QUALITY ASSURANCE PROCEDURE FOR SRS AND SRT TREATMENTS

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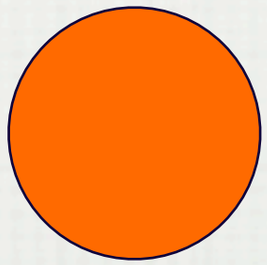
SRS / SRT TREATMENTS

- INTRODUCED IN 2009 AT RIGA EAST UNIVERSITY HOSPITAL.
- EQUIPMENT:
  - NOVALIS TX (VARIAN), EXACTRAC (BRAINLAB)
- VARIOUS LOCALIZATIONS:
  - HEAD, LIVER ETC.

CHALLENGES

- FRACTIONATED TREATMENT

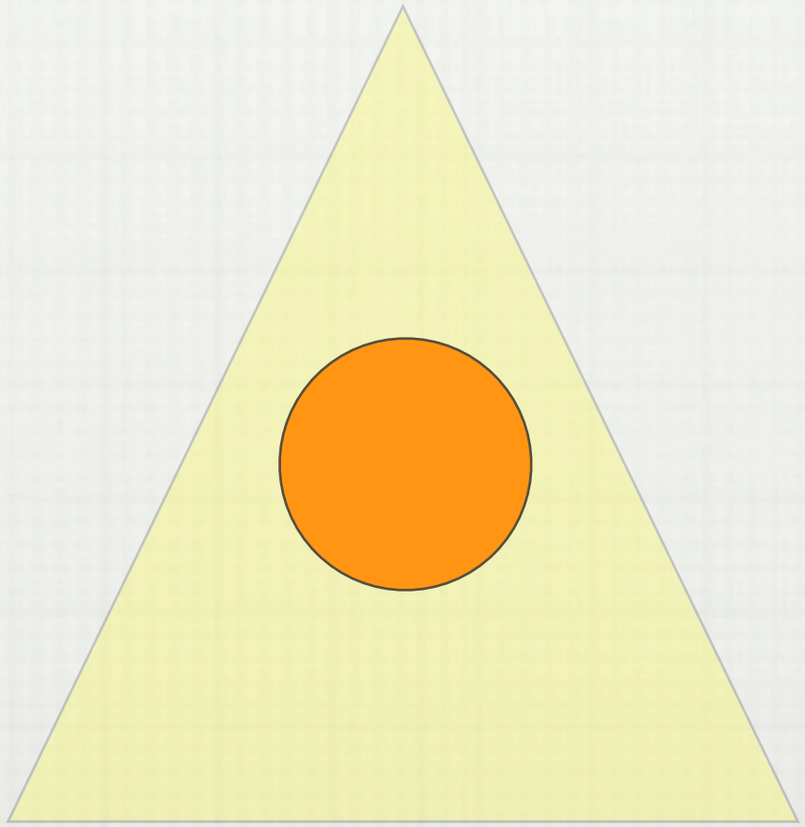


1 - 5 GY PER FRACTION

