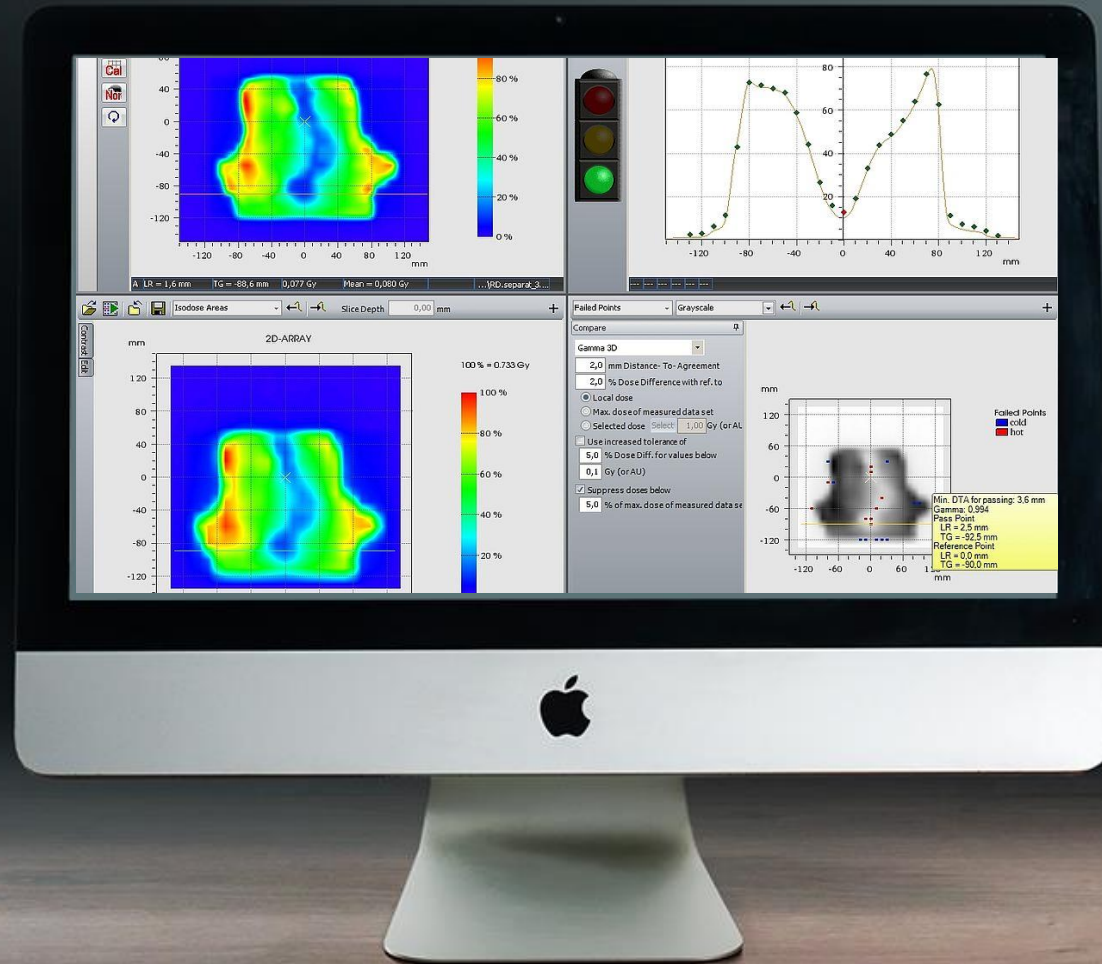


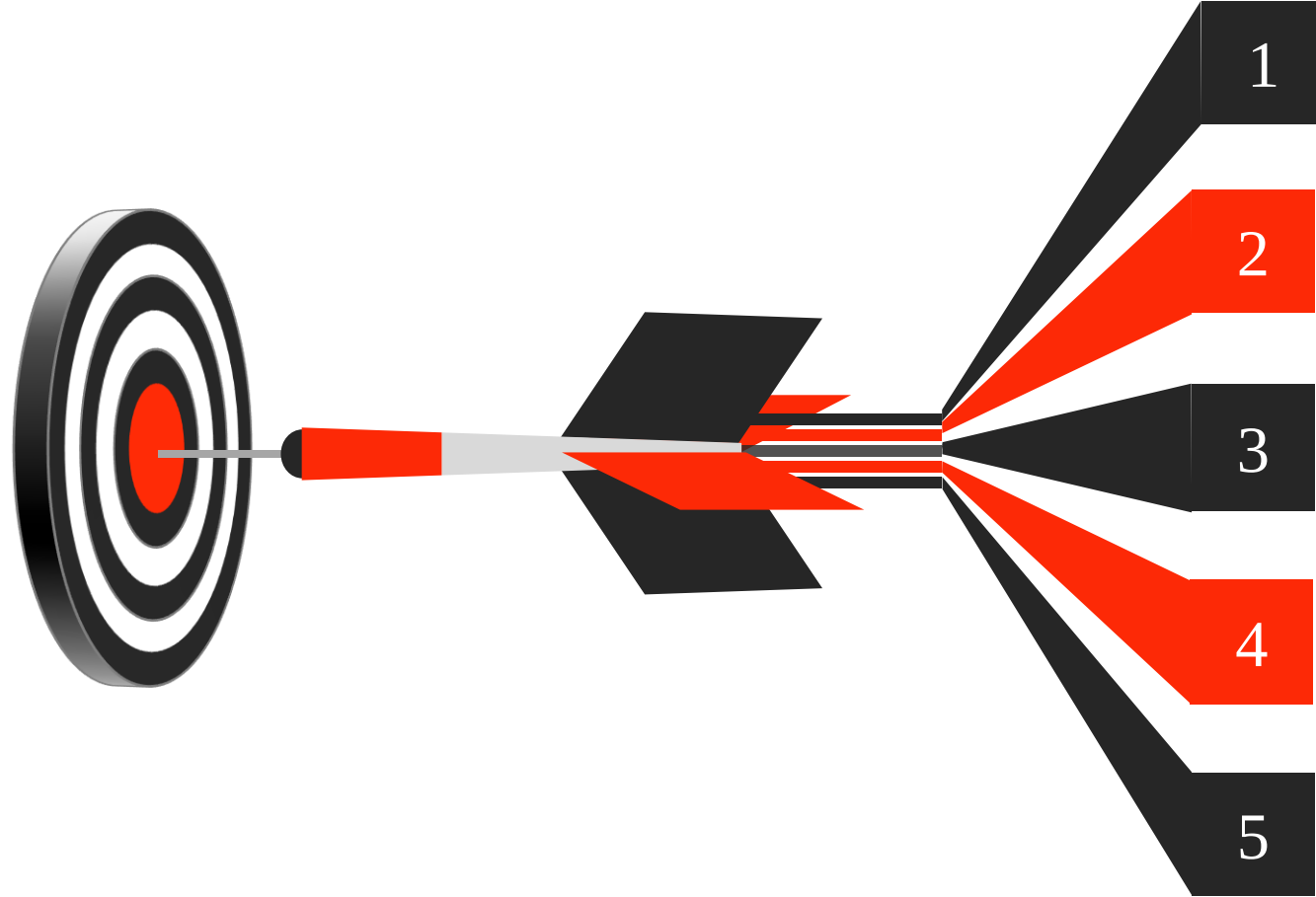
# Radyoterapide Hasta Tedavi Planlarının Kalite Kontrolü ve Değerlendirilmesi

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Basaksehir Cam ve Sakura Sehir Hastanesi  
Radyasyon Onkolojisi Klinigi



# Ajanda



1 Patient QA ve Önemi

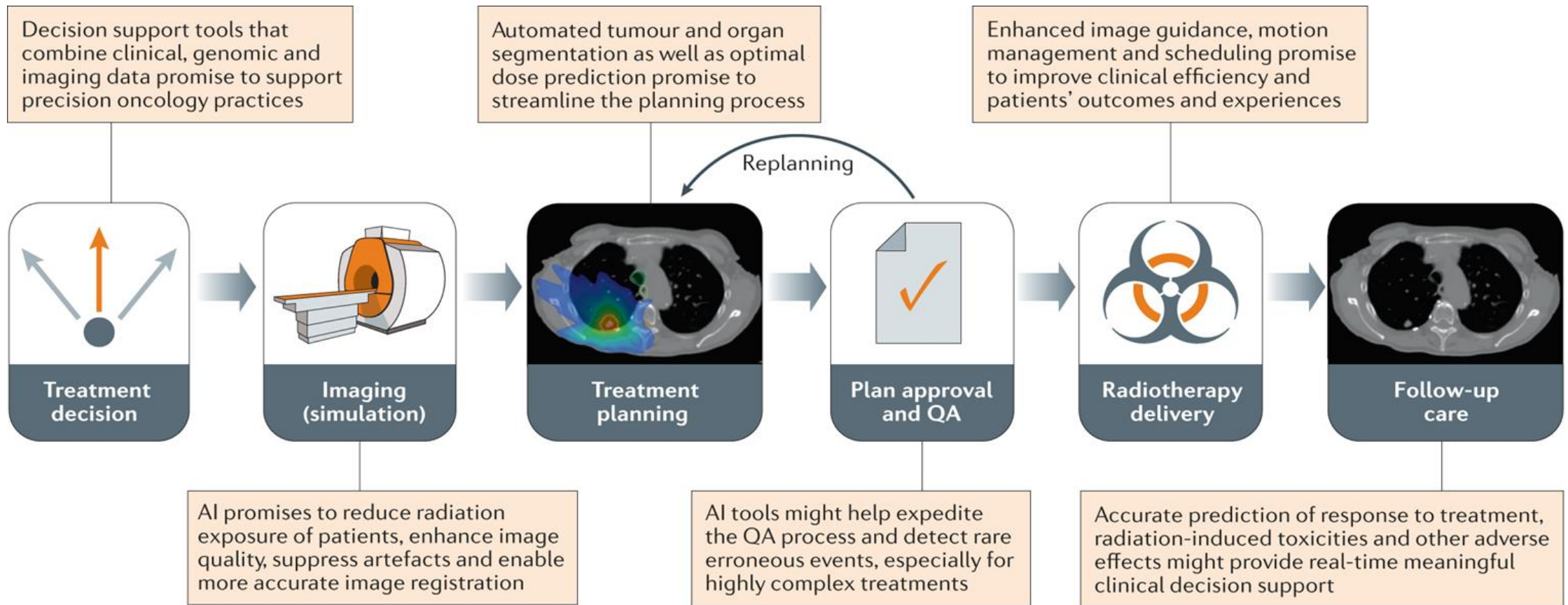
2 Fantom gereksinimleri

3 Konvansiyonel vs SRS/SBRT

4 Güncel Yaklaşımlar

5 Sonuç

# Klinik Protokol



# Patient QA ve Onemi



- Yoğunluk Ayarlı Radyoterapi, Volumetrik Arc Radyoterapi, ve Helikal Tomoterapi tedavilerinde tedavi planlama parametreleri MLC pozisyonuna, doz hızına masa hareketine ve acısına, gantry ve kolimator açılarına bağlıdır. Bu kompleks optimizasyon sayesinde istenilen seviyede konformal planlar elde edilir.
- MLC hareketinin karmaşıklığı, tedavi planlama sistemlerindeki doz hesaplama algoritmalarına ait sınırlılıklar planlanan ve verilen doz arasında farklılığa sebep olabilir.



# Patient QA ve Onemi

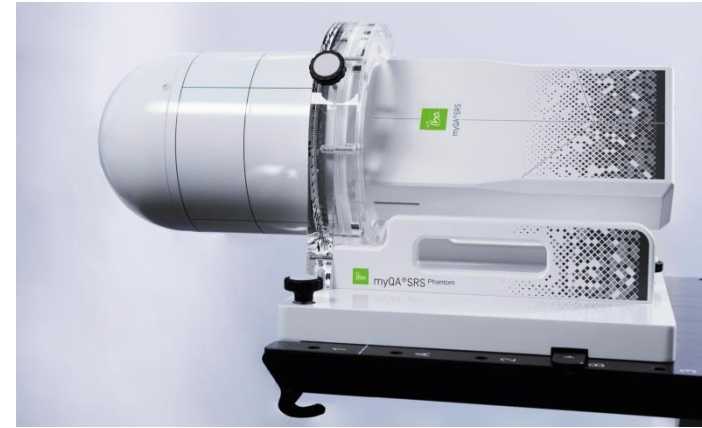


- Uluslararası Radyasyon Birimleri ve Ölçümleri Komisyonu (ICRU) raporuna göre; hastaya verilen doz ile planlanan doz arasındaki fark %5 sınırları içerisinde olmalıdır. Bunu sağlayabilmek için tedavi süresince uygulanan tüm adımlarda toplam hatanın %5 i aşmaması gerekir.
- Teknolojinin gelişmesi ile birlikte daha kompleks tedaviler uygulanmaya başlamış ve buna bağlı olarak radyasyonun güvenli bir şekilde verilmesini sağlamak amacıyla gelişmiş QA ölçümlerine ve analizlerine duyulan ihtiyaç artmıştır.
- Buna göre hastaya özgü kalite temini, hastaya planlanan dozun güvenli bir şekilde verilmesini sağlamak amacıyla planlama parametrelerinin özellikle fantomlar aracılığıyla alınan ölçümler veya gelişmiş yazılım programları ile kontrol edilmesidir.

