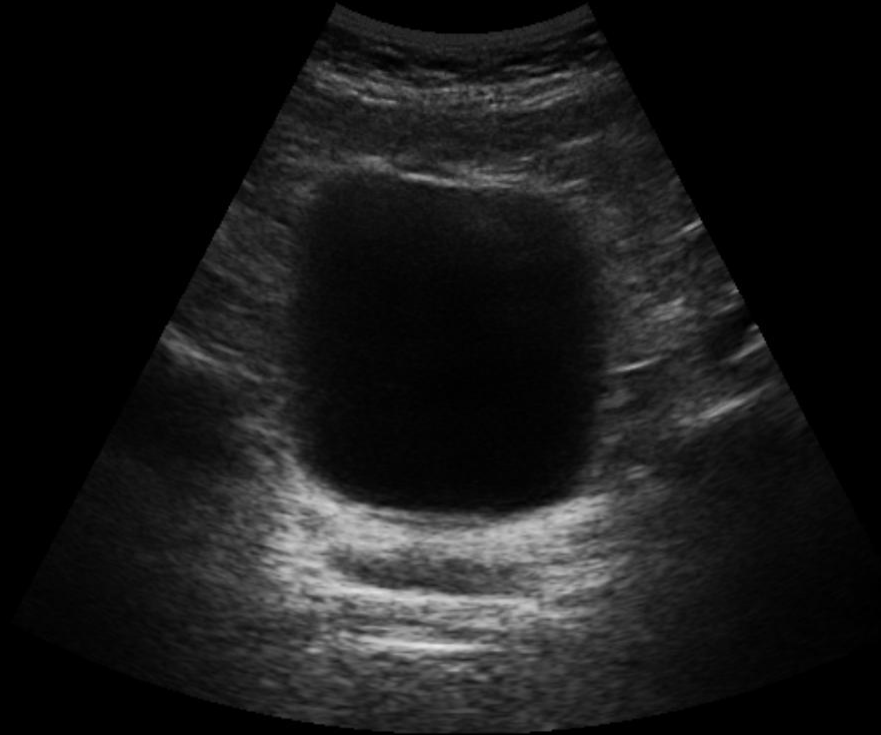
Simulate  
Clarity Guide

Patient

Load U/S



Segment



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User Bora Tas Server

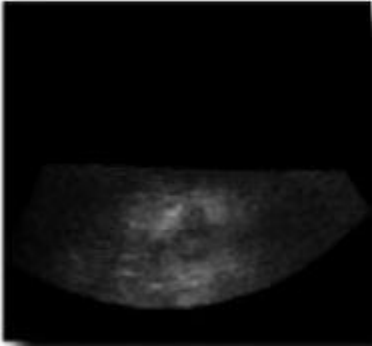
# MESANE KONTROLÜ



Prostat



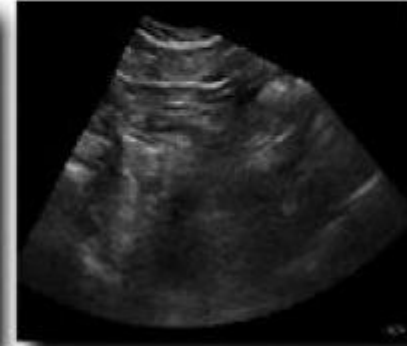
Mesane