10 - 39 FRACTIONS

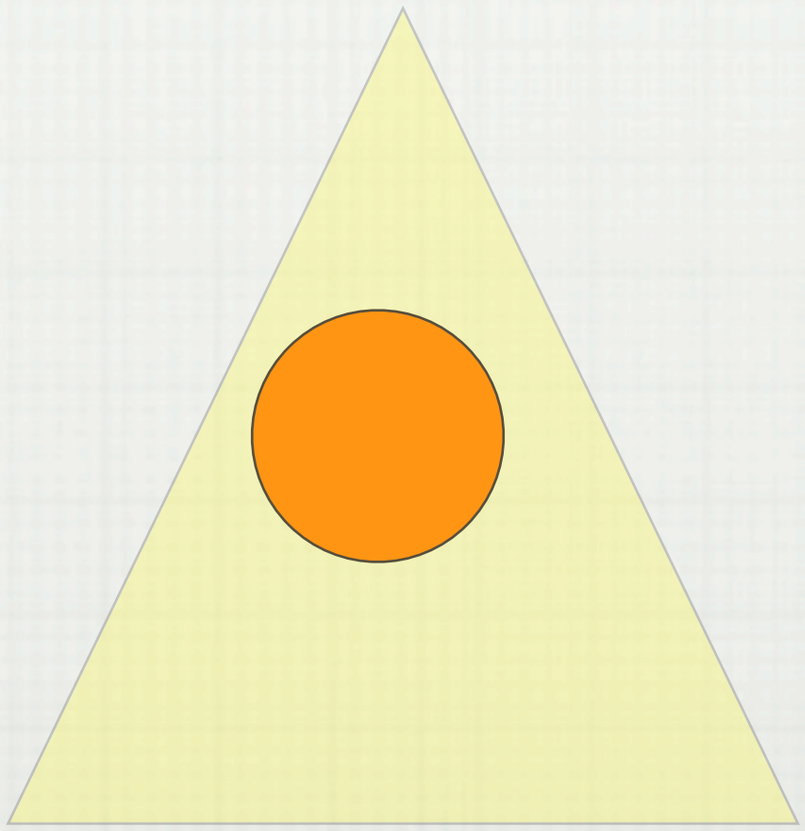
CHALLENGES

- FRACTIONATED TREATMENT



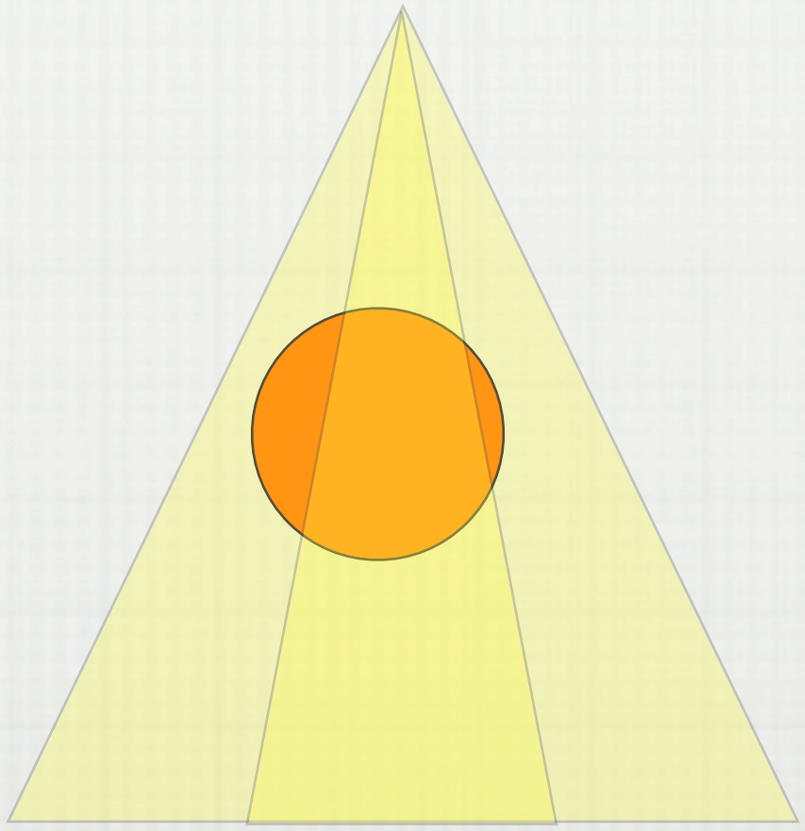
CHALLENGES

- FRACTIONATED TREATMENT



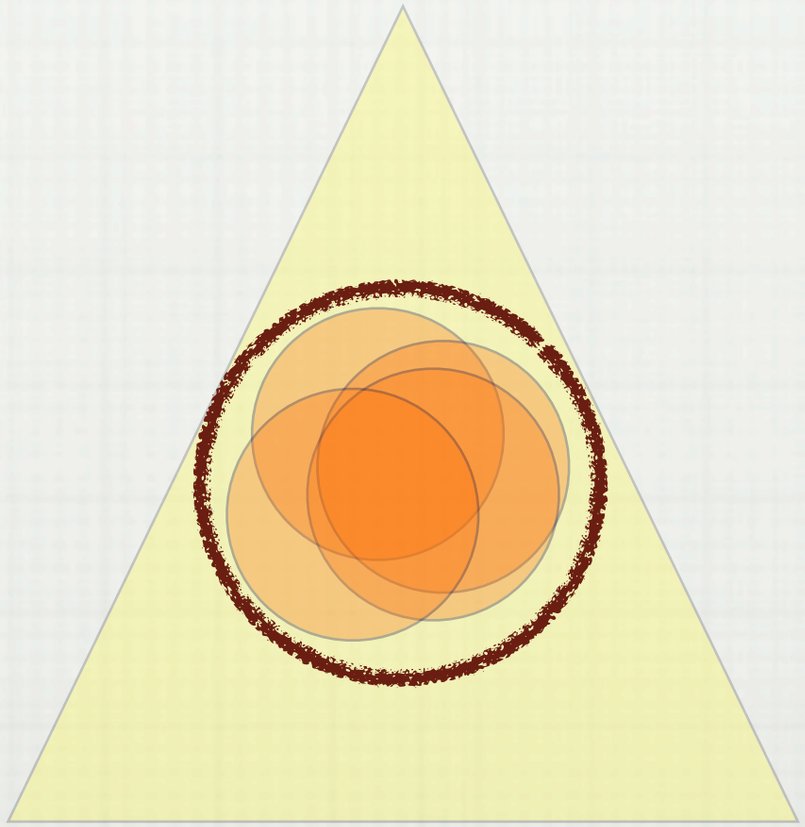
CHALLENGES

- FRACTIONATED TREATMENT



CHALLENGES

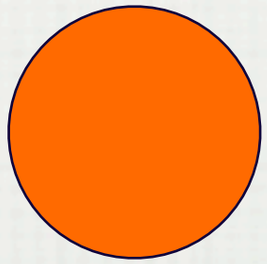
- FRACTIONATED TREATMENT



MISTREATMENT OF A SINGLE FRACTION DOES NOT HAVE SIGNIFICANT IMPACT ON DELIVERED DOSE