# Fantom gereksinimleri



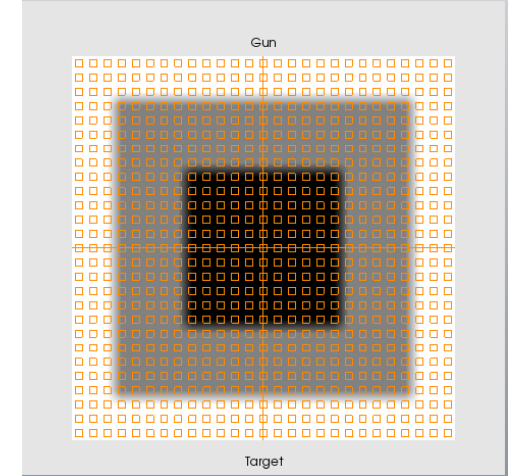
- QA için kullanılan fantomların hastaya verilen dozu ölçebilecek ve geometrik ve dozimetrik hataların değerlendirilmesine imkan sağlayacak özellikte olması gerekmektedir.
- Hastaya özgü kalite kontrol işlemine başlamadan önce her fantomun üretici kriterleri dikkate alınmalıdır.



# PTW Octavius Genel Özellikleri



- 2D Array, merkezden merkeze 10 mm uzaklıktaki iyon odalarından oluşur.
- Her bir iyon odasının boyutu  $5 \times 5 \times 5 \text{ mm}^3$ 'tür.
- Array, motorlu silindirik polistiren fantomun içine yerleştirilir.
- Portalla eşzamanlı olarak döndürüldüğü için ışın her zaman detektör dizisine dik olarak çarpar.



27 cm x 27 cm

# PTW Octavius Genel Özellikleri



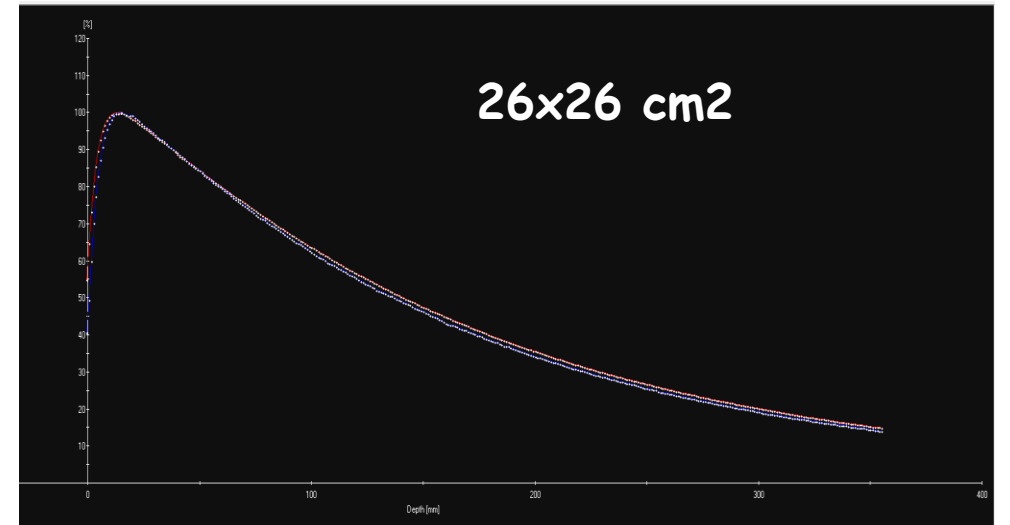
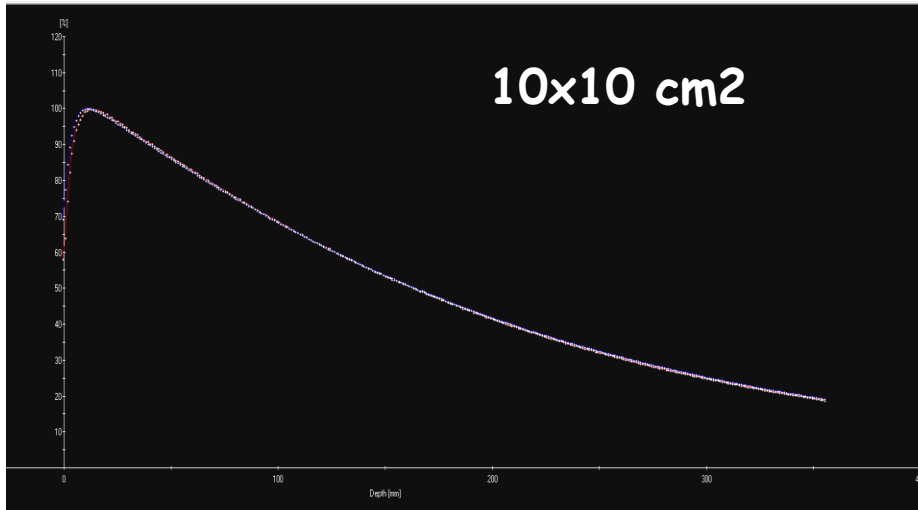
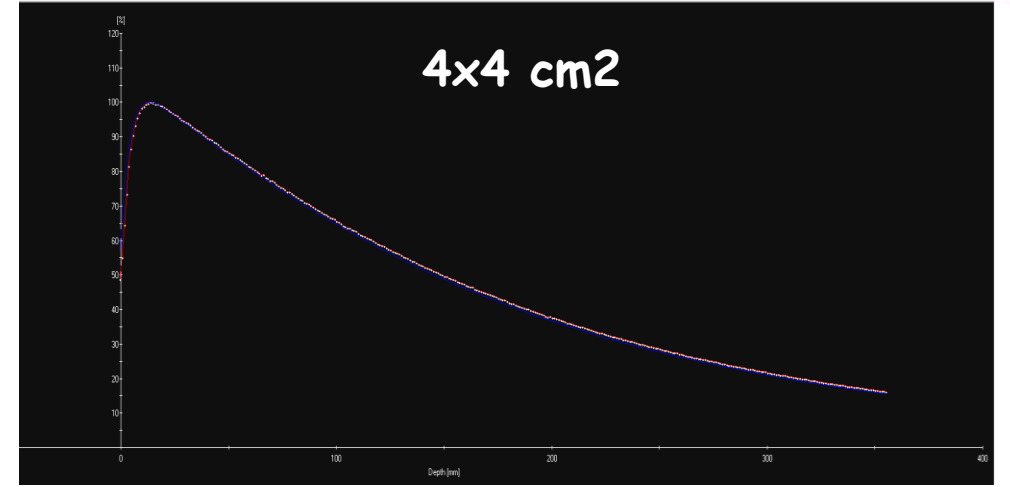
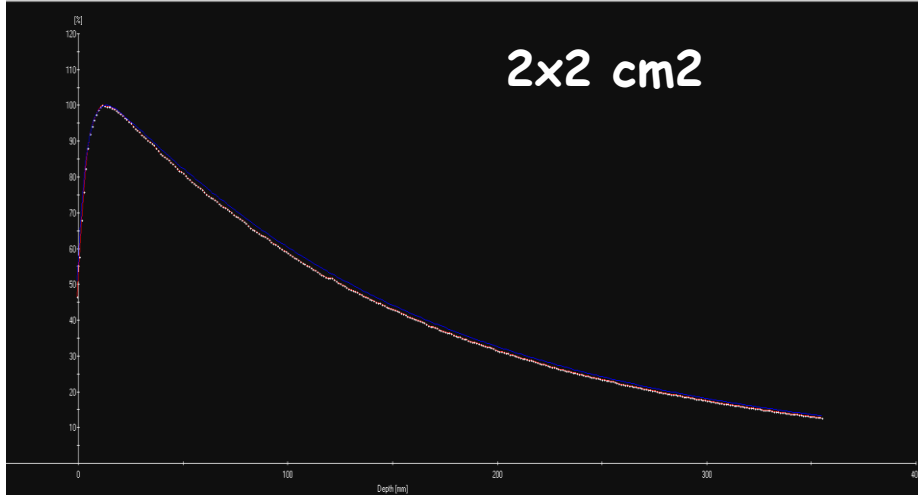
## Quality Assurance



- Üretici kriterlerine göre fantom commissioning testleri Elekta VersaHD Cihazında yapılmıştır.
- 2x2cm<sup>2</sup> den 26x26cm<sup>2</sup> ye kadar olacak şekilde PDD ölçümleri alınmıştır.
- SSD = 85 cm
- Küçük alanlar için < 5cm<sup>2</sup> (Active Volume = 0.016 cm<sup>3</sup>) → PTW PinPoint Ion Chamber
- Büyük alanlar için ≥ 5 cm<sup>2</sup> (Active Volume = 0.07 cm<sup>3</sup>) → PTW Semiflex 3D Ion Chamber

| Alan Boyutu<br>(cm <sup>2</sup> ) | QI<br>SSD = 100 cm | QI<br>SSD = 85 cm | Fark<br>(%) |
|-----------------------------------|--------------------|-------------------|-------------|
| 2x2                               | 0.6173             | 0.6238            | 1.05        |
| 4x4                               | 0.6335             | 0.6400            | 1.02        |
| 10x10                             | 0.6683             | 0.6739            | 0.83        |
| 26x26                             | 0.7090             | 0.7143            | 0.75        |

# PTW Octavius Genel Özellikleri



# Convansiyonel tedavilerde hasta QA



- En yaygın QA modeli planlanan dozun 2D veya 3D doz ölçümleriyle karşılaştırılmasını içerir.
- Gama analizi veya Gamam indeks analizi olarak bilinen Gama değerlendirme yöntemi bu tür Ölçümleri karşılaştırmak için kullanılan en yaygın yöntemdir.
- Bu teknik uzaysal alandaki minimum Öklid mesafesi olan her noktanın gama değerini hesaplayarak, ölçülen doz dağılımını planlanan doz dağılımıyla niceliksel olarak karşılaştırır.
- Bölgesel olarak doz dağılım farkı hesaplanan doz dağılımının ölçümle uyuşmadığı bölgelerdeki Farklılıktır.

# Convansiyonel tedavilerde hasta QA

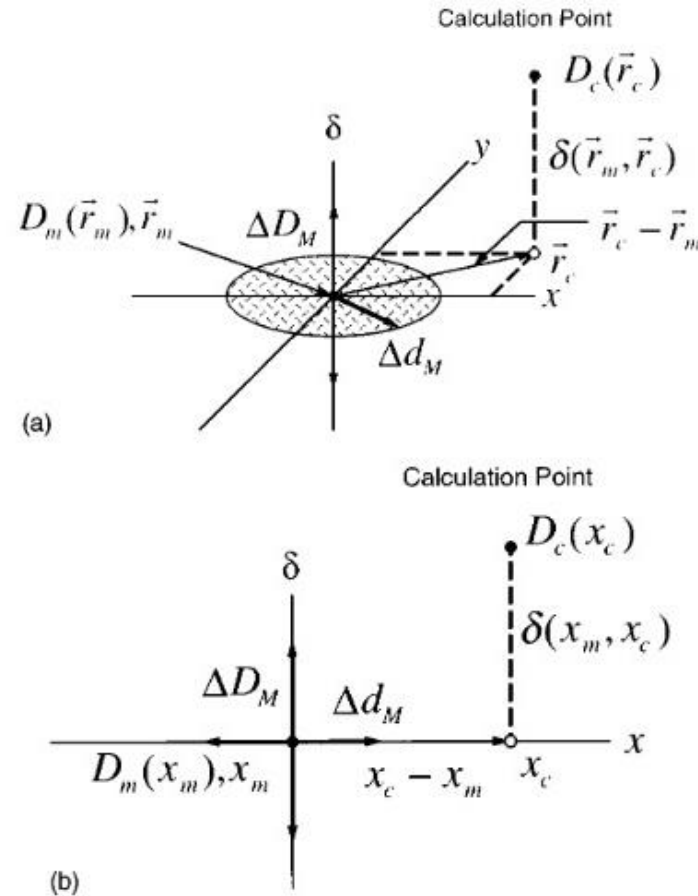


FIG. 1. Geometric representation of dose distribution evaluation criteria for the dose-difference and distance-to-agreement tests. (a) Two-dimensional representation. (b) One-dimensional representation.

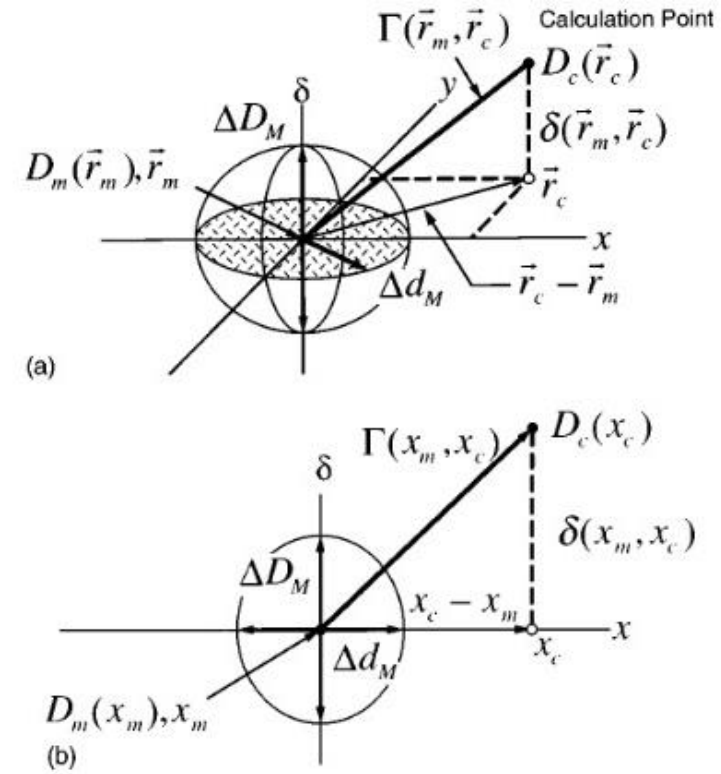


FIG. 2. Geometric representation of dose distribution evaluation criteria using the combined ellipsoidal dose-difference and distance-to-agreement tests. (a) Two-dimensional representation. (b) One-dimensional representation.

