Tomotherapy and Patient QA (Part 1)

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Medical Physicist

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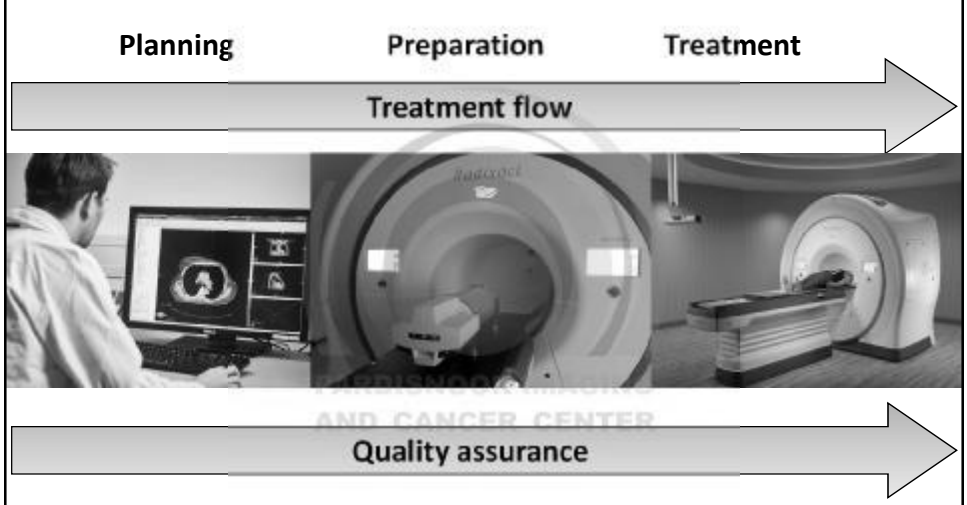