CHALLENGES

- RADIO-SURGERY

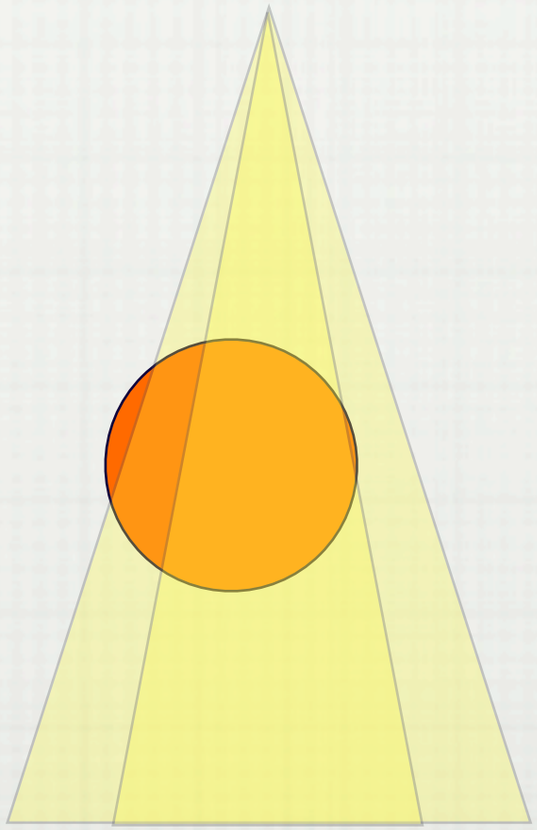


4 - 20 GY PER FRACTION

1 - 3 FRACTIONS

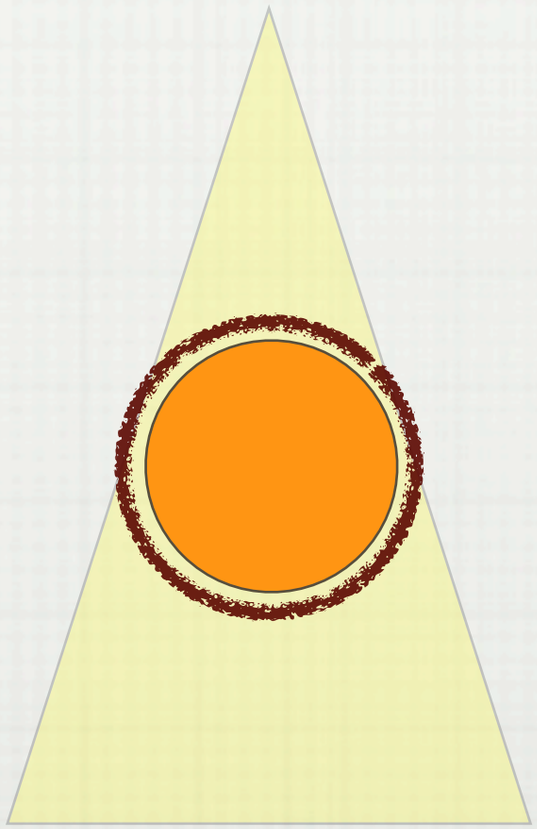
CHALLENGES

- RADIO-SURGERY



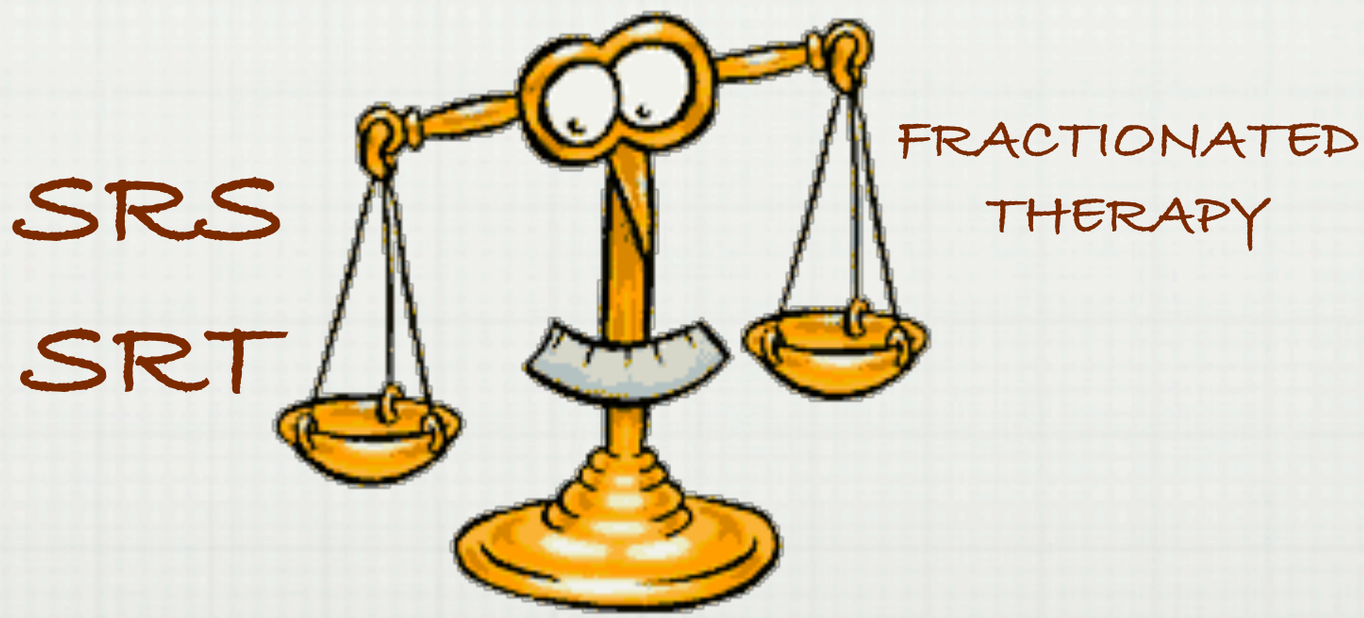
CHALLENGES

- RADIO-SURGERY



MISTREATMENT IN A SINGLE FRACTION HAS SIGNIFICANT IMPACT ON ALL THE TREATMENT

TREATMENT ACCURACY



SRS / SRT REQUIRES HIGHER QUALITY
IN TERMS OF TREATMENT DELIVERY

