ORAMED 2011

Workshop on Optimization of Radiation Protection of Medical Staff

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Investigation of radiation exposure of medical personnel in SIRT

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SIRT Selective Internal Radiation Therapy procedural method

- Injection of ^{90}Y-marked microspheres into the A. hepatica
- Causes a radio embolisation to a part of the capillaries
- Background:

  Metastases and the carcinoma of the liver are better supplied with blood than normal tissue

SIRT Selective Internal Radiation Therapy procedure

- Evaluation
  - Inspection of the vascular situation
  - Exclusion of a pulmonary shunt by applicating ^{99m}Tc-HSA or ^{99m}Tc-MAA into an artery
  - Purpose of the dystopian drain
- SIRT
  - 2nd catheterization within two weeks
  - Fill the shot with ^{90}Y activity
  - Application into the artery with ^{90}Y-marked microspheres
  - Post-therapeutic Bremsstrahlen scintigraphy

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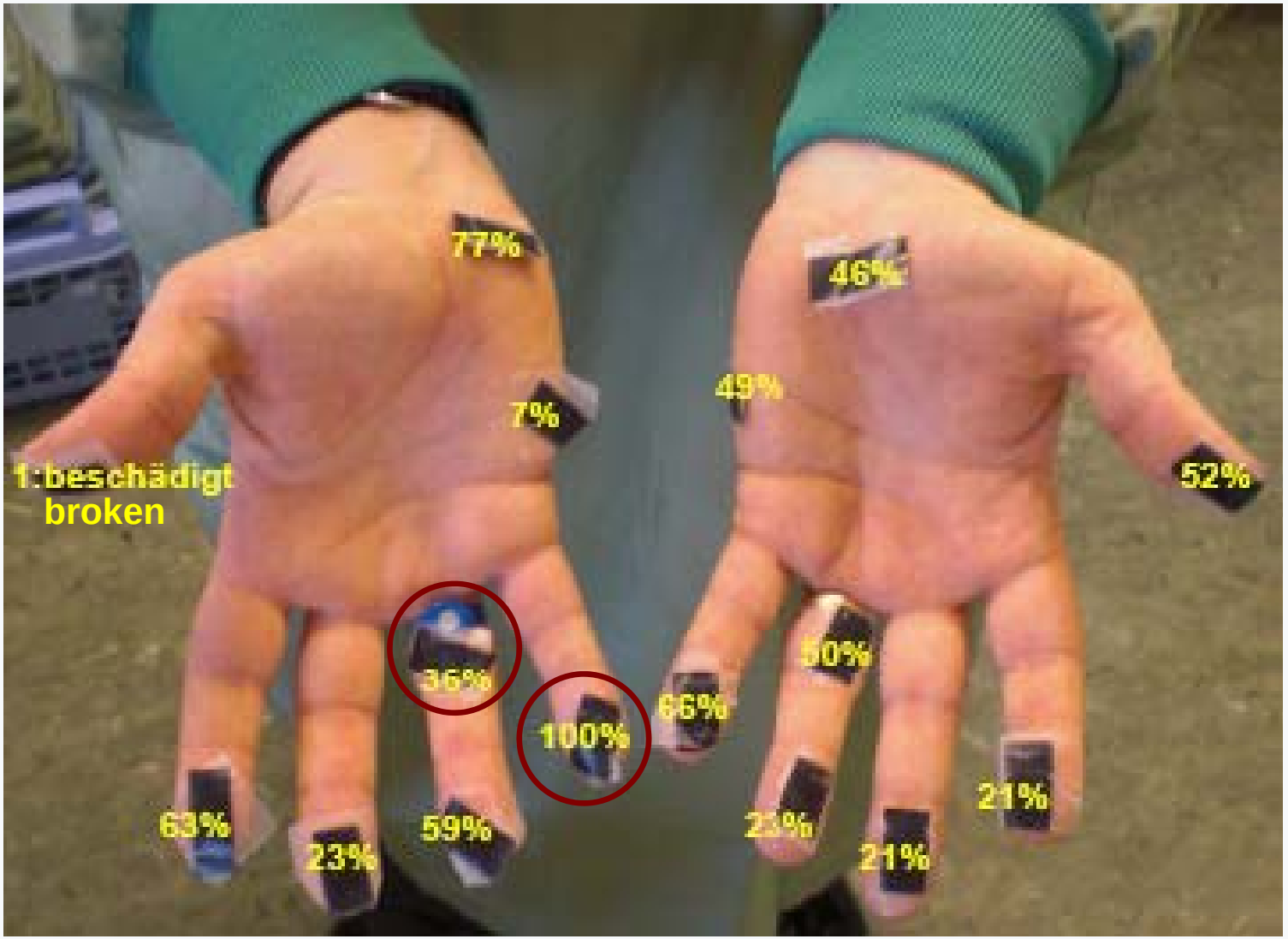
Radiation dose for personnel?