MESANE TABANI / PROSTAT



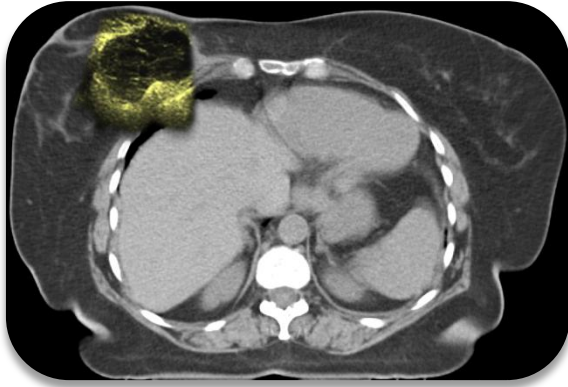
ORTA MESANE



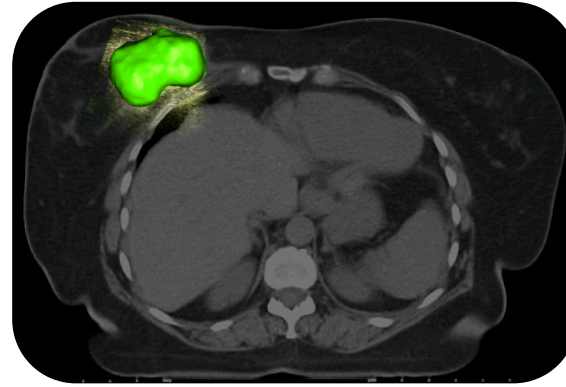
MESANE TEPESİNİN ÜSTÜ  
(BAĞIRSAK)



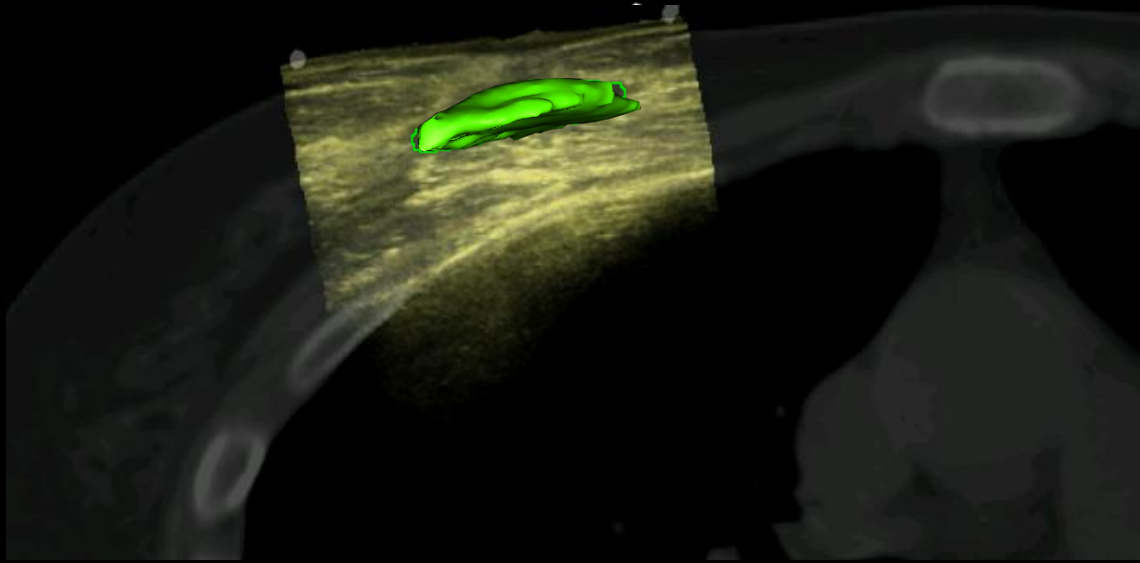
# MEME



Sim



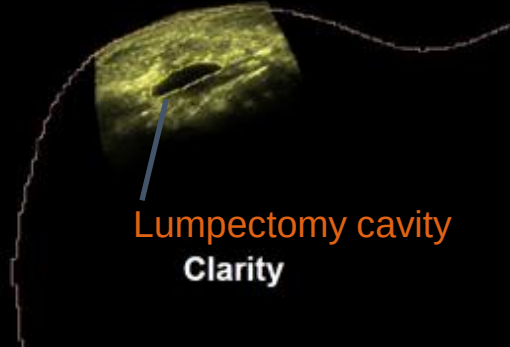
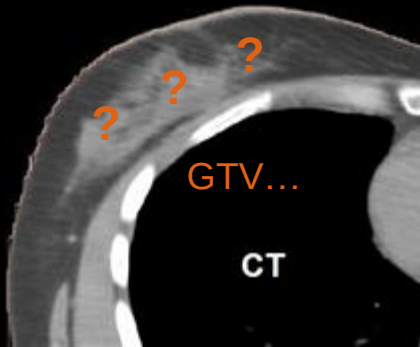
Linac



