Patient preparation for treatment

ICTP SCHOOL ON MEDICAL PHYSICS
Radiation Therapy:
Dosimetry and Treatment Planning
for Basic and Advanced Applications
ICTP, Trieste 2019

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Preparation and Verification of Radiotherapy Laboratory
General rules

• The aim of preparation
  • To be able to deliver the prescribed dose to the PTV according to the treatment plan accepted by the radiotherapist,
    • to minimize the geometrical uncertainties of irradiation

• To ensure a smooth implementation of treatment,
  • to minimize the treatment irradiation time,
    • to minimize the intrafractional movement,
    • to avoid breaks in irradiation.
General rules

![Graph showing TCP and NTCP probabilities versus dose (Gy).]
General rules

![Graph showing TCP and NTCP probability vs. dose](image)

- TCP (Target Control Probability)
- NTCP (Normal Tissue Complication Probability)

Dose (Gy) vs. Probability
General rules
• TCP changes are cause by geometrical errors

> 

• NTCP changes are caused by geometrical errors:

>
• TCP changes are cause by geometrical errors

> (CTV-PTV) margin

• NTCP changes are caused by geometrical errors:

➢ any geometrical errors for serial organs
   (Planning Organ at Risk Volume)
???

??? geometrical errors for parallel organs
What should we know about

- Patient’s body is not a rigid object (there is one exception),
  - in the process of a patient preparation for irradiation we are looking for the mean position of his or her body,
    - it is impossible to avoid certain differences in a patient's position,
      - a set-up margin has to be added to the CTV
  - the position of the CTV with respect to anatomical landmarks might be not stable,
    - an internal margin has to be added.
To be ready for patient preparation

uncertainty ± 1 mm

QA program has to be implemented!
What we should do?

• to ensure a good cooperation with a patient,
  • explanation of what is radiotherapy – empathy,
  • an explanation of how preparation and irradiation will proceed,
    • the language (words) we are using, play a key role,
  • implementation (session) time matched to the general condition of each patient.

https://voices.uchicago.edu/roecsg/patient-education/
Special instructions

• In case of 6D table a special, detailed instruction must be given
  • the patient opposes changing the rotation of the table
Immobilization???

• Due to elasticity the patient’s body cannot be immobilized!
  • “To ensure reproducibility” is better term to describe what we should do!
    • Reproducibility is achieved if the most convenient position of a body is achieved!
      • Avoid stretching a patient’s muscles is important.

• Exception
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Muscles stretching problem

Conclusions: Among the three techniques, no-immobilization technique with leg separator was the most reproducible technique with the smallest PTV margins. For obvious reasons, this technique is the least time consuming and most economically viable in developing countries.
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Muscles stretching problem

Home made vacuum

Orfit

No - immobilization technique with leg separator was the best
Comfortable position

- patient’s opinion is important

Not comfortable

Much better

kyphosis problem
Errors in immobilization preparation

The edge of the immobilisation system is hurting
Rotations

System designed in our center for irradiation in the region of thorax
Individual vacuum support

BodyFix

particularly useful for sarcomas patients
Patient’s body position should be reproducible

• Not the mask!

Lee, ... Strahlenther Onkol 2014 · 190:94–99
Average (reproducible) position

• How to determine the average position?
  • It is just the mean position of several

• That's why
  • patient should be placed several times
    and his or her position should be checked
    if it is reproducible
    • comparison of several
      pairs of orthogonal images
Average (reproducible) position

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CT might be one of the most source of systematic errors
Average position preliminary simulation conventional simulator

2 cm difference - vertical

second set-up: 8 minutes later

preliminary simulation: good result

portal control results
Average position
preliminary simulation
CT-simulation

Two topograms (scout views)

small difference in hier
Geometrical reference point

• Isocenter is defined with respect to
  • geometrical reference point
  • anatomical structures

Precise, unequivocal description of this point is a must!
Geometrical reference point

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  - geometrical reference point
  - anatomical structures

If isocenter position is changed (second phase of treatment) you must be very, very careful!

Precise, unequivocal description of this point is a must!
DRR for set-up verification

• Quality of DRRs depends on the slice thickness and separation
  • recommended are ≤3 mm/ ≤3 mm
    • spiral mode - reconstruction!

• It is recommended to place the geometrical reference point in the one of reconstructed slice
DRR preparation for set-up control

- The edges of anatomical structures should be delineated

H&N

breast
DRR preparation for set-up control

• Be careful with symmetry!

Vertebrae are very similar to each other.
Special techniques

• Patient’s preparation for treatment
  • Deep Inspiration Breath Hold technique (DIBH)

• Pelvis irradiation
  • Prostate
    • “gold markers”
    • spacers
  • Ginecology
    • bladder filling

free breathing

depth inspiration breath hold
DIBH
Deep Inspiration Breath Hold
for left breast cancer

• To diminish the dose to heart

• In cooperation with Polish Company Optinav we designed the optical system for preparation of these patients for DIBH
Preparation mould room

Before training

After training
Prostate - spacers

- Biomaterials placed between the prostate and rectum
  - To reduce rectal dose

ProSpace™ Balloon (BioProtect Inc.)
Prostate spacers
our experience – 8 first patients

Correct – 4 patients
Little up – 3 patients
Little down – 1 patient
Advantage - dose to rectum
Set-up control of prostate patients

- Position of the prostate is not well linked to the bone structures
  - traditional methods of setup control are not appropriate
    - "gold markers" as a surrogate of prostate position
Preparation should be checked

• Portal control
Preparation should be checked

- Portal control
Summary

• Every step in radiotherapy should be performed with high quality!

• Preparation plays a very important role in radiotherapy chain.
  • cooperation with a patient
  • applying the right solution for each individual situation

• Portal control gives the answers the patient's preparation
Preparation is very important!

Thank you very much for your listening!
A few tips

• Medical physicists play a very important role in radiotherapy
  • dosimetry
  • Quality Assurance (Quality Control)
  • Treatment Planning

  but always

• The most important is: a critical look at the results.

• Please cooperate with radiation technologists!
  • Your theoretical background is very needed!
PhD

• In different countries there might be different PhDs

• Phd might be very scientific

• Phd might be practical one
  • This one enables making treatment better!

• **Remember that you are serving your patients!!!**