TREATMENT ACCURACY

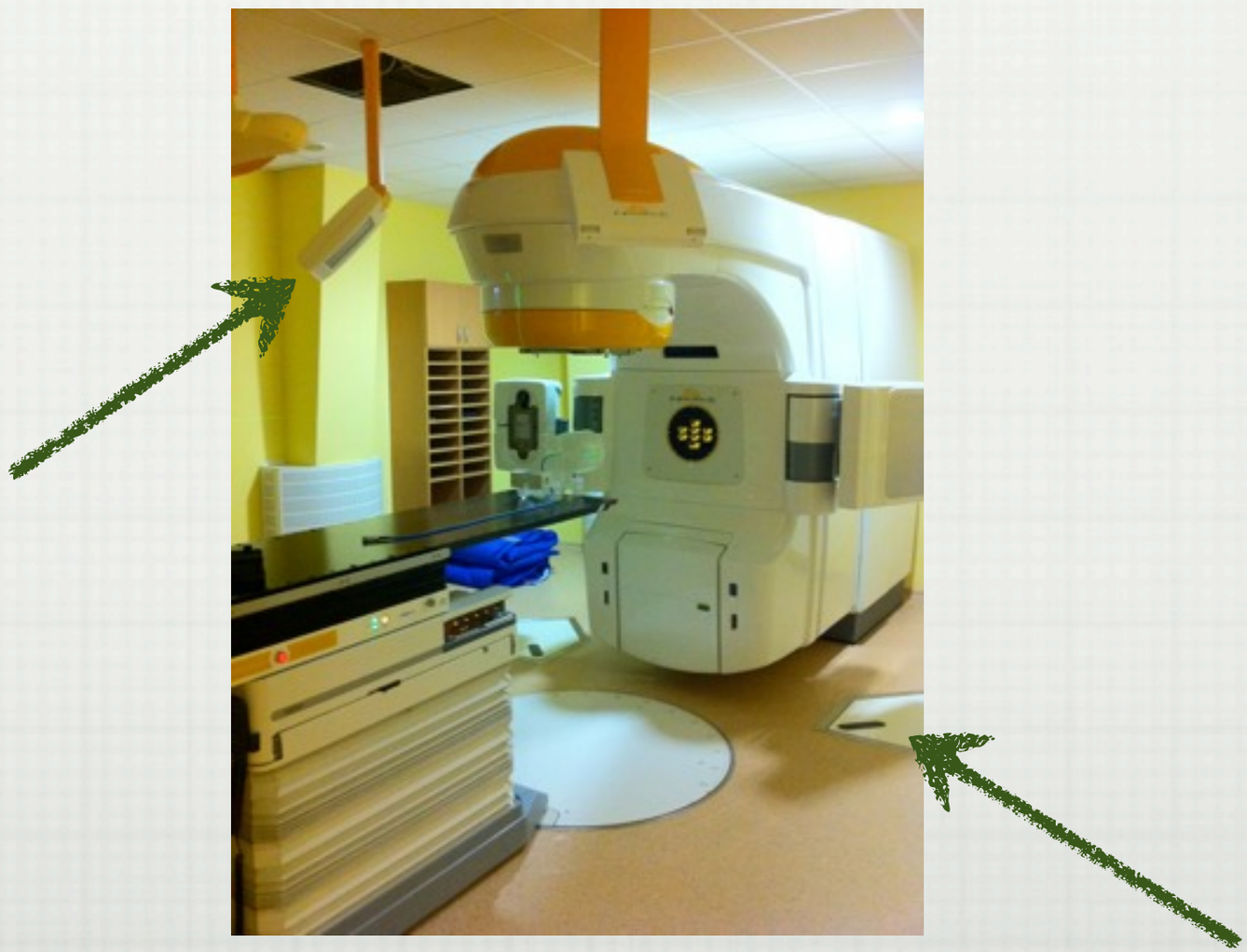
SRS / SRT REQUIRES EXTENDED QUALITY ASSURANCE PROCEDURE

CAUSES OF INACCURACY

- PATIENT POSITIONING
- MISCONFIGURATION OF TPS
- SOFTWARE BUGS
- MECHANICAL FAULTS OF TREATMENT DELIVERY SYSTEM
- MIS-CALIBRATION OF LINAC
  - IONIZATION CHAMBERS
  - MECHANICAL INDICATORS

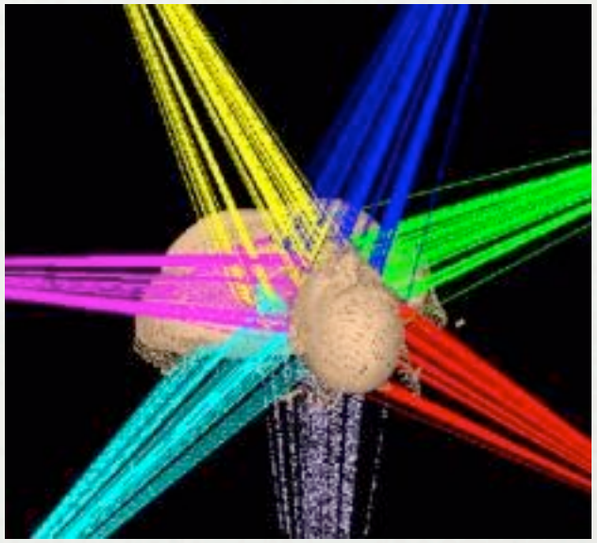
POSITION UNCERTAINTIES

- EXACTRAC (BRAINLAB)