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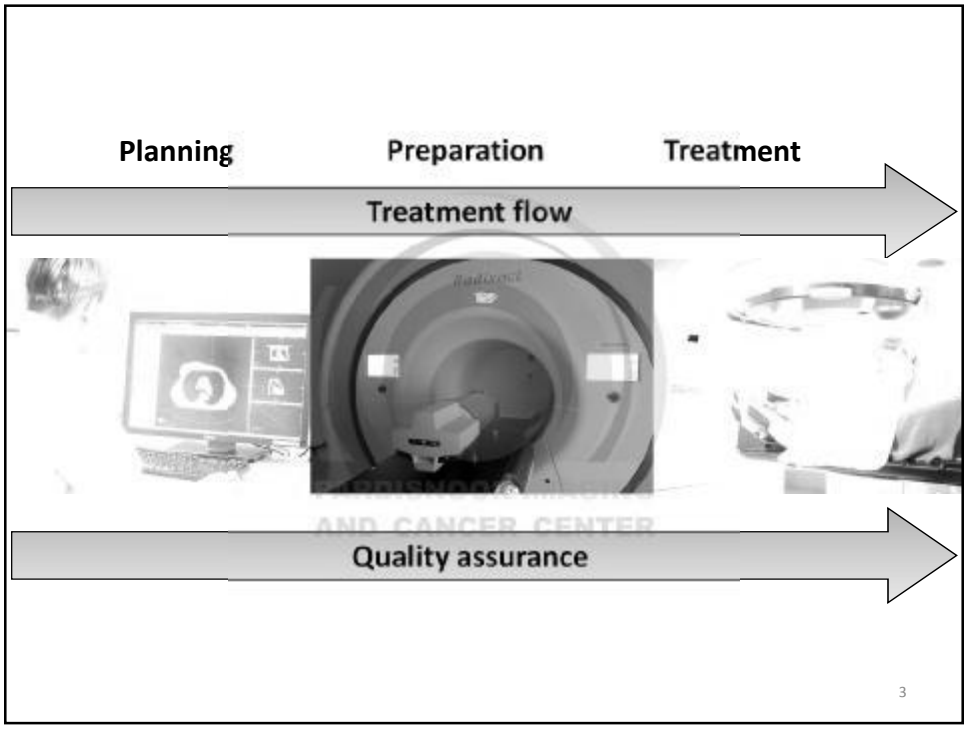
Planning
Preparation
Treatment
Treatment flow
Quality assurance
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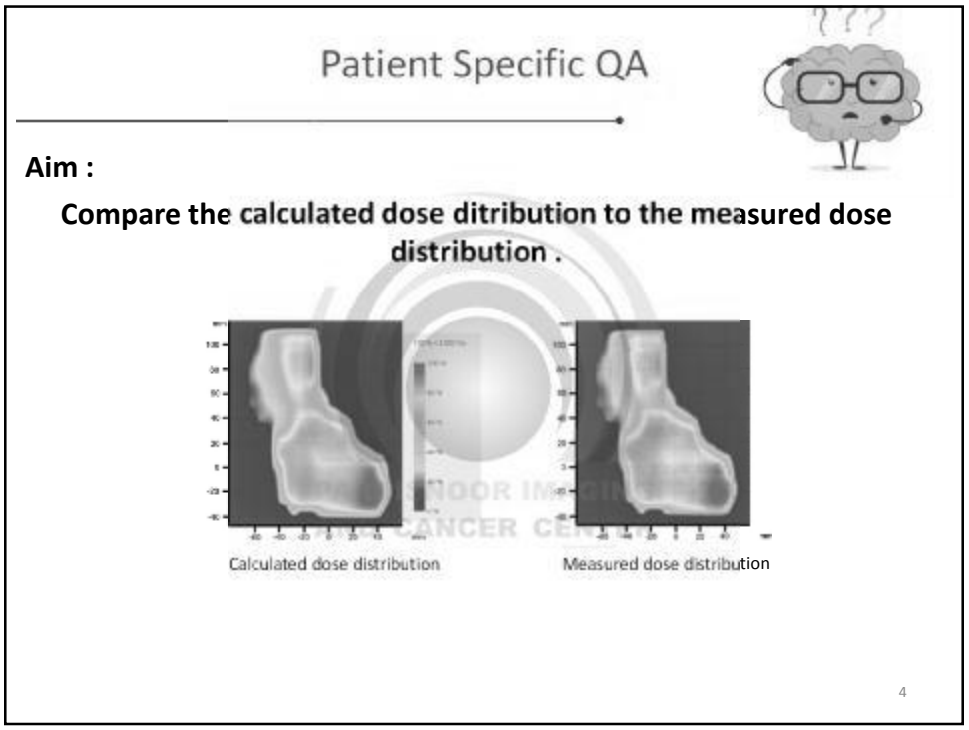
Patient Specific QA
Aim :
Compare the calculated dose ditribution to the measured dose distribution .
Calculated dose distribution
Measured dose distribution
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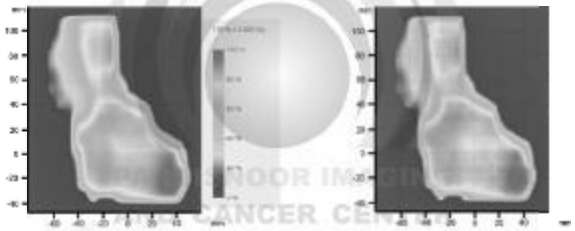
Patient Specific QA

Aim :

Compare the calculated dose ditribution to the measured dose distribution .



Calculated dose distribution Measured dose distribution

- **For individual Patients**
- **Before first treatment session**

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Source of Errors

- Errors in Treatment Planning Systems
- Errors in Treatment Delivery Machine
- Errors in PS-QA Process
- Errors in Calibrations

What should be checked?

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Patient Specific QA

What is the acceptable value to approve the PS-QA?

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Patient Specific QA

What is the acceptable value to approve the PS-QA?

- The American Association of Physicists in Medicine(AAPM) TG-119 reported that the **3% dose difference and 3 mm DTA** criteria is most commonly used by physicists in pretreatment IMRT QA.

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Patient Specific QA

What is the acceptable value to approve the PS-QA?

- The American Association of Physicists in Medicine(AAPM) TG-119 reported that the **3% dose difference and 3 mm DTA** criteria is most commonly used by physicists in pretreatment IMRT QA.

95- 97% , 3% DD 3mm DTA

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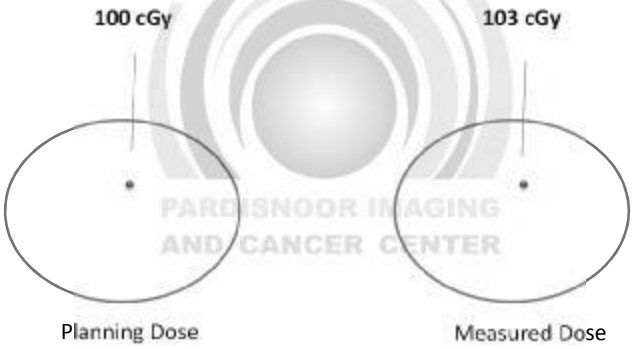
Dose Deviation

DD represents the Measured and Calculated Dose differences .