# Convansiyonel tedavilerde hasta QA



- Değerlendirilen ve referans doz dağılımları arasındaki uyum iki kabul kriteri kullanılarak hesaplanır.

% doz farkı  $\Delta D$

mm cinsinden uyuma olan mesafe DTA

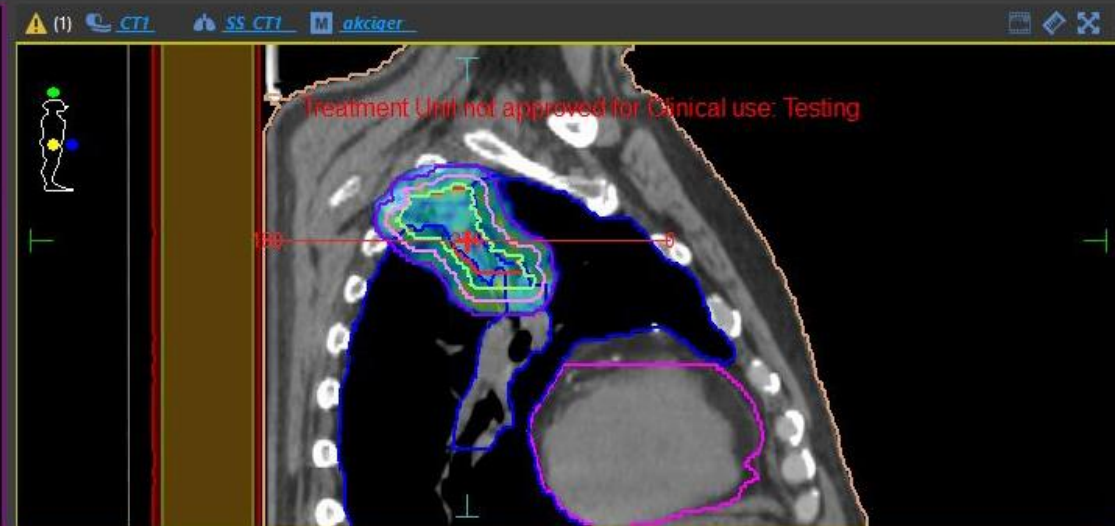
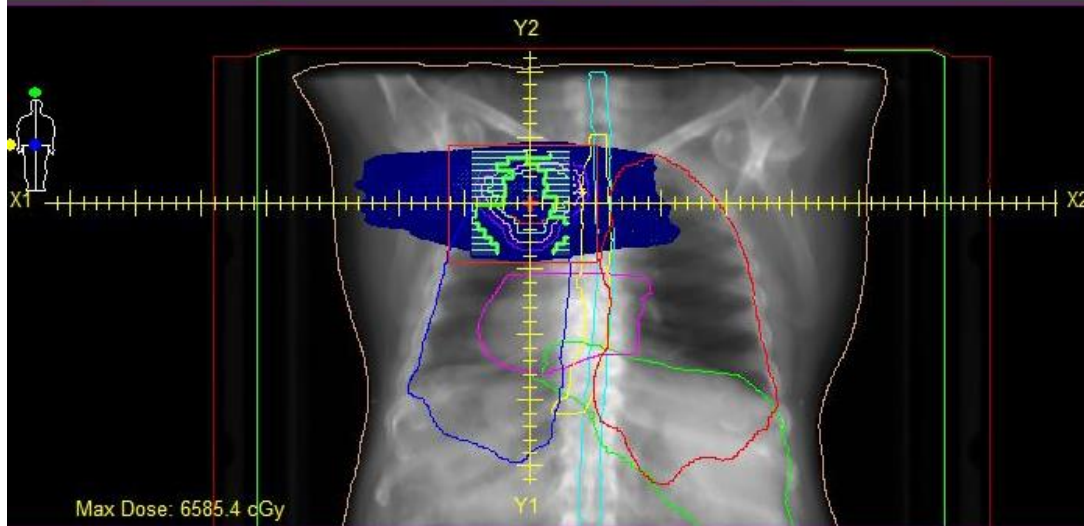
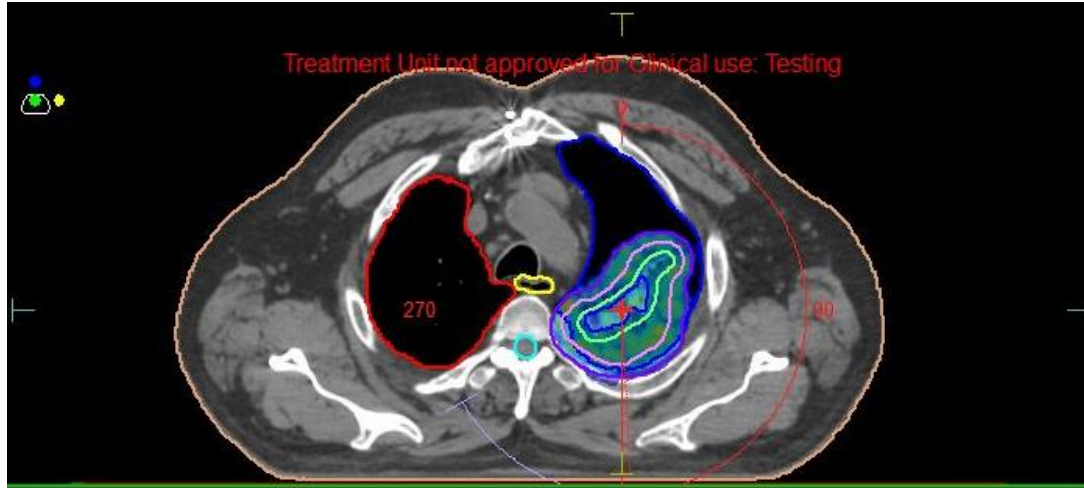
- DTA, ölçülen bir veri noktası ile hesaplanan doz dağılımında aynı dozu gösteren en yakın nokta arasındaki mesafedir.
- Gama analizi, her bir noktaya atanan gama indeksi değerlerini üretir. Bunun için  $\leq 1$  gama indeksi değerleri başarılı veya başarısız olduğunu gösterir.
- Gama dağılımındaki geçiş noktalarının yüzdesine gama geçiş (%GP) oranı adı verilir.
- En yaygın kullanılan gama analizi parametreleri %3  $\Delta D$  ve 3 mm DTA kriteridir.

# Convansiyonel tedavilerde hasta QA

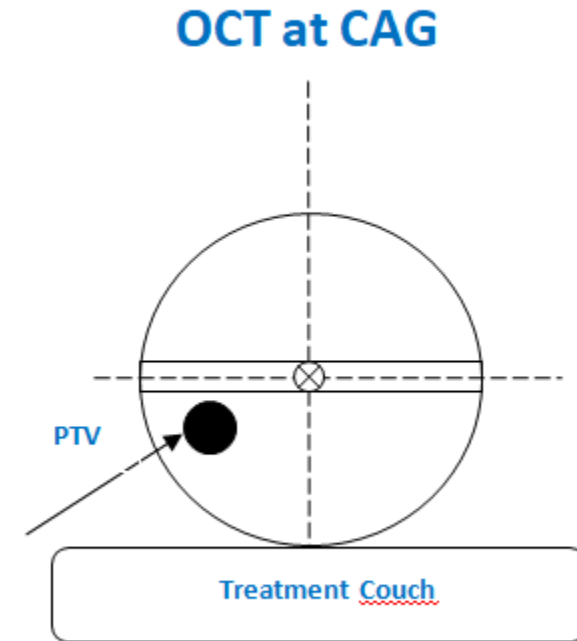
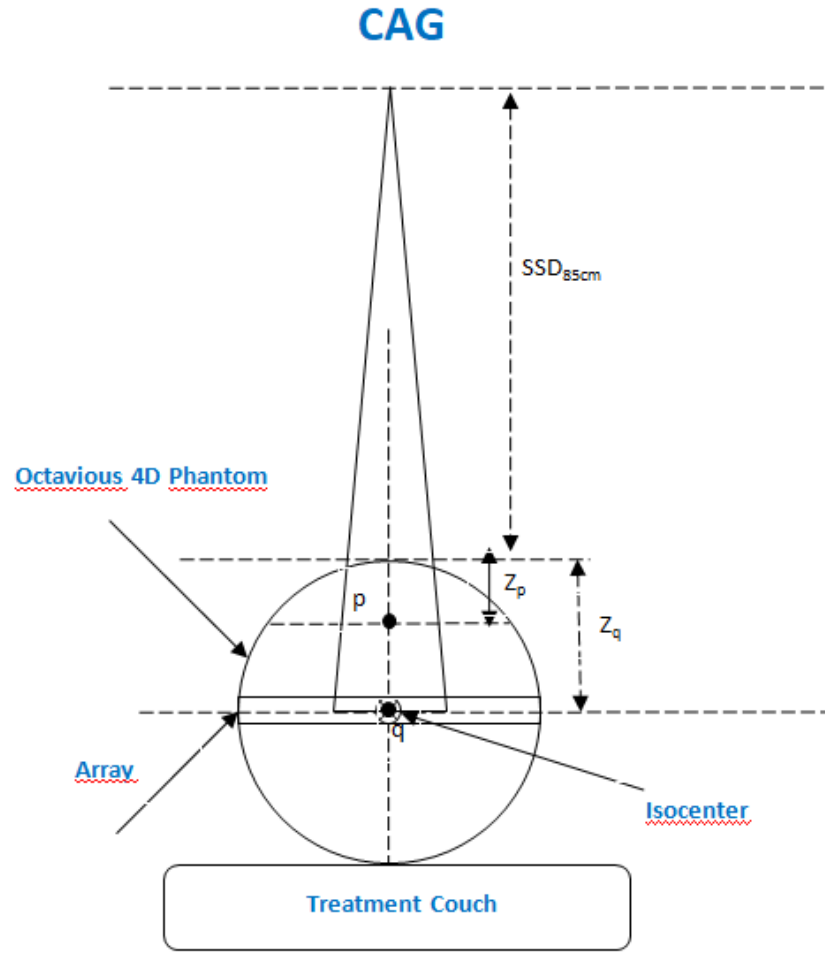


- Global gama deęerlendirmesi yzde farklarını her noktaya kadar global olarak kullanan tek bir deęere gre normalleřtirir. Bu deęer planlanan maksimum dozdur.
- Yerel gama deęerlendirmesi ise her noktadaki yzde farklarını beklenen doza gre normalleřtirir.
- Bu nedenle aynı kriterlerin ve daha dřk doz esięinin kullanıldıęı global gama tarafından hesaplanan % gama analizi geęme kriteri %GP her zaman yerel gamaya eřit olandan daha yksek olacaktır.