QUALITY ASSURANCE

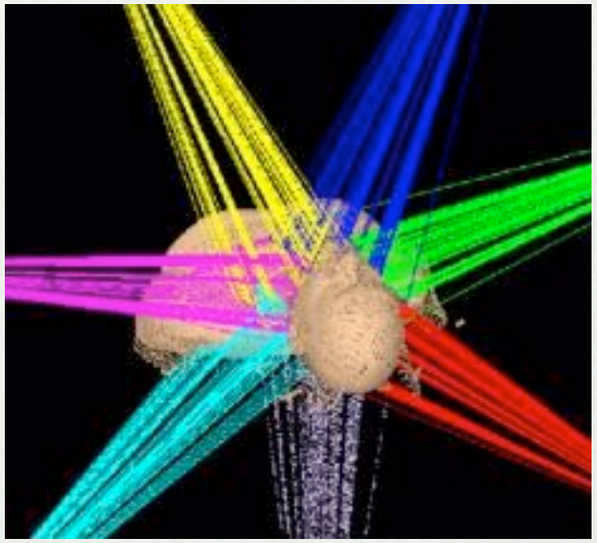
HARDWARE RELATED



PATIENT RELATED

QUALITY ASSURANCE

HARDWARE RELATED



PATIENT RELATED

PATIENT-RELATED QA FOR SRS/SRT

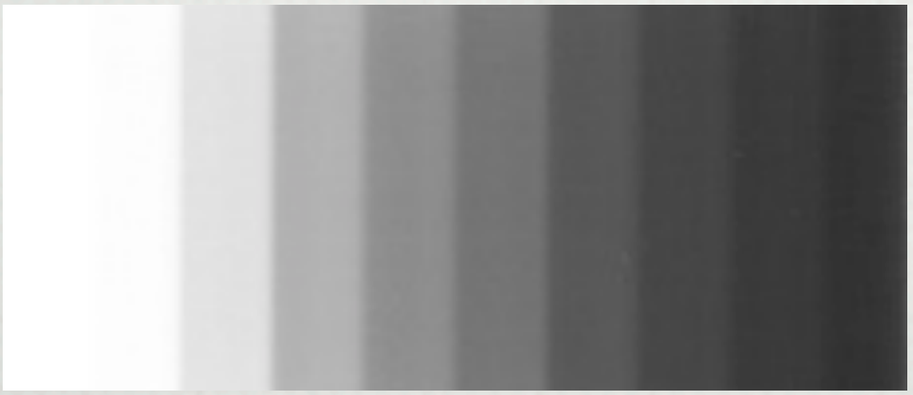
- DOSE PLANE MEASUREMENT
- ABSOLUTE POINT-DOSE MEASUREMENT
- WINSTON-LUTZ TEST

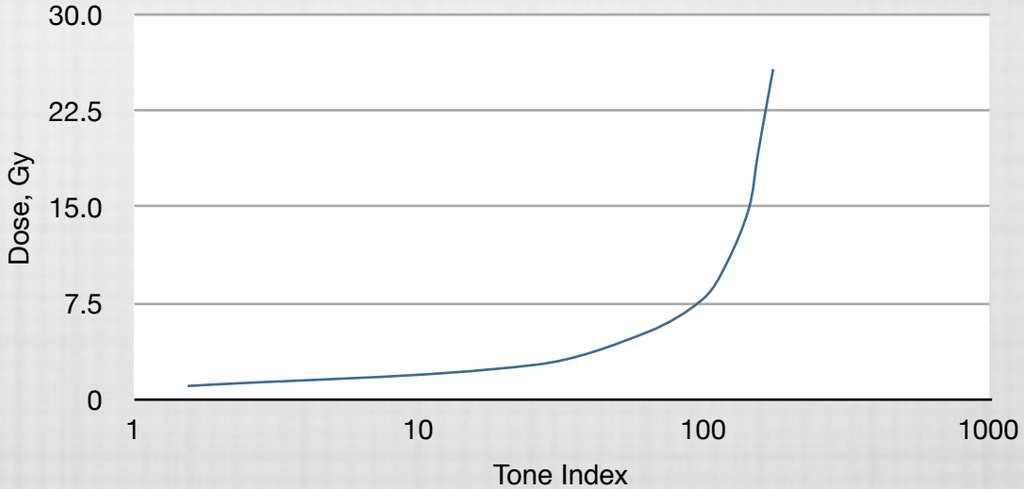
DOSE PLANE MEASUREMENT

1. CALCULATION OF TREATMENT PLAN ON QA PHANTOM
2. MEASUREMENT WITH RADIOCHROMIC FILM
3. COMPARISON OF MEASURED DOSE VS CALCULATED

FILM DOSIMETRY

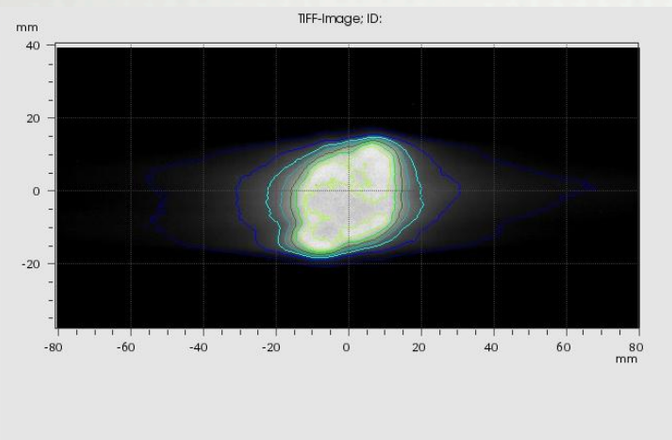
- GAFCHROMIC EBT 2 (ISP) FILMS
- DOSE RANGE UP TO 40 GY
- CALIBRATION: TEST FILM WITH KNOWN DOSE
- METHOD: COMPOSITE ANALYSIS