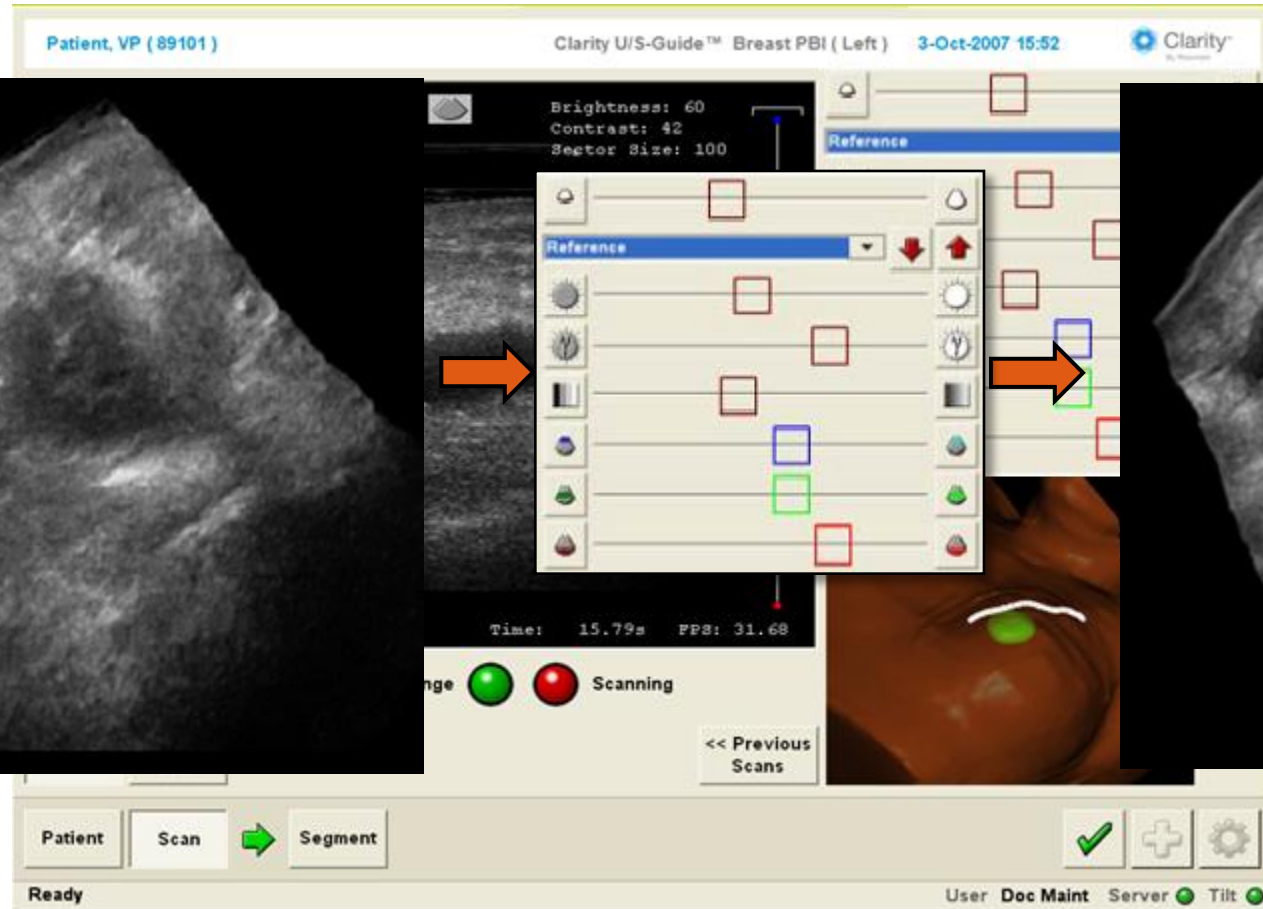
- USG ile tümör yatağı volümü belirlenmekte
- Inter-fractional düzeltme