Dose exposition during the different work steps Questions

- Radiation dose during the preparation in the laboratory
- Is there a risk of incorporation?
- Radiation dose for the physician during the application
- Exposure of radiation for the physician‘s eyes during the application
- Radiation dose during the disposal of the tubular system after the therapy

For the measurement TLDs were used

Allocation of the partial body doses on the hands during the preparation of the microspheres



Results of the partial body dose $H_p(0,07)$ during the preparation of the activity

activity [GBq]	maximum left hand [mSv]	maximum right hand [mSv]
Box 1: 1.09 Box 2: 1.14	l. middle finger (near palm) 0.27 ± 0.06	side of hand 0.26 ± 0.07
Box 1: 0.54 Box 2: 0.56 Box 3: 0.28	l. little finger (fingertip) 0.66 ± 0.11	r. little finger (fingertip) 1.00 ± 0.15

Maximal radiation dose of 1 mSv (relates to the measurement so far)

Factor 3 between dose at fingertip and ring confirmed

Is there a risk of incorporation?

air test while preparing the activity in the laboratory

beta activity [Bq/filter]	beta activity [Bq/m³]	dose [µSv]
3280	262.4	0.19

Results of the partial body dose $H_p(0.07)$ preparing the application boxes and inject the patient

activity [GBq]	maximum left hand [mSv]	maximum right hand [mSv]	work steps
Box 1: 0.91 **Box 2: 0.92**	**l. thumb (fingertip) 0.04 ± 0.02**	**r. index finger (fingertip) 0.08 ± 0.03**	**Preparation of application box 1**
huge differences	**l. thumb (fingertip) 1.09 ± 0.28**	**r. middle finger (fingertip) 1.02 ± 0.27**	**Preparation of application box 2**
	l. index finger (fingertip) 0.95 ± 0.24	**r. index finger (fingertip) 1.28 ± 0.27**	**Injection application box 1**
ca. 1-2 mSv per Box	**l. thumb (fingertip) 1.36 ± 0.34**	**r. index finger (fingertip) 1.48 ± 0.46**	**Injection application box 2**

Doses are in the range of 1 to 2 mSv

Results of the partial body dose $H_p(0.07)$ preparing the application boxes and inject the patient

activity [GBq]	Dose for the eyes [mSv]
Box 1: 1.09 Box 2: 1.14	glasses left side 0.30 ± 0.06
Box 1: 0.54 Box 2: 0.56 Box 3: 0.28	glasses left side 0.93 ± 0.16

Exposition on the eyes up to 1 mSv

Results of the partial body dose $H_p(0.07)$ directly after therapy by emptying boxes of the application