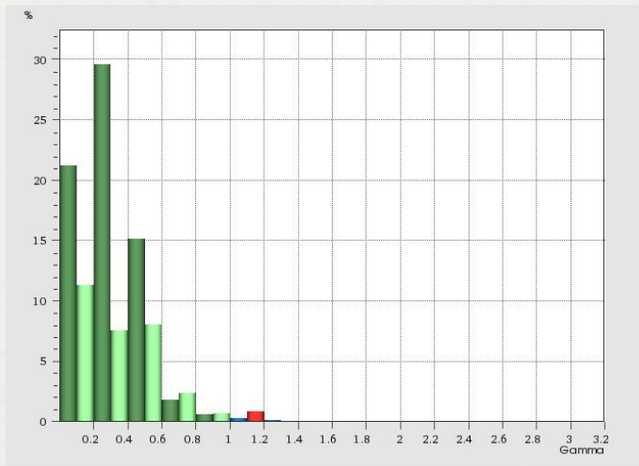


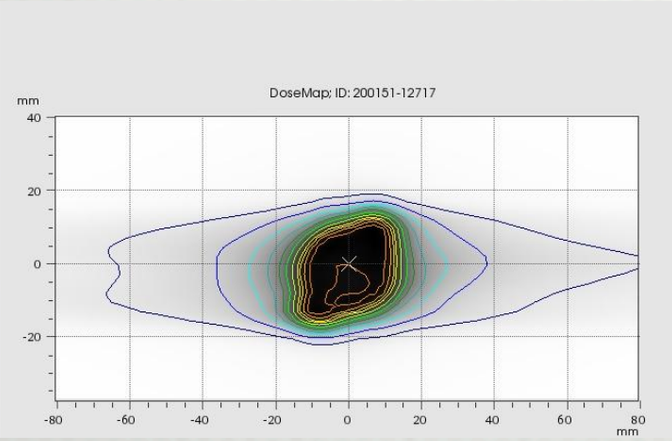


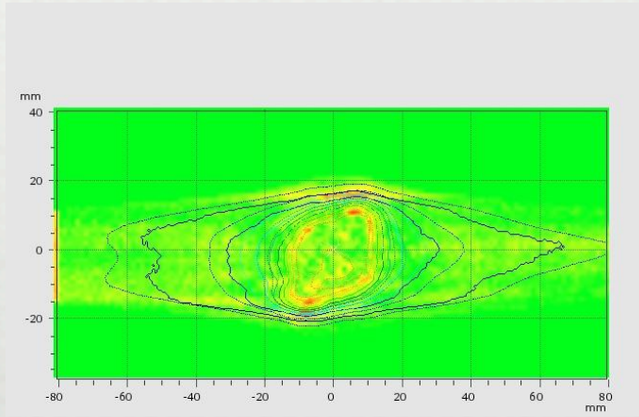
FILM DOSIMETRY

- ANALYSIS:
  - GAMMA INDEX - 1MM / 5% / SUPPRESS < 5%









ACCEPTABLE:

GAMMA PASS > 90%

UNACCEPTABLE:

GAMMA PASS <85%

MEAN 96.4 ± 2.6 %

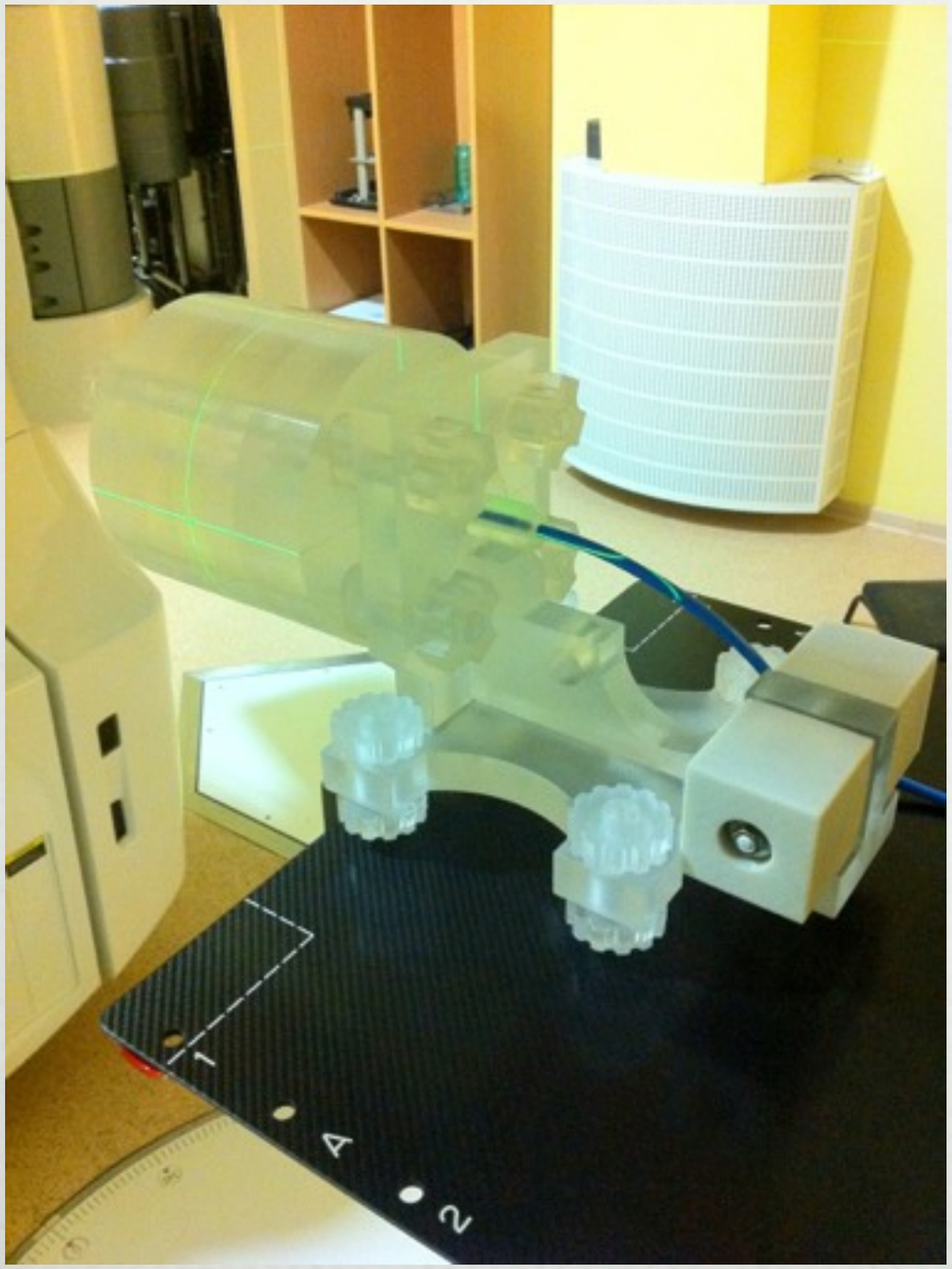
PATIENT-RELATED QA FOR SRS/SRT

- ☑ DOSE PLANE MEASUREMENT
- ☐ ABSOLUTE POINT-DOSE MEASUREMENT
- ☐ WINSTON-LUTZ TEST

POINT DOSE MEASUREMENT

1. CALCULATION OF TREATMENT PLAN ON QA PHANTOM
2. MEASUREMENT WITH IONIZATION CHAMBER
3. COMPARISON OF MEASURED DOSE VS CALCULATED