# Akciğer hastası için QA



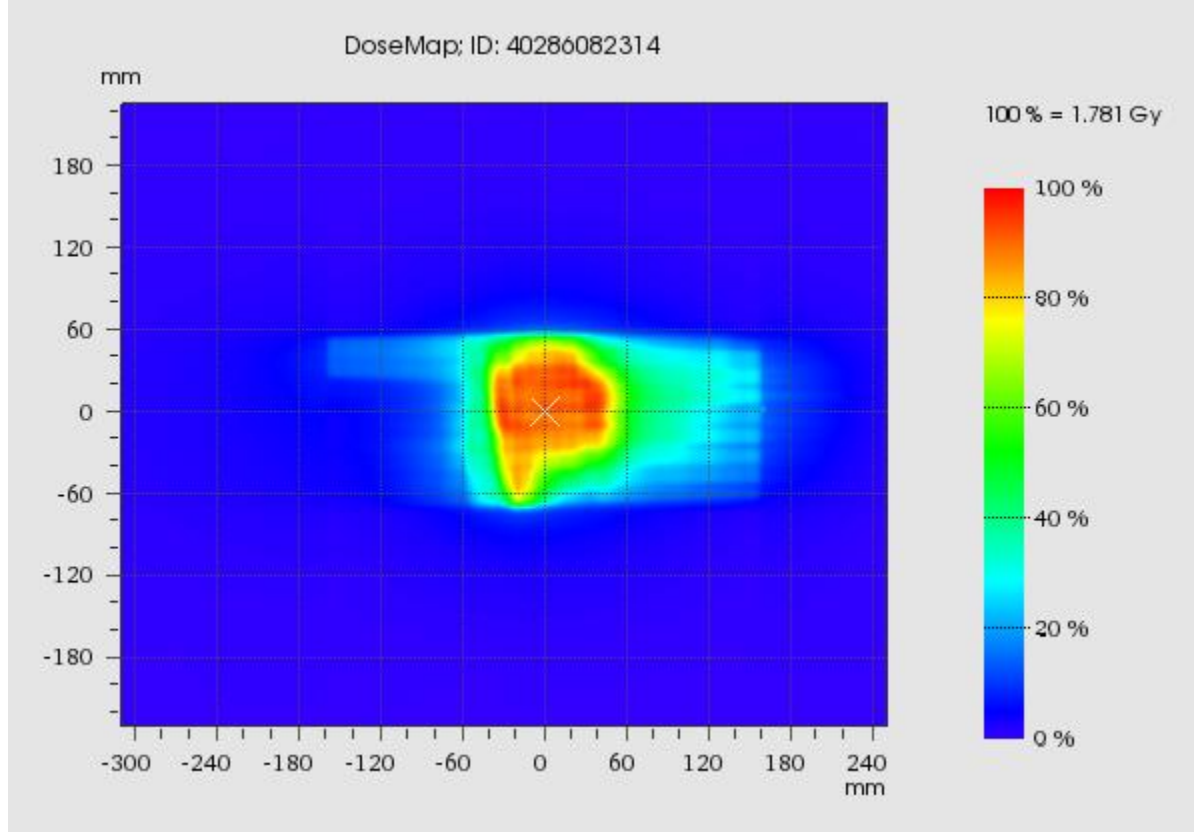
# Akciğer hastası için QA



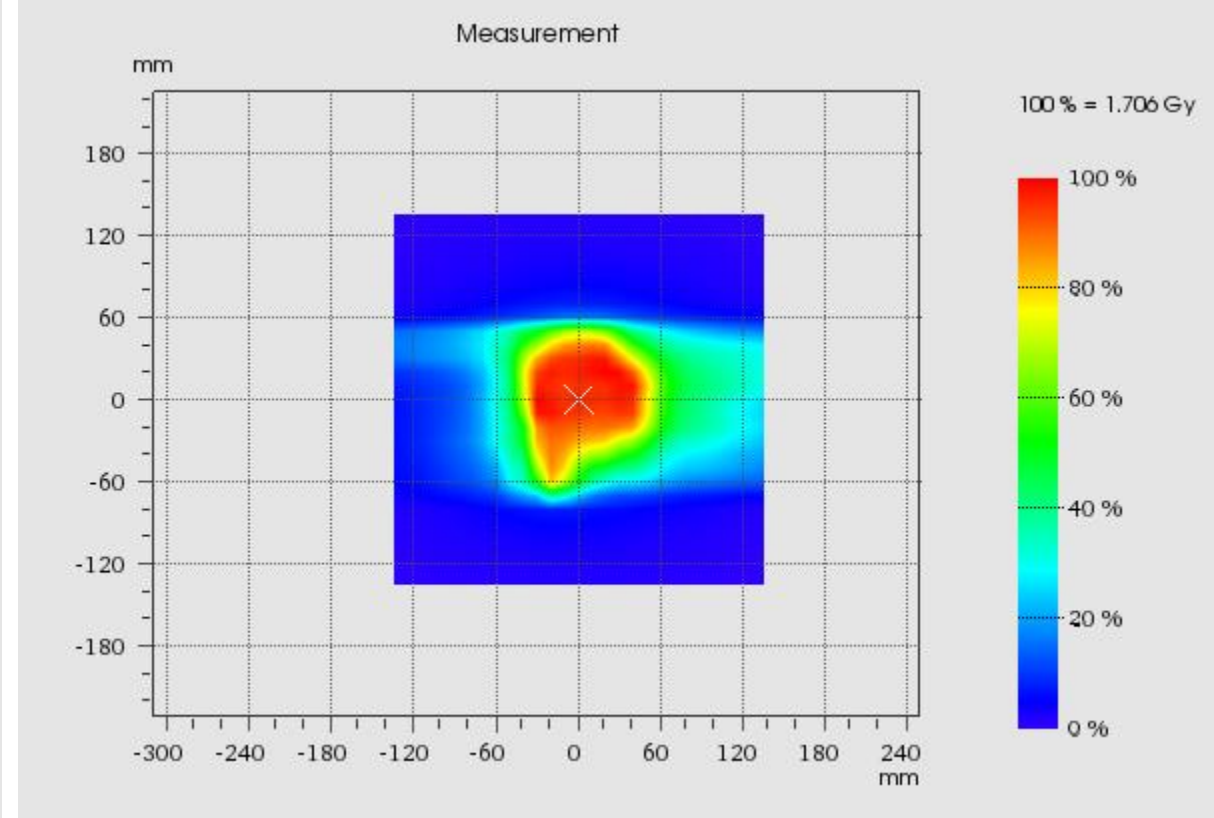
# Akciğer hastası için QA



Planlanan Doz Dağılımı



Ölçülen doz Dağılımı



# Akciğer hastası için QA



**Compare**

<none>

Gamma 3D

3.0 mm Distance- To- Agreement

3.0 % Dose Difference with ref. to

☒ Local dose

☐ Max. dose of calculated volume

☐ Selected dose Select 1.00 Gy (or AU)

☐ Use increased tolerance of

5.0 % Dose Diff. for values below

0.1 Gy (or AU)

☒ Suppress dose below

10.0 % of max. dose of calculated volume

|                                  |                   |
|----------------------------------|-------------------|
| <b>Statistics</b>                |                   |
| Number of Dose Points:           | 729               |
| Evaluated Dose Points:           | 294 (40.3 %)      |
| Passed:                          | 286 (97.3 %)      |
| Failed:                          | 8 (2.7 %)         |
| Result:                          | 97.3 %            |
| <b>Gamma 3D</b>                  |                   |
| Arithmetic Mean:                 | 0.364             |
| Min: (LR=10.0 mm / TG=-10.0 mm)  | 0.007             |
| Max: (LR=-100.0 mm / TG=30.0 mm) | 1.182             |
| Median:                          | 0.297             |
| <b>Absolute Difference</b>       |                   |
| Arithmetic Mean:                 | 0.016 Gy          |
| Min: (LR=-20.0 mm / TG=60.0 mm)  | 0.000 Gy          |
| Max: (LR=-50.0 mm / TG=20.0 mm)  | 0.048 Gy          |
| Median:                          | 0.015 Gy          |
| <b>Settings</b>                  |                   |
| Passing criteria: Gamma <=       | 1.0               |
| Green:                           | 90.0 % to 100.0 % |
| Yellow:                          | 75.0 % to 90.0 %  |
| Red:                             | 0.0 % to 75.0 %   |

# Akciğer hastası için QA



Compare

<none>

Gamma 3D

3.0 mm Distance- To- Agreement

3.0 % Dose Difference with ref. to

☒ Local dose

☐ Max. dose of calculated volume

☐ Selected dose  Gy (or AU)

☐ Use increased tolerance of

5.0 % Dose Diff. for values below

0.1 Gy (or AU)

☒ Suppress dose below

5.0 % of max. dose of calculated volume

## Statistics

|                        |              |
|------------------------|--------------|
| Number of Dose Points: | 729          |
| Evaluated Dose Points: | 403 (55.3 %) |
| Passed:                | 350 (86.8 %) |
| Failed:                | 53 (13.2 %)  |
| Result:                | 86.8 %       |

## Gamma 3D

|                                   |       |
|-----------------------------------|-------|
| Arithmetic Mean:                  | 0.522 |
| Min: (LR=10.0 mm / TG=-10.0 mm)   | 0.007 |
| Max: (LR=-130.0 mm / TG=-50.0 mm) | 3.478 |
| Median:                           | 0.373 |

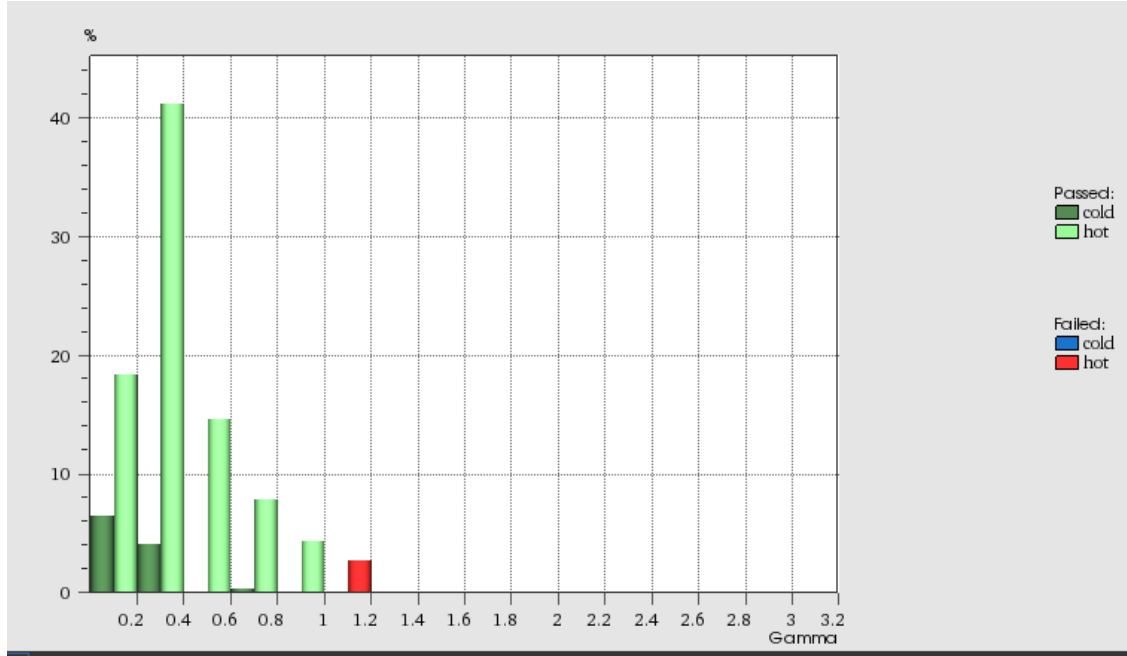
## Absolute Difference

|                                 |          |
|---------------------------------|----------|
| Arithmetic Mean:                | 0.015 Gy |
| Min: (LR=-30.0 mm / TG=60.0 mm) | 0.000 Gy |
| Max: (LR=-50.0 mm / TG=20.0 mm) | 0.048 Gy |
| Median:                         | 0.014 Gy |

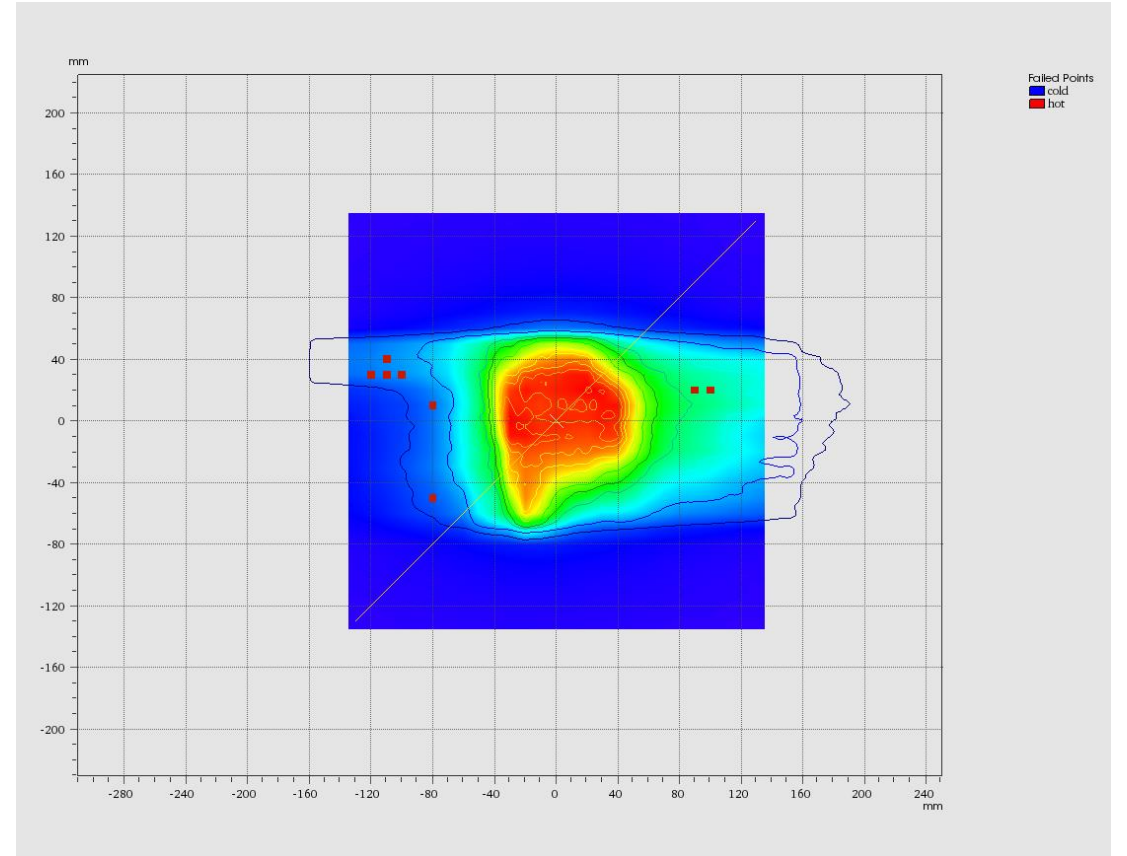
## Settings

|                            |                   |
|----------------------------|-------------------|
| Passing criteria: Gamma <= | 1.0               |
| Green:                     | 90.0 % to 100.0 % |
| Yellow:                    | 75.0 % to 90.0 %  |
| Red:                       | 0.0 % to 75.0 %   |