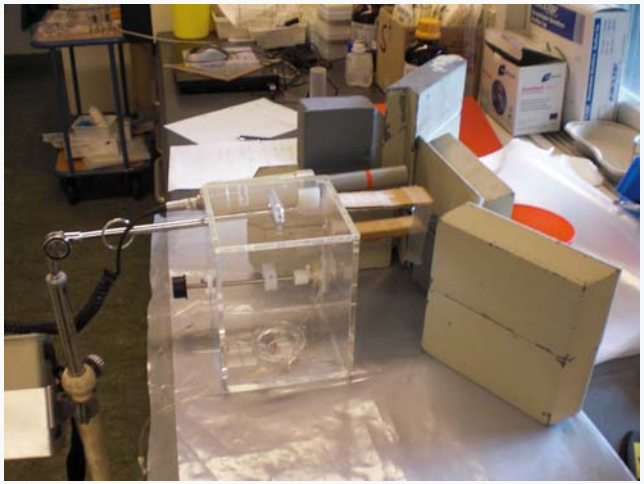
number of the empty boxes	maximum left hand [mSv]	Maximum right hand [mSv]
2	l. **index finger** (**fingertip**) 0.30 ± 0.06	r. **index finger** (**fingertip**) 0.43 ± 0.11
3	l. **middle finger** (**fingertip**) 0.99 ± 0.22	r. **index finger** (**fingertip**) 2.00 ± 0.45

Even if you try to avoid direct contact high doses occur (round about twice the dose of the preparation)

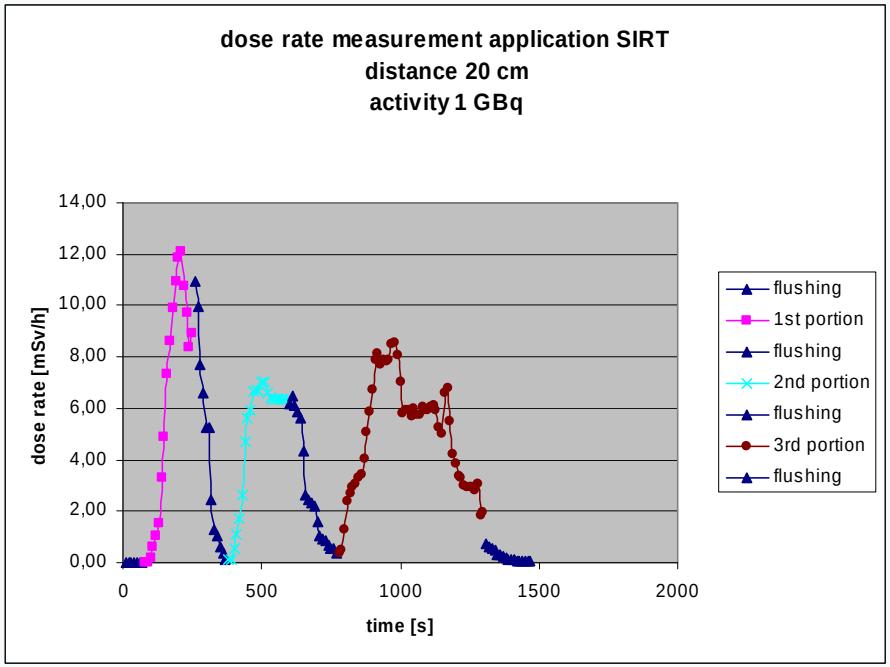
How it will go on

- More checking of the dose during the application – dose rate in different distances to the tubular system
- Dose rate resulting from the exposition in regards to the tubular system

Adjustment of the application in the laboratory



application of the activity in three steps, interrupted by flushing the tubular system