USG ile Memenin yumuřak doku anatomisi kolayca ayırt edilebilir

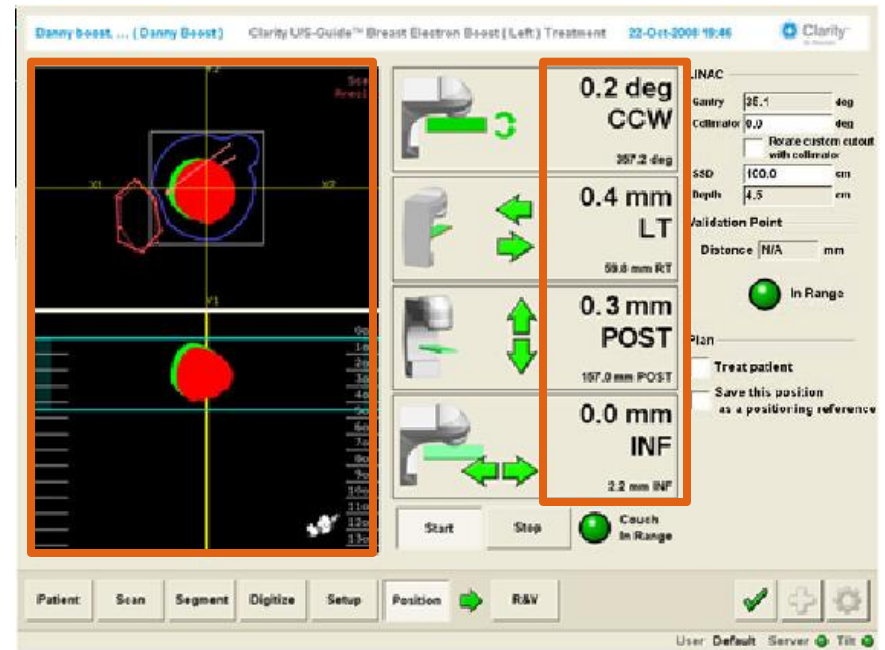


# Yumuşak doku görüntü optimizasyonu



Case details

# Structure Based IGRT

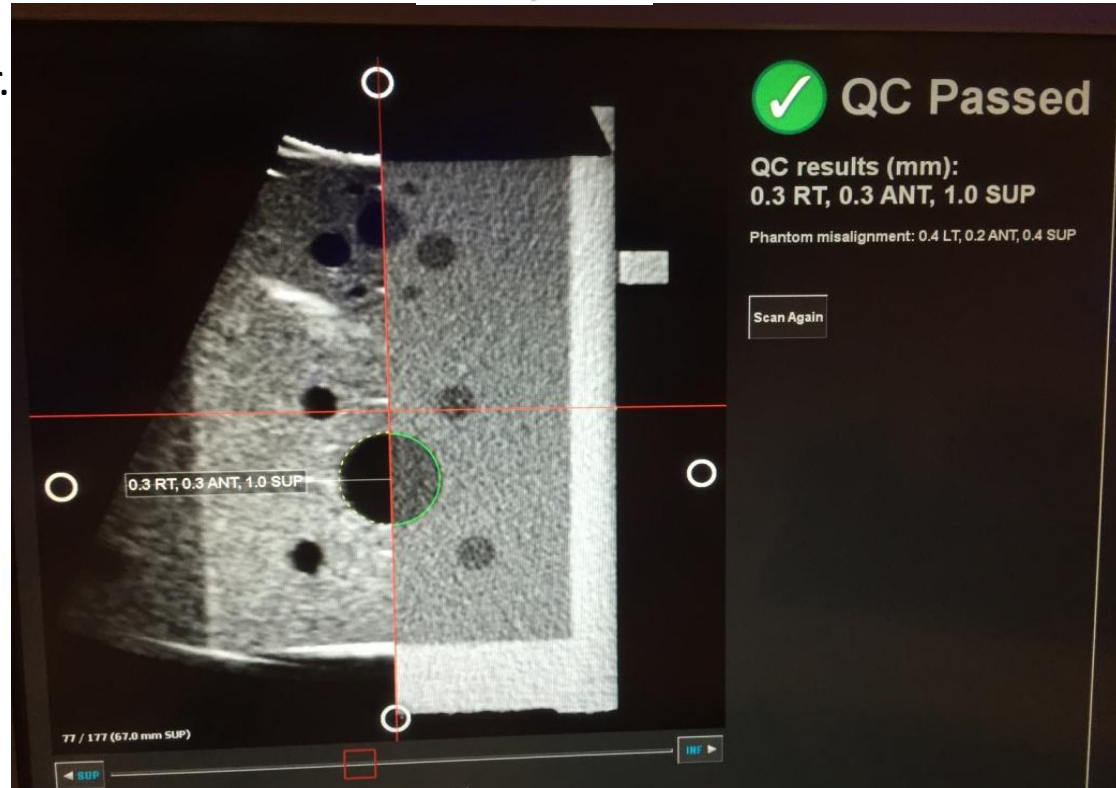
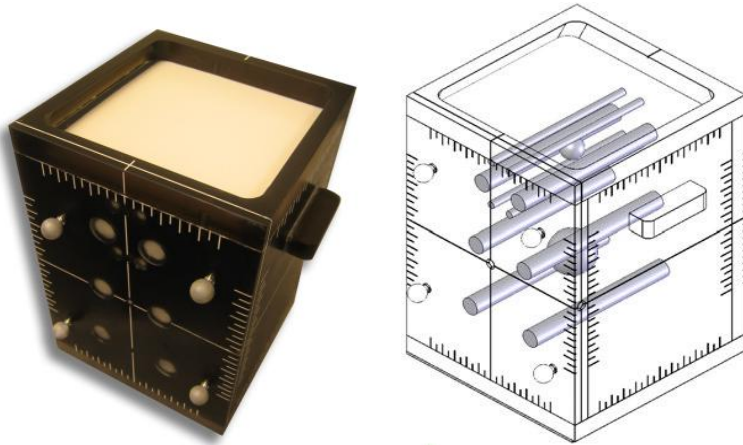
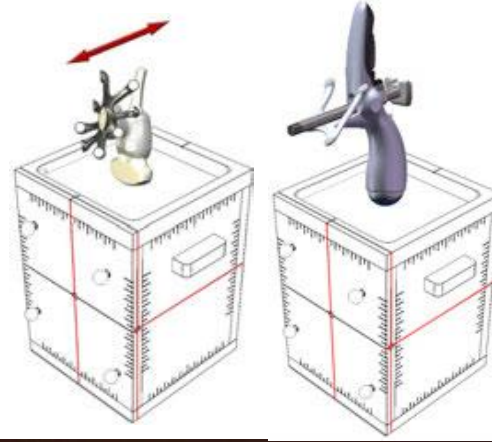