# Akciger hastası için QA



Lokal dağılıma bağlı olarak Gama analizi



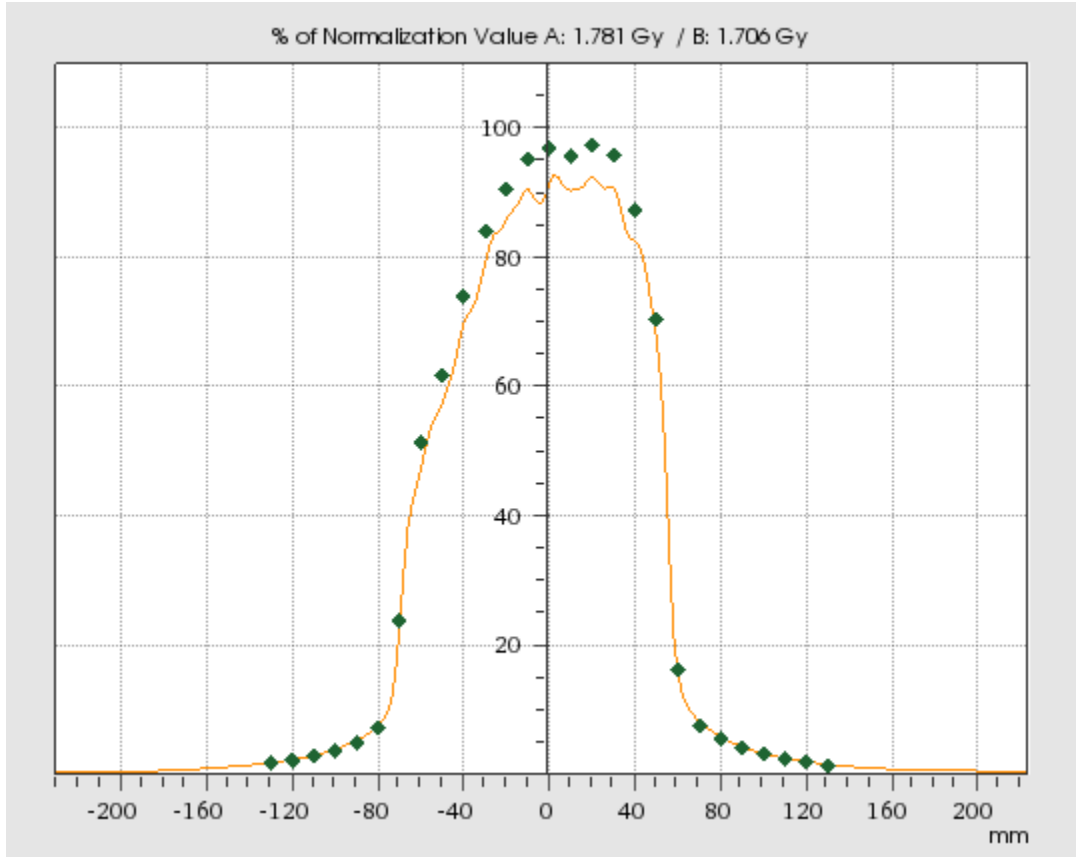
## Gama analizi dağılım cetveli

|   | ▲      | -130.0 | -120.0 | -110.0 | -100.0 | -90.0 | -80.0 | -70.0 | -60.0 | -50.0 | -40.0 | -30.0 | -20.0 | -10.0 | 0.0   | 10.0  | 20.0  | 30.0  | 40.0  | 50.0  | 60.0  | 70.0  | 80.0  | 90.0  | 100.0 | 110.0 | 120.0 | 130.0 |
|---|--------|--------|--------|--------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| ▶ | 130.0  | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | 120.0  | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | 110.0  | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | 100.0  | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | 90.0   | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | 80.0   | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | 70.0   | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | 60.0   | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | 0.010 | 0.141 | 0.443 | 0.513 | 0.426 | 0.248 | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | 50.0   | 0.194  | 0.193  | 0.490  | 0.186  | 0.300 | 0.237 | 0.300 | 0.229 | 0.342 | 0.187 | 0.168 | 0.169 | 0.216 | 0.013 | 0.210 | 0.043 | 0.199 | 0.194 | 0.250 | 0.320 | 0.309 | 0.374 | 0.378 | 0.172 | 0.239 | 0.272 | 0.076 |
|   | 40.0   | 0.501  | 0.880  | 1.000  | 0.605  | 0.820 | 0.621 | 0.719 | 0.375 | 0.534 | 0.289 | 0.457 | 0.032 | 0.191 | 0.377 | 0.268 | 0.178 | 0.272 | 0.240 | 0.337 | 0.704 | 0.785 | 0.986 | 0.957 | 0.713 | 0.929 | 0.280 | 0.085 |
|   | 30.0   | 0.324  | 1.067  | 1.160  | 1.182  | 0.999 | 0.654 | 0.657 | 0.367 | 0.531 | 0.167 | 0.254 | 0.117 | 0.281 | 0.268 | 0.298 | 0.117 | 0.204 | 0.171 | 0.226 | 0.361 | 0.517 | 0.795 | 0.993 | 0.753 | 0.718 | 0.308 | 0.167 |
|   | 20.0   | ---    | ---    | ---    | ---    | 0.571 | 0.592 | 0.691 | 0.460 | 0.598 | 0.251 | 0.523 | 0.250 | 0.397 | 0.275 | 0.282 | 0.127 | 0.058 | 0.236 | 0.269 | 0.296 | 0.478 | 0.680 | 1.066 | 1.082 | 0.914 | 0.275 | 0.186 |
|   | 10.0   | ---    | ---    | ---    | ---    | ---   | 1.036 | 0.817 | 0.530 | 0.765 | 0.250 | 0.544 | 0.654 | 0.699 | 0.432 | 0.439 | 0.510 | 0.281 | 0.276 | 0.375 | 0.375 | 0.537 | 0.495 | 0.685 | 0.474 | 0.668 | 0.362 | 0.258 |
|   | 0.0    | ---    | ---    | ---    | ---    | ---   | 0.909 | 0.624 | 0.444 | 0.703 | 0.289 | 0.394 | 0.545 | 0.529 | 0.385 | 0.217 | 0.209 | 0.167 | 0.241 | 0.336 | 0.373 | 0.480 | 0.444 | 0.425 | 0.330 | 0.385 | 0.246 | 0.279 |
|   | -10.0  | ---    | ---    | ---    | ---    | ---   | 0.858 | 0.504 | 0.352 | 0.931 | 0.236 | 0.026 | 0.288 | 0.287 | 0.258 | 0.007 | 0.166 | 0.049 | 0.076 | 0.251 | 0.351 | 0.375 | 0.383 | 0.448 | 0.343 | 0.409 | 0.203 | 0.439 |
|   | -20.0  | ---    | ---    | ---    | ---    | ---   | 0.605 | 0.373 | 0.318 | 0.597 | 0.263 | 0.167 | 0.217 | 0.383 | 0.298 | 0.074 | 0.254 | 0.260 | 0.174 | 0.296 | 0.316 | 0.290 | 0.300 | 0.226 | 0.281 | 0.255 | 0.179 | 0.296 |
|   | -30.0  | ---    | ---    | ---    | ---    | 0.800 | 0.727 | 0.386 | 0.333 | 0.306 | 0.239 | 0.100 | 0.189 | 0.304 | 0.335 | 0.135 | 0.172 | 0.248 | 0.206 | 0.236 | 0.352 | 0.314 | 0.411 | 0.409 | 0.407 | 0.383 | 0.236 | 0.509 |
|   | -40.0  | ---    | ---    | ---    | ---    | ---   | 0.868 | 0.309 | 0.373 | 0.241 | 0.330 | 0.252 | 0.020 | 0.170 | 0.262 | 0.047 | 0.013 | 0.167 | 0.099 | 0.170 | 0.168 | 0.167 | 0.236 | 0.253 | 0.277 | 0.335 | 0.178 | 0.403 |
|   | -50.0  | ---    | ---    | ---    | ---    | ---   | 1.021 | 0.290 | 0.368 | 0.485 | 0.375 | 0.249 | 0.159 | 0.273 | 0.354 | 0.200 | 0.183 | 0.300 | 0.168 | 0.188 | 0.167 | 0.167 | 0.289 | 0.236 | 0.054 | 0.171 | 0.316 | 0.094 |
|   | -60.0  | ---    | ---    | ---    | ---    | ---   | ---   | 0.500 | 0.527 | 0.161 | 0.282 | 0.011 | 0.109 | 0.240 | 0.405 | 0.296 | 0.181 | 0.334 | 0.197 | 0.209 | 0.236 | 0.160 | 0.167 | 0.238 | 0.369 | 0.012 | 0.376 | 0.175 |
|   | -70.0  | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | 0.388 | 0.302 | 0.192 | 0.632 | 0.168 | 0.109 | 0.239 | 0.167 | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | -80.0  | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | -90.0  | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | -100.0 | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | -110.0 | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | -120.0 | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |
|   | -130.0 | ---    | ---    | ---    | ---    | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   | ---   |