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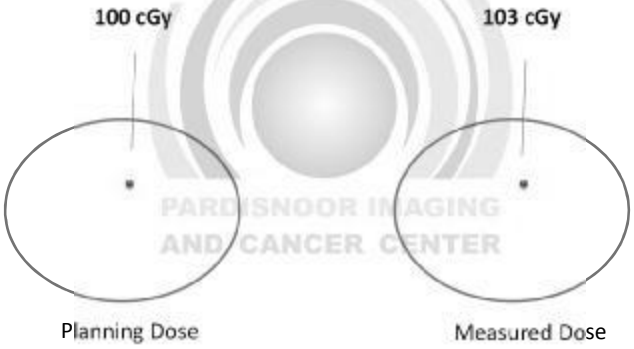
Distance to Agreement

DTA represents the distance between Measured and Calculated Dose.

Van Dyk et al (1993) used the concept of the DTA for QA

Harms et al (1998) : introduce DTA algorithm



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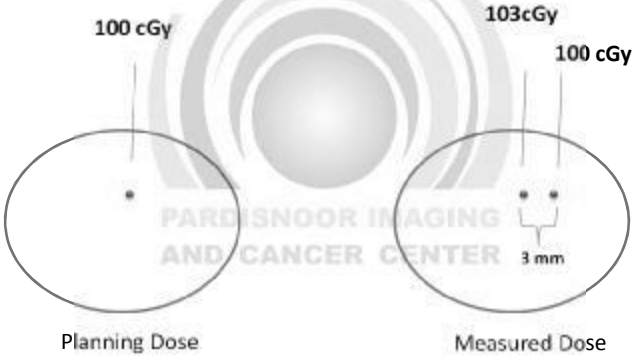
Distance to Agreement

DTA represents the distance between Measured and Calculated Dose.



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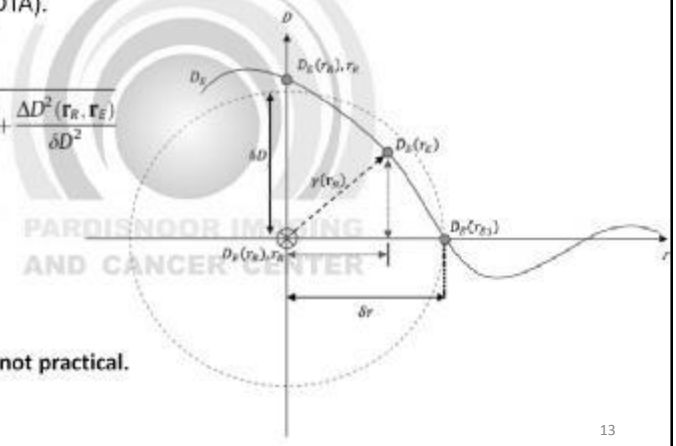
Gamma Index

This method, first introduced by Low et al (1998).

This standard method evaluates the coincidence between the calculated and measured dose distributions by utilizing the percent dose difference (DD) and distance to agreement (DTA).

$$\Gamma(\mathbf{r}_R, \mathbf{r}_E) = \sqrt{\frac{\Delta r^2(\mathbf{r}_R, \mathbf{r}_E)}{\delta r^2} + \frac{\Delta D^2(\mathbf{r}_R, \mathbf{r}_E)}{\delta D^2}}$$



$\gamma \leq 1$ Pass

$\gamma > 1$ Fail

100% passing is ideal but not practical.