# QA

Kalibrasyon fantomu USG için sabit, solid bir ortam sağlar.

Organların akustik özelliklerini taklit eden (Zerdine) maddeden yapılmıştır.

Fantom izomerkeze yerleştirilir.  
Tarama ile Küre ve plakalar belirlenir.

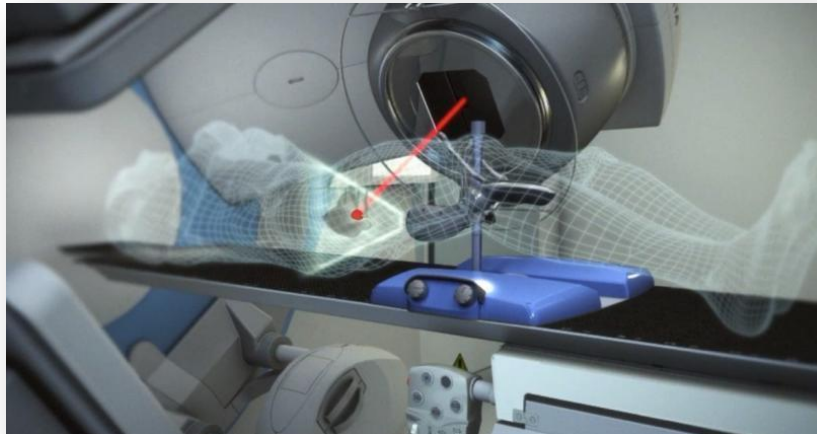


# Avantaj ve Dezavantajlar

- Ek radyasyon yok
- Gerçek zamanlı takip
- Hedef volüm kontrolama



- Görüntü kalitesi düşük
- Prob açısı ve sürüklemeye bağlı görüntü kalitesi
- Sudan farklı yoğunluklara sahip yapılar artifact'lar oluşturabilir. (Hava, kemik)
- Prob basıncına bağlı hedefi hareket ettirebilmekte
- İş yükü - Zaman







Teşekkür ederim..