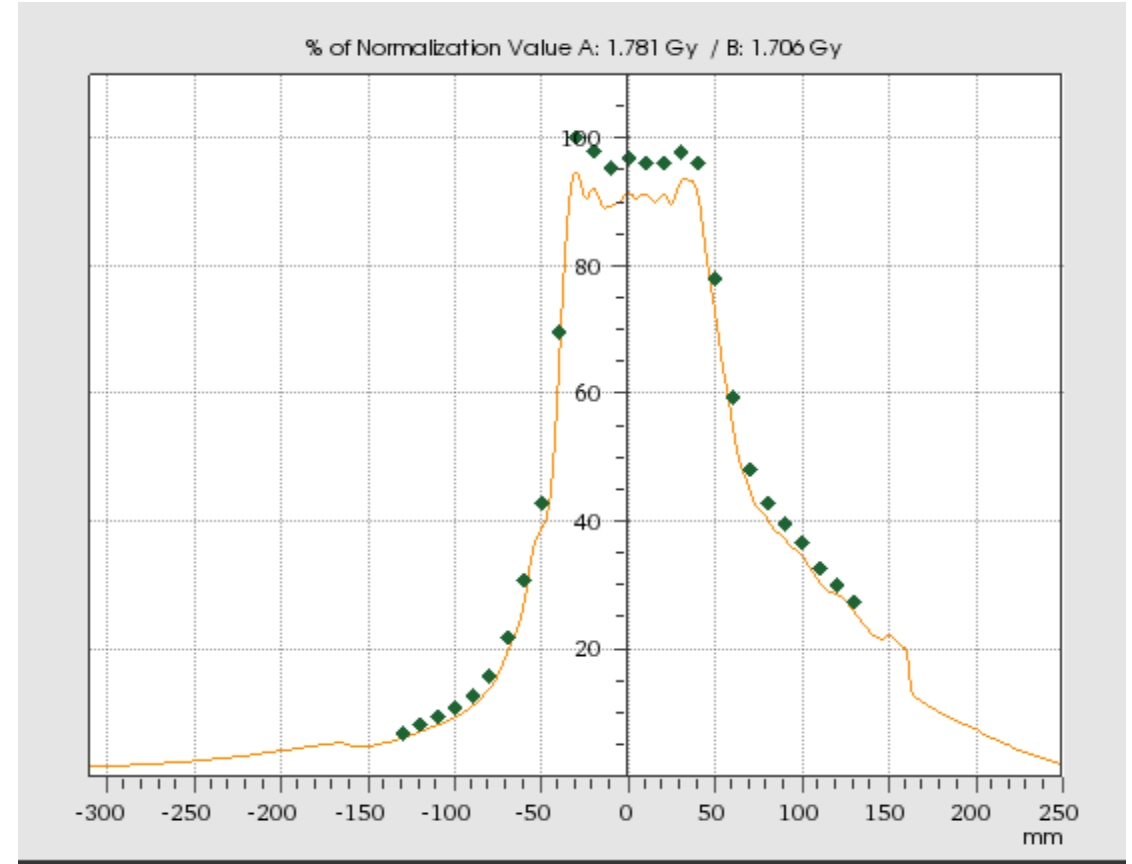
# Akciğer hastası için QA



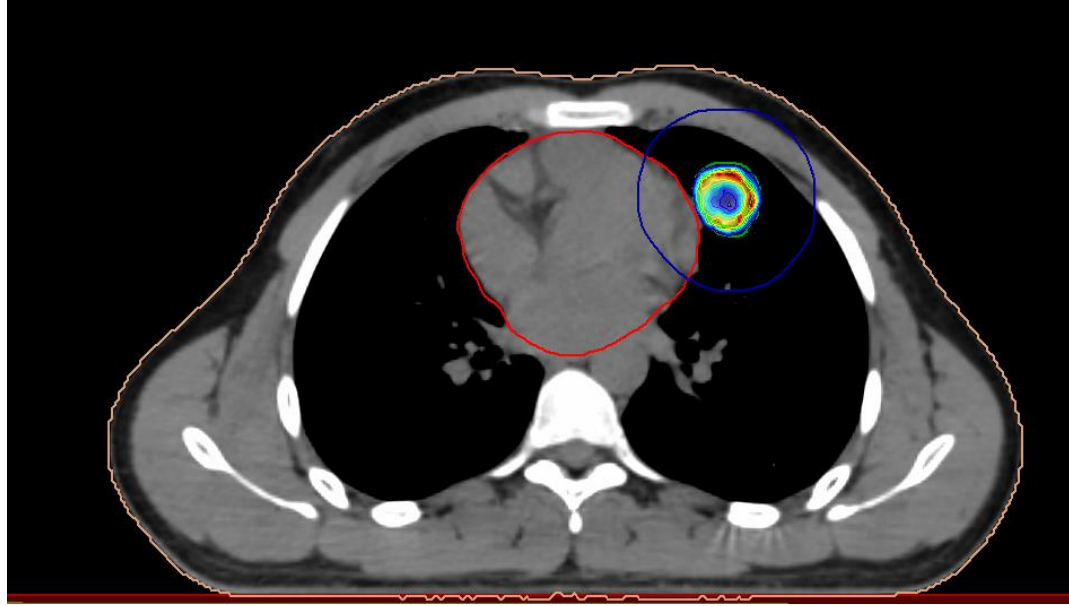
GT yönü



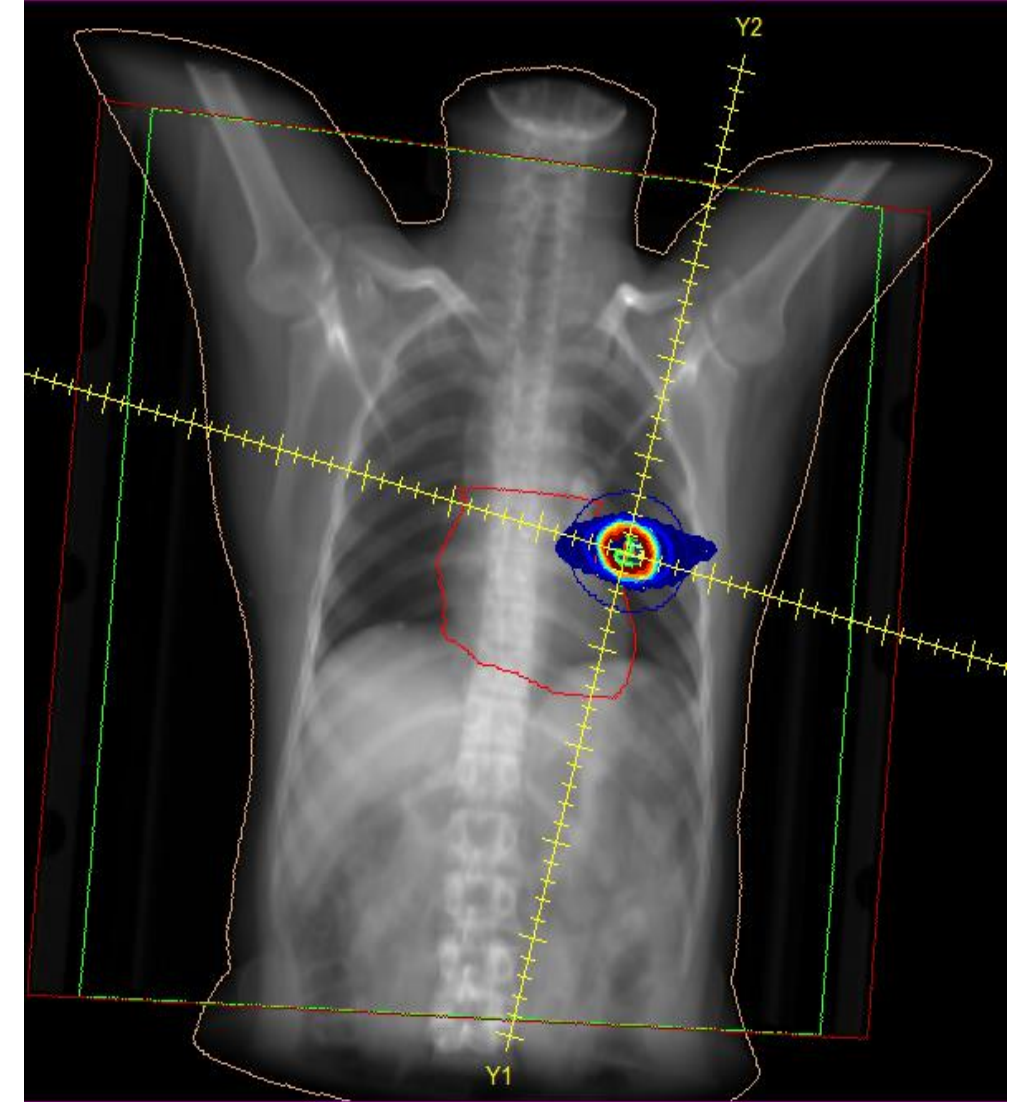
LT Yönü



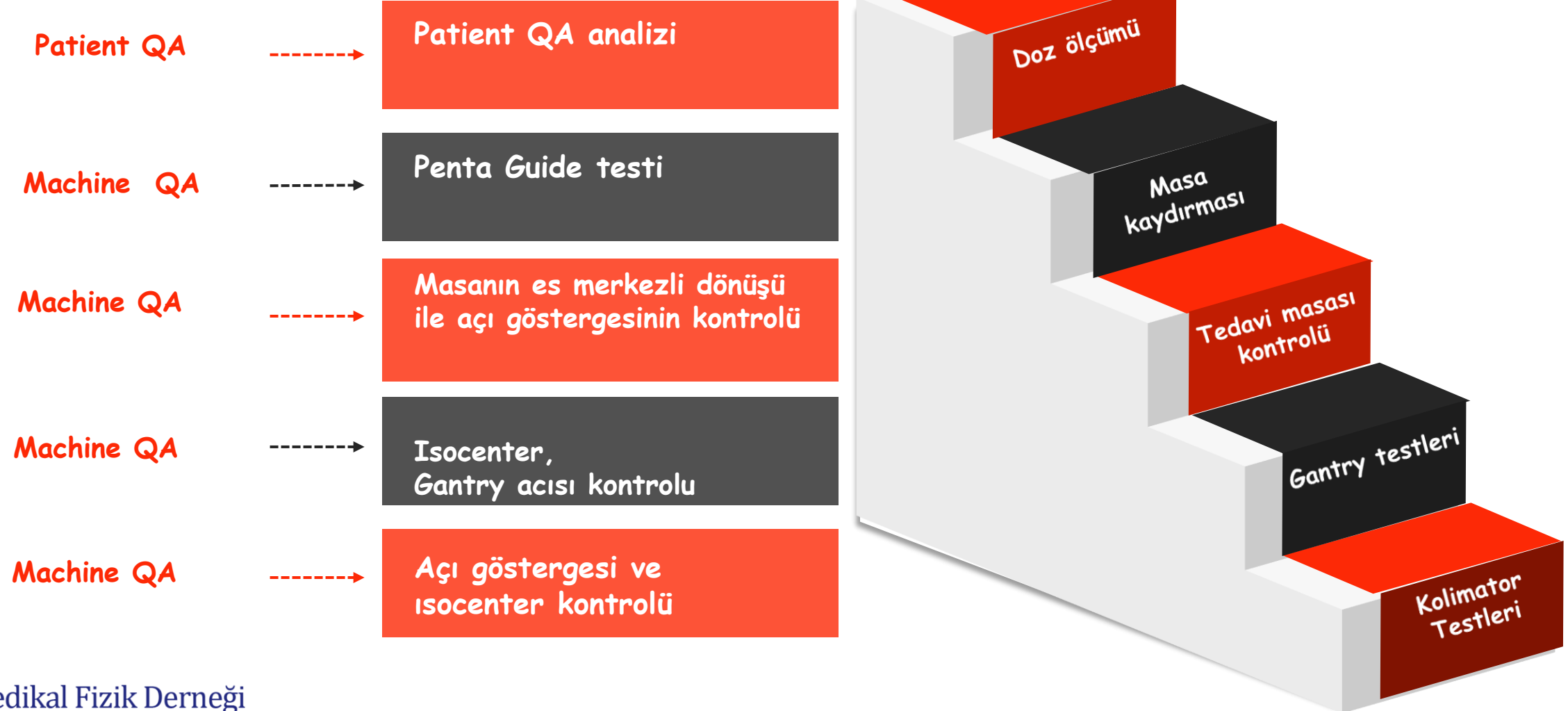
# Akciğer SBRT Patient QA



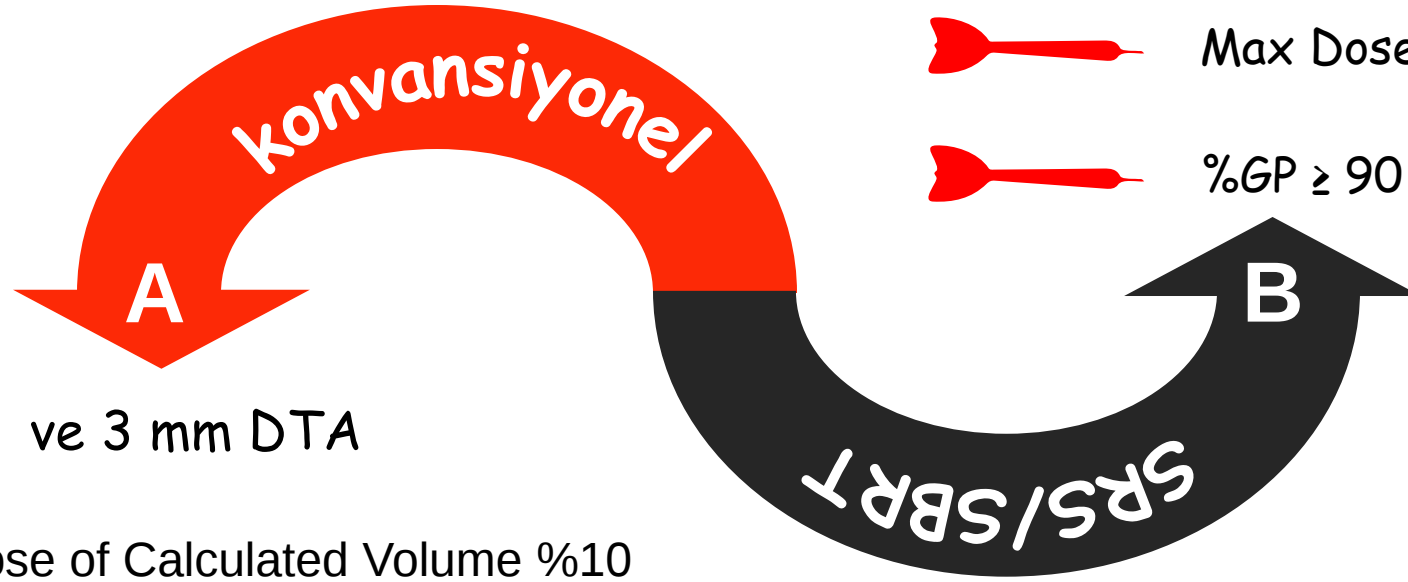
| Beam | Description | SSD (cm) | Dir | Gantry Start (deg) | Arc   | Inc  | Collimator (deg) | Couch (deg) | Field  |
|------|-------------|----------|-----|--------------------|-------|------|------------------|-------------|--------|
| 1    | 10vmat      | 85.34    | CCW | 180.0              | 200.0 | 20.0 | 45.0             | 5.0         | [Auto] |
| 2    | 11vmat      | 95.10    | CW  | 340.0              | 200.0 | 20.0 | 345.0            | 355.0       | [Auto] |
| 5    | 12vmat      | 85.24    | CCW | 180.0              | 200.0 | 20.0 | 345.0            | 5.0         | [Auto] |
| 3    | 13vmat      | 94.73    | CW  | 340.0              | 200.0 | 20.0 | 45.0             | 355.0       | [Auto] |
| 4    | 14vmat      | 94.52    | CW  | 340.0              | 40.0  | 10.0 | 90.0             | 90.0        | [Auto] |
| 6    | 15vmat      | 95.60    | CCW | 20.0               | 40.0  | 10.0 | 0.0              | 90.0        | [Auto] |



# Akciğer SBRT Patient QA



# Konvansiyonel vs SRS SBSR Patient QA



%3  $\Delta D$  ve 3 mm DTA



Max Dose of Calculated Volume %10



%GP  $\geq$  95



Hassas detektore ihtiyac vardır



%2  $\Delta D$  ve 2 mm DTA



Max Dose of Calculated Volume %10



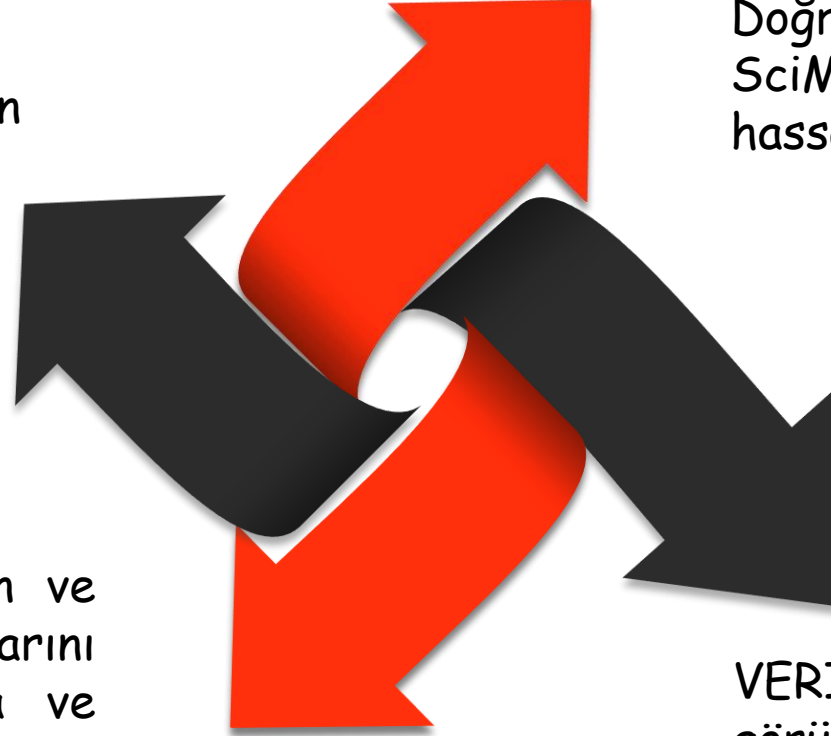
%GP  $\geq$  90

# VeriQA: SciMoCa



Tek platformda görselleştirme, plan değerlendirme ve raporlandırılmasına olanak sağlayan modüler bir platform.