POINT DOSE MEASUREMENT



- HAND-MADE PHANTOM
- PINPOINT CHAMBER (PTW)
  - 0.016 CM^3

ANALYSIS:
LOCAL DIFFERENCE IN %

ACCEPTABLE < 3%
UNACCEPTABLE > 5%

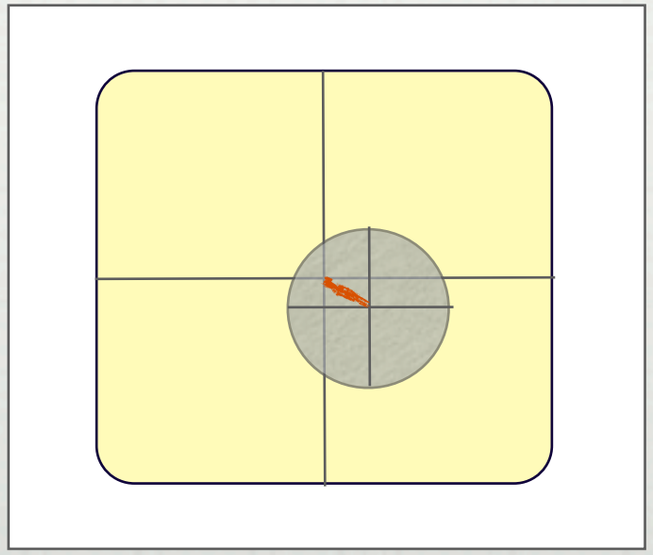
MEAN -1.2 ± 1.6 %

PATIENT-RELATED QA FOR SRS/SRT

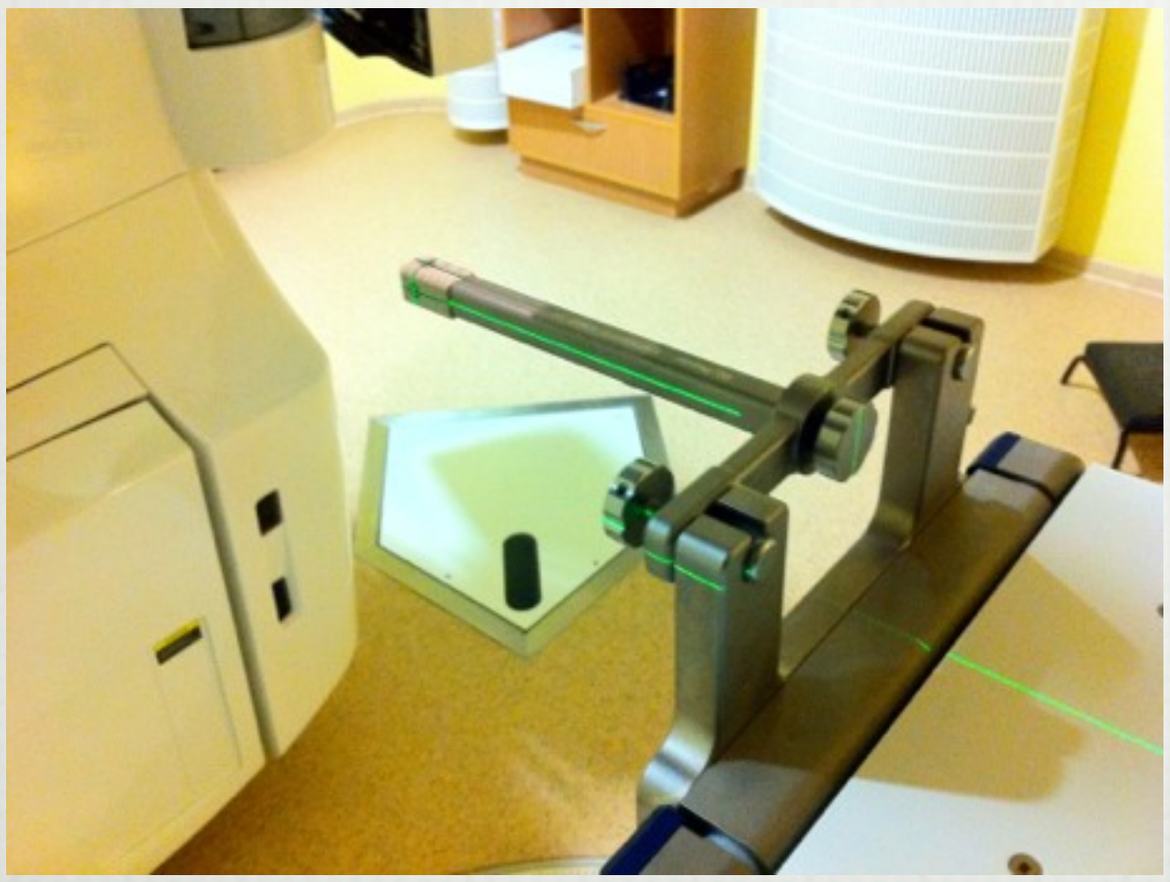
- [x] DOSE PLANE MEASUREMENT
- [x] ABSOLUTE POINT-DOSE MEASUREMENT
- [ ] WINSTON-LUTZ TEST

WINSTON-LUTZ TEST

1. ALIGN POINTER TO ISOCENTRE
2. TAKE PORTAL IMAGES FROM NECESSARY ANGLES
3. DETERMINE CENTRE OF FIELD
4. DETERMINE CENTRE OF POINTER SPHERE
5. DETERMINE THE DISTANCE BETWEEN CENTERS

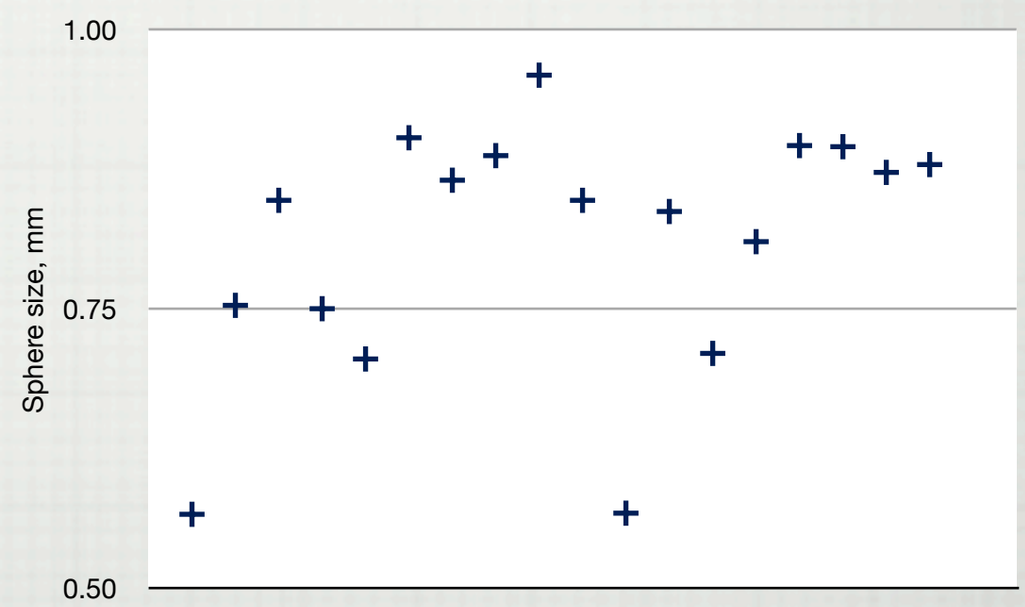


WINSTON-LUTZ TEST



ACCEPTABLE < 1MM

UNACCEPTABLE > 1MM



PATIENT-RELATED QA FOR SRS/SRT

- ☑ DOSE PLANE MEASUREMENT
- ☑ ABSOLUTE POINT-DOSE MEASUREMENT
- ☑ WINSTON-LUTZ TEST

CONCLUSIONS

- THE DEVELOPED PATIENT RELATED QA PROCEDURE IS SUFFICIENT TO VERIFY ACCURACY OF TREATMENT PLANNING SYSTEM CALCULATIONS, PRECISION OF TREATMENT DELIVERY MECHANICS AND SYSTEM IN GENERAL.
- ADDITIONAL MACHINE RELATED VERIFICATIONS ARE NECESSARY.
- QA PROGRAM, BASED ON DESCRIBED PRINCIPLES, HAS BEEN IMPLEMENTED IN RIGA EAST UNIVERSITY HOSPITAL.

THANK YOU!

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