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Gamma Index

- **Global Gamma Index**
- **Local Gamma Index**

The contrast between the two types is the way the dose difference is calculated.

$$\mathrm{DD} = \frac{\text{Measured} - \text{Calculated dose}}{\text{Normalization Value}}$$

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Gamma Index

- **Global Gamma Index**

  Normalization Value = Max Dose of the Plan

  $$\frac{103-100}{210}$$

- **Local Gamma Index**

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The contrast between the two types is the way the dose difference is calculated.

$$DD = \frac{\text{Measured} - \text{Calculated dose}}{\text{Normalization Value}}$$

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Gamma Index

- **Global Gamma Index**

  Normalization Value = Max Dose of the Plan

  $$\frac{103-100}{210}$$

- **Local Gamma Index**

  Normalization Value = Calculated dose at the currently evaluated pixel

  $$\frac{103-100}{100}$$

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The contrast between the two types is the way the dose difference is calculated.

$$DD = \frac{\text{Measured} - \text{Calculated dose}}{\text{Normalization Value}}$$

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Gamma Index

Dose Thresholding:

The American Association of Physicists in Medicine Task Group 119 instructed institutions to use a low-dose threshold of 10% or a region of interest determined by the jaw setting when they collected gamma analysis quality assurance (QA) data for the planar dose distribution.

Gamma Index

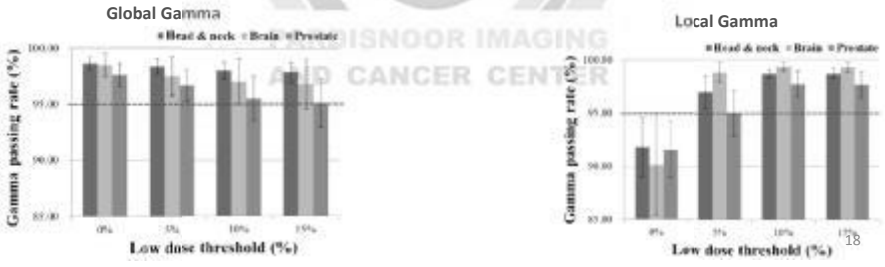
Ji-Hye Song and et al .2015

performed a gamma analysis

- A total of 30 treatment plans (Brain , H&N and Prostate)
- with various low-dose thresholds in the range of 0% to 15%
- both global and local normalization
- different acceptance criteria (3%/3 mm, 2%/2 mm, and 1%/1 mm)
- e Portal Dosimetry software

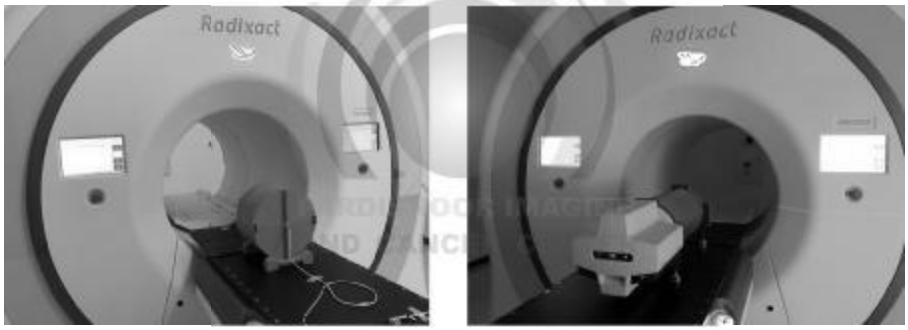
For Global Gamma normalization : The %GP decreased as the low-dose threshold increased from 0% to 15%

For Local Gamma normalization : The %GP increased as the low-dose threshold increased from 0% to 15%



Tomo Patient Specific QA

Cheese Phantom **Delta4+ Phantom**



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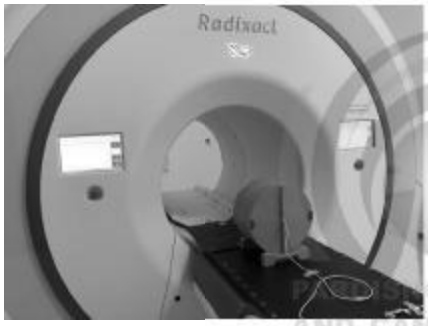
Tomo Patient Specific QA (Cheese Phantom)



Standard Imaging A1SL "Slimline Miniature Shonka Chamber"

Collecting Volume:	0.056 cm³
Nominal Calibration Factor:	60 R/nC
Centroid of Collecting Volume:	4.1 mm from tip of chamber
Collector Diameter:	1.0 mm
Outside Diameter of Shell Collecting Volume:	6.25 mm
Wall Thickness:	1.1 mm
Shell, Collector, and Guard Material:	A1SL – Shonka Air-Equiv. plastic C552

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Tomo Patient Specific QA

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Thank You For Your Attention

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