Monte Carlo Doz Hesaplamaları:  
Doğruluğu ve güvenilirliği ile bilinen köklü SciMoCa™ Monte Carlo algoritması ile hassas doz hesabı.



Deformable image registration ve dose accumulation araçlarını kullanarak kapsamlı 3D gama ve DVH analizi ile tedavi planı değerlendirmesi

VERIQA RT EPID 3D ile elde edilen görüntülerden gerçek 3 boyutlu hasta dozunun yeniden oluşturulmasını sağlayan hem tedavi öncesi hem de in vivo EPID dozimetrisi için tam otomatik bir çözüm



# VERIQA RT MonteCarlo 3D

Fully automated workflow from DICOM import to documentation

## RT Plan Export

VERIQA receives DICOM RT data from TPS and automatically starts the QA workflow.

## Results

Dose results can be directly accessed via web browser and exported to RT View/Evaluate for further analysis and comparison.

## Documentation

Multiple options are available to document the results: PDF report, DICOM export to PACS, Track-it export



## Calculation

RT MonteCarlo 3D recalculates and compares dose based on settings in assigned evaluation template and sends email notification.

## Approval

Results are approved or rejected by an authorized user. Comments can be added at each important step in the verification process, ensuring full traceability of the results.

# VERIQA RT MonteCarlo 3D

## SciMoCa™ algorithm — accurate and effective

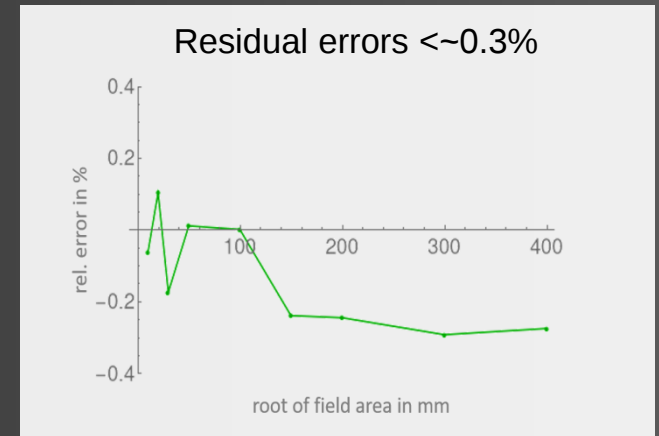
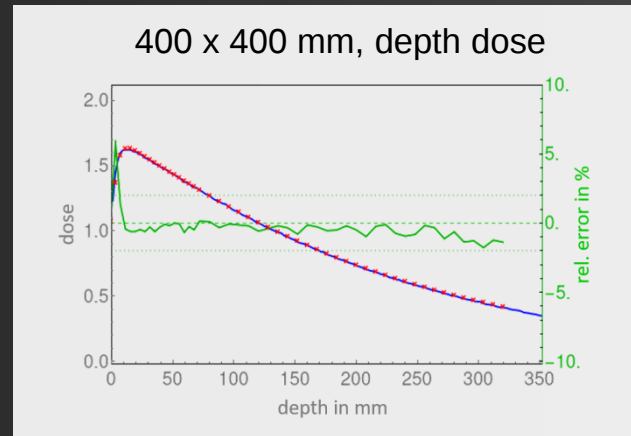
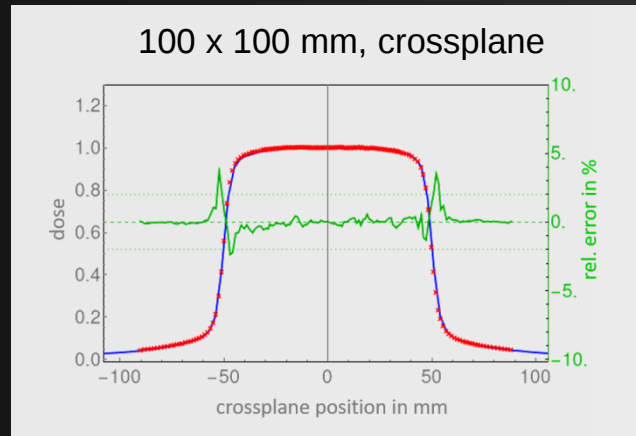
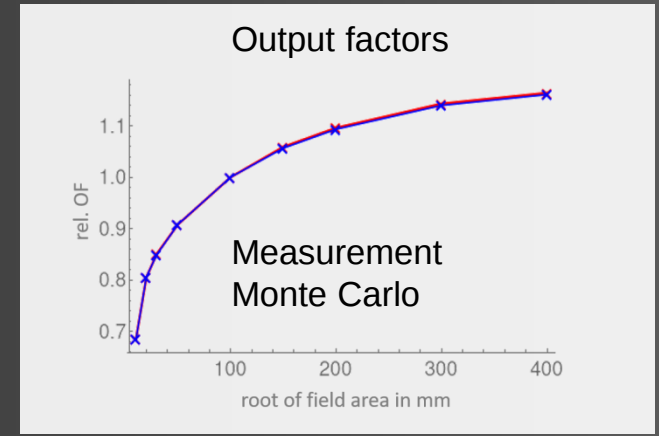
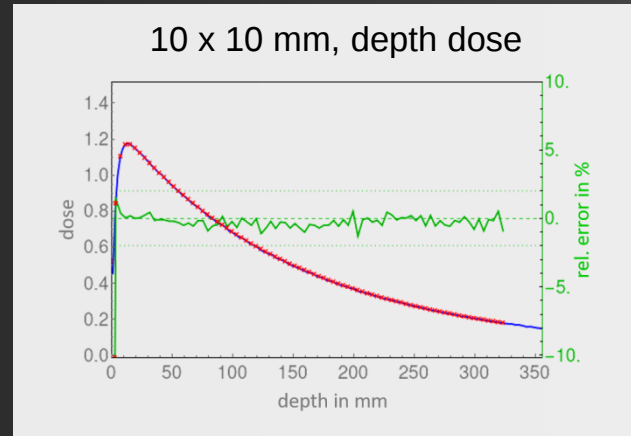
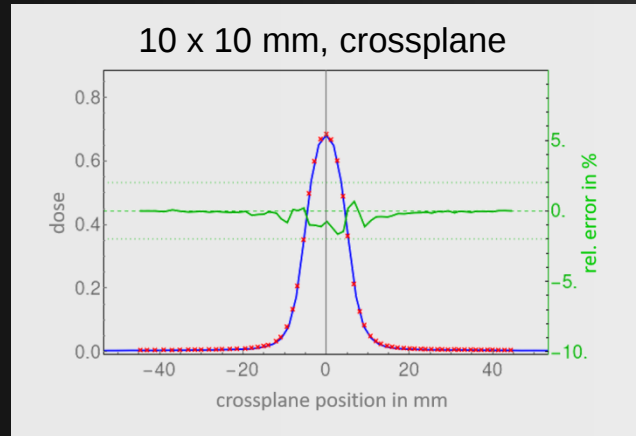
- ▶ Unique beam modelling process for high-quality beam models

- ▶ Beam models based on:

Golden beam measurement from vendor

or

Water phantom measurements from customer

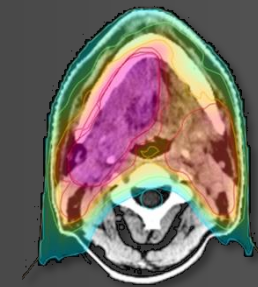
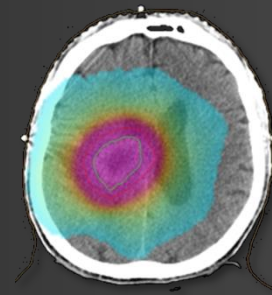
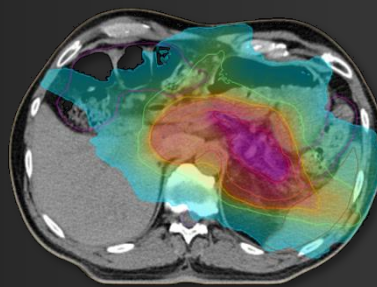
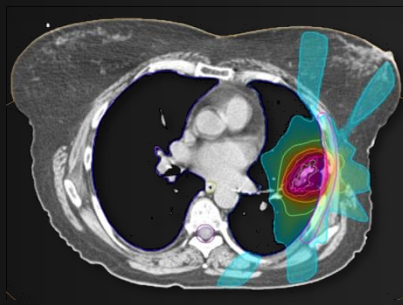


# VERIQA RT MonteCarlo 3D

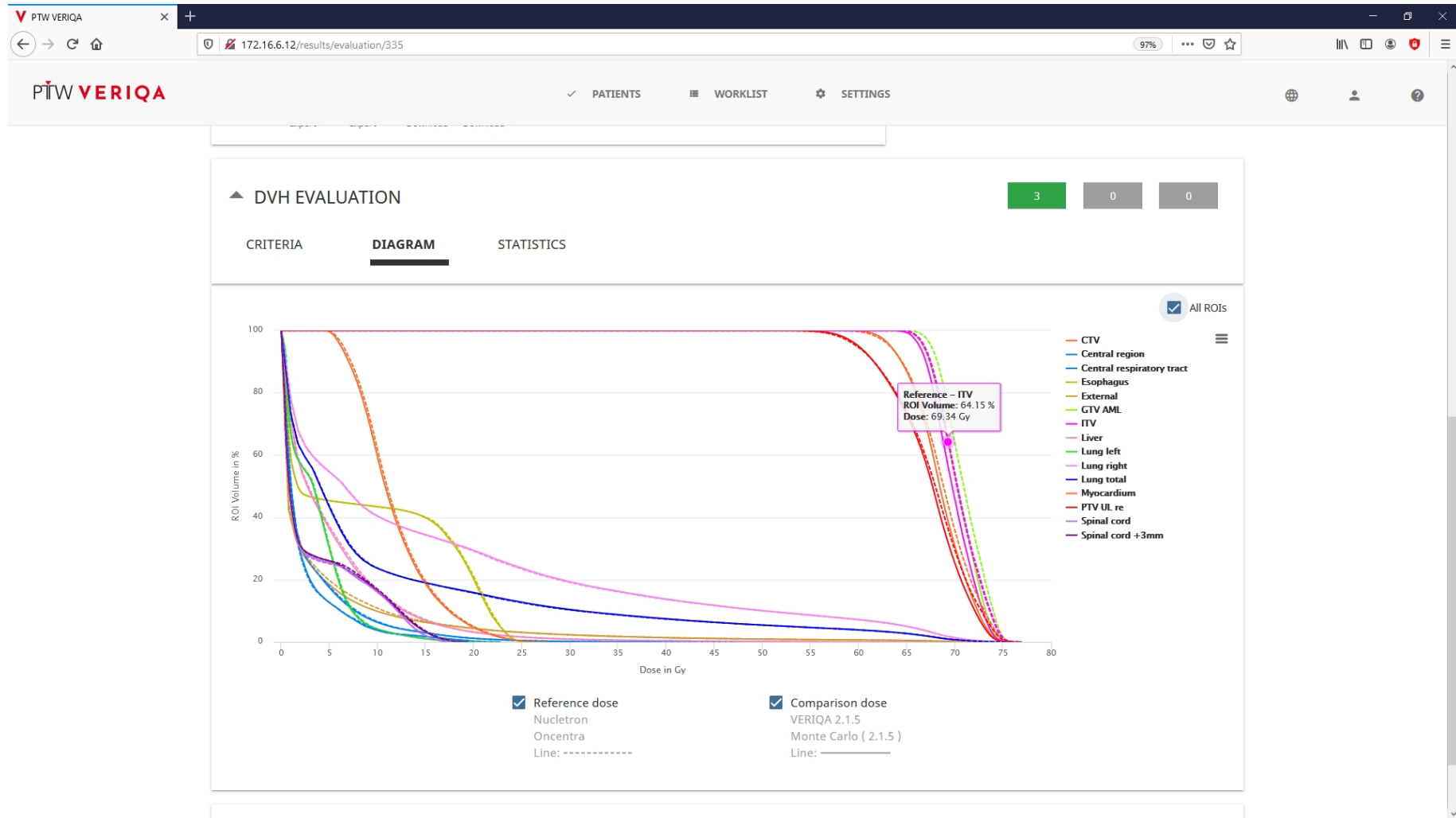
## SciMoCa™ algorithm – speed and accuracy combined

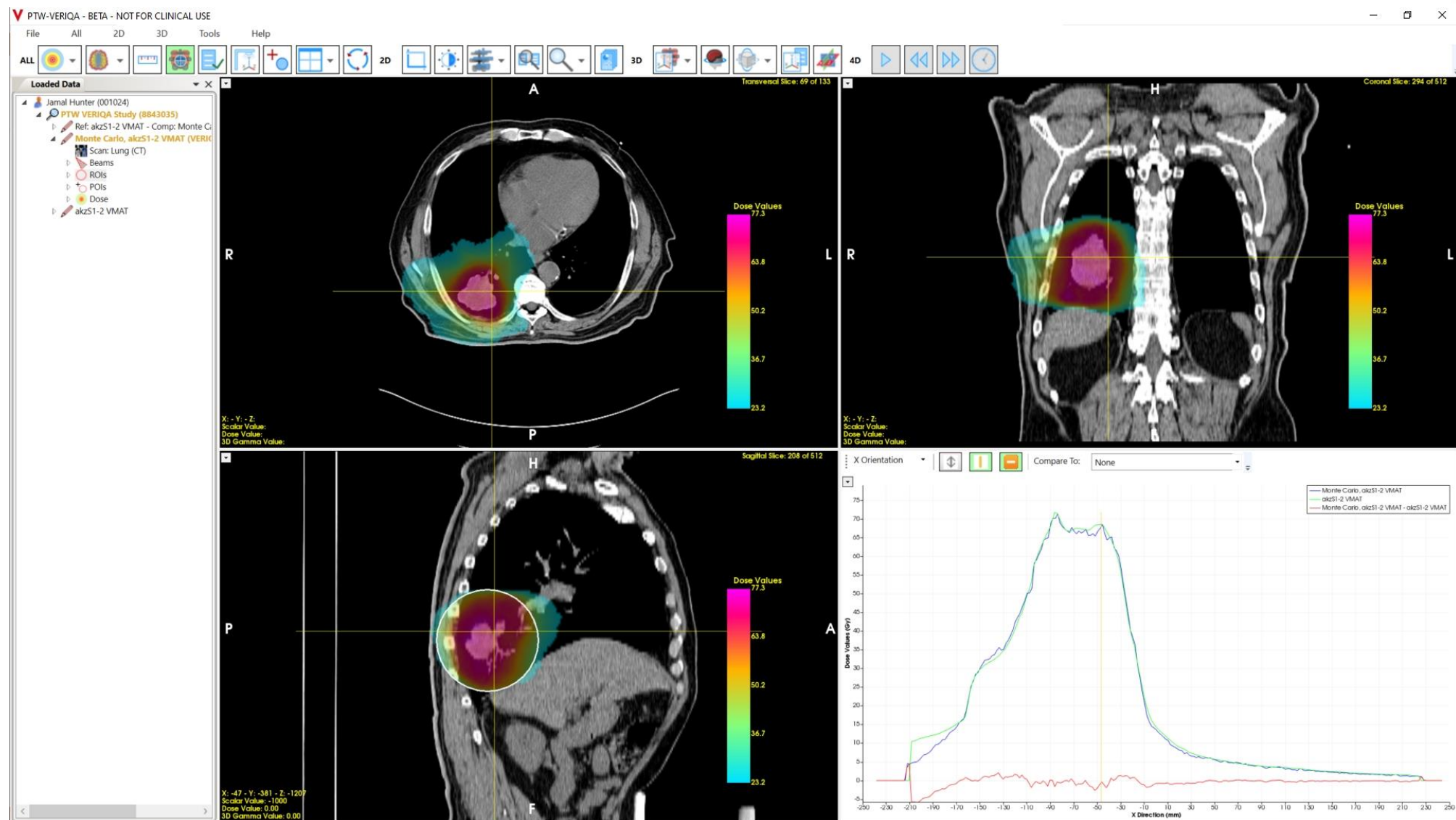
|                  | Lung SBRT                | Pancreas                                                       | Brain                                         | H&N                                                            |
|------------------|--------------------------|----------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------|
|                  | 3D / 7 beams<br>6 MV FFF | VMAT / 2 arcs / 180 CP <sup>1</sup><br>6 MV – SIB <sup>2</sup> | VMAT / 1 arc / 90 CP <sup>1</sup><br>6 MV FFF | VMAT / 2 arcs / 180 CP <sup>1</sup><br>6 MV – SIB <sup>2</sup> |
| PTV Volume       | 46.45 cm <sup>3</sup>    | 589.26 cm <sup>3</sup>                                         | 264.48 cm <sup>3</sup>                        | 907.74 cm <sup>3</sup>                                         |
| Dose grid size   | 3 x 3 x 3 mm             | 3 x 3 x 3 mm                                                   | 2 x 2 x 2 mm                                  | 2 x 2 x 2 mm                                                   |
| MC accuracy      | 1%                       | 1%                                                             | 0.5%                                          | 0.5%                                                           |
| Calculation time | 12 sec                   | 30 sec                                                         | 46 sec                                        | 246 sec                                                        |

Calculated on a dual  
12-core Intel Xeon  
Silver 4214 2.2 GHz  
server with hyper-  
threading  
(48 logical cores)



<sup>1</sup>Control Point    <sup>2</sup>Simultaneous Integrated Boost







TIME RANGE  
2019-04-22 - 2019-05-24

RADIATION UNIT  
Linac 1

SOFTWARE  
VERIQA

MEASURING DEVICE  
-

MEASUREMENT PARAMETERS

Class name: Reference plan

Matrix compare mode: Gamma 3D volume

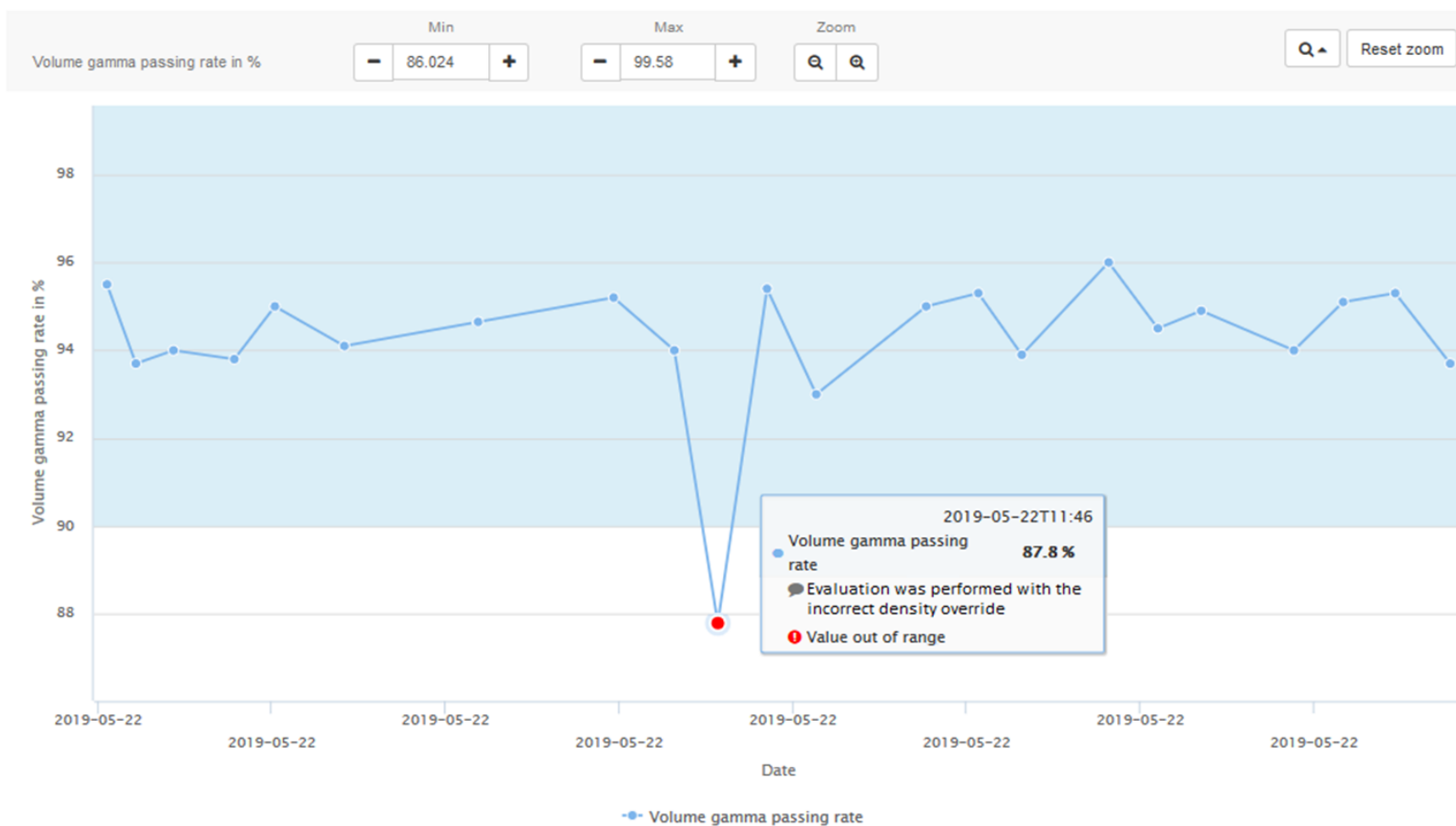
Dose evaluation threshold: 10.0 %

Gamma index calculation: Use 2nd and 3rd pass

Distance to agreement criteria: 3.0 mm

Dose difference criteria: 3.0 %

Dose difference referral: Local dose



# Patient QA vs Plan Değerlendirmesi



Zaman alır

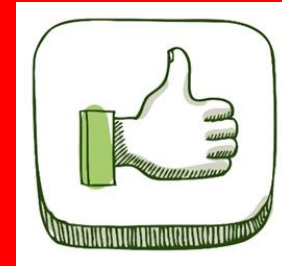
Fantom  
Kullanımına  
İhtiyaç  
vardır

SRS SBRT için  
farklı detektör  
kullanımı  
gerekir

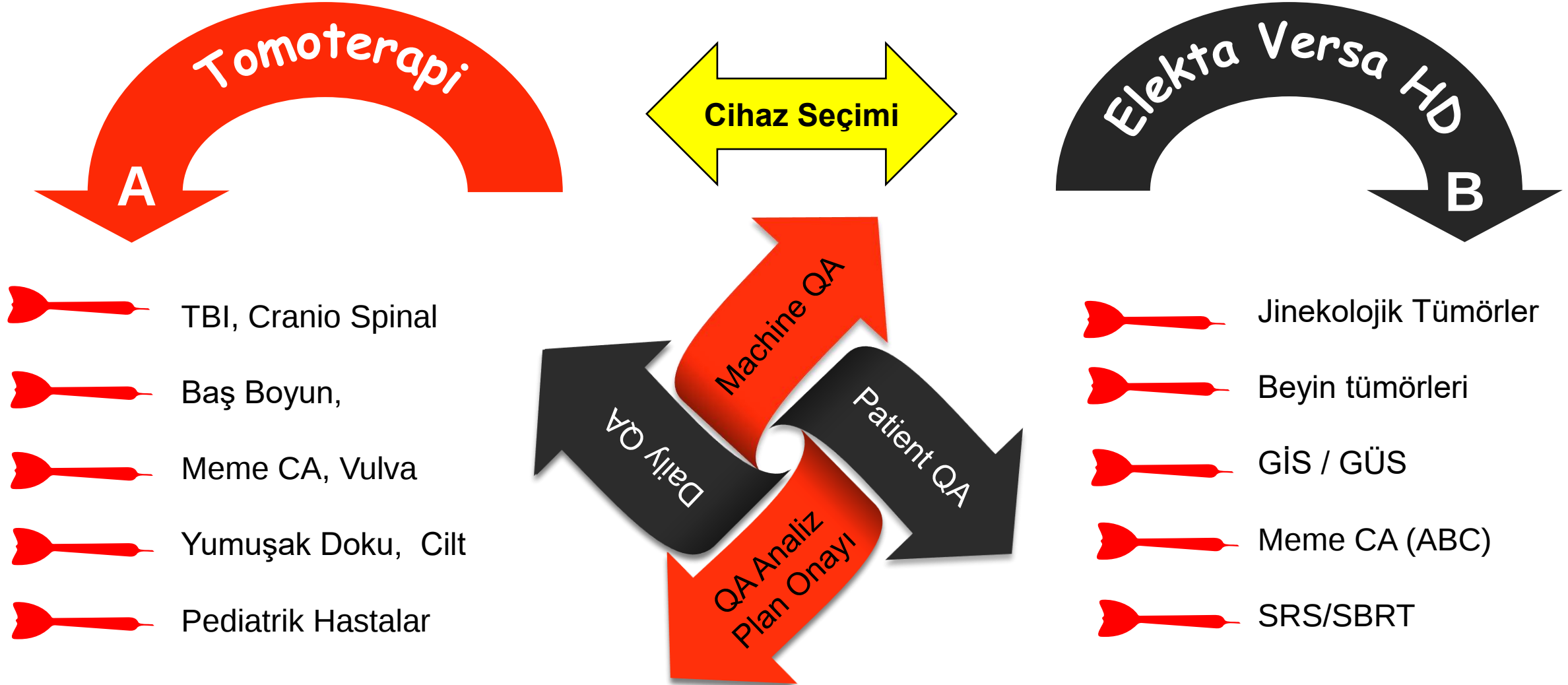
Zamandan  
tasarruf  
sağlar

Fantom  
kullanımına  
gerek yoktur

Her hasta  
için  
uygulanabilir



# Biz ne yapıyoruz?



# Sonuc



Radyoterapide hastaya özgü kalite kontrol özellikle VMAT gibi kompleks tedavi planlarının doğruluğu için Oldukça önemlidir

QA için kullanılan fantomların hastaya verilen dozu ölçebilecek, geometrik ve dozimetrik hataların değerlendirilmesine imkan sağlayacak özellikte olması gerekmektedir.

Farklı tedavi planları için uygulanacak olan gama analizi kriterleri planlama modalitesine, fantom özelliklerine ve klinik protokole göre belirlenmelidir.