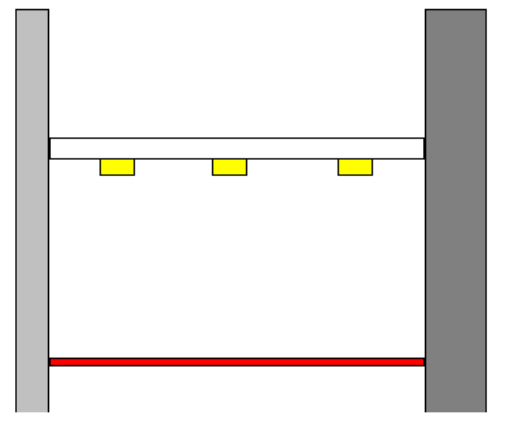


Measurement of the local dose H‘(0,07,Ω) at the tube with the activity inside

Measurements at the tubular system were taken at distances of 5 cm and 20 cm

application phases	max. dose [mSv]	max. dose rate [mSv/h]	distance to tube [cm]
1	9.10 ± 2.19	87.36	
2	10.15 ± 2.20	78.61	5
3	2.75 ± 0.64	19.41	
1	2.55 ± 0.57	16.52	
2	2.41 ± 0.59	13.64	20
3	2.30 ± 0.47	16.23	

Monte Carlo simulation to measure the tube with the activity inside (MCNPX)



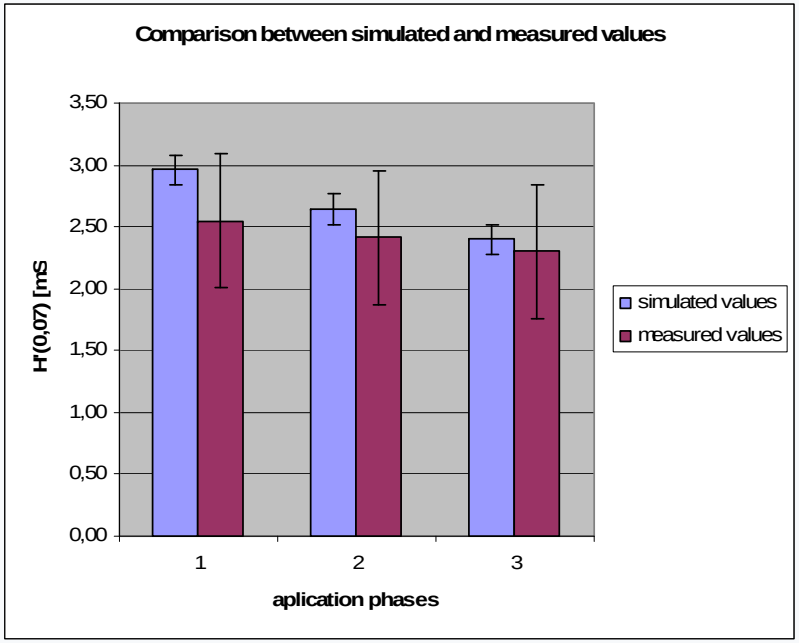
light grey: acryl glas shield

dark grey: lead shied

yellow: TLDs

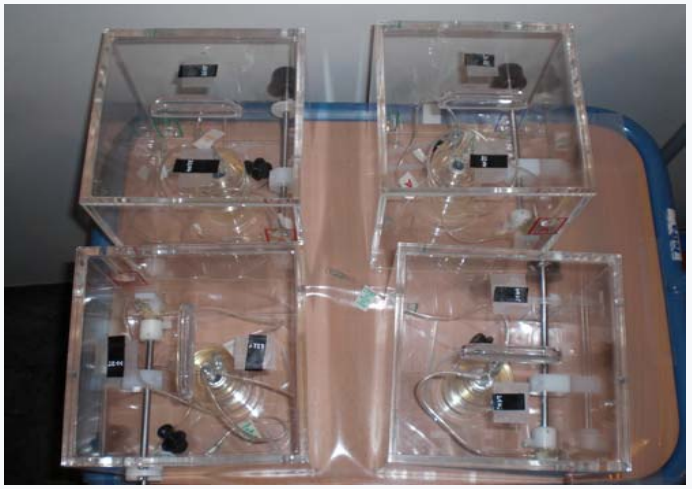
red: tube with activity

simulated value [mSv]	max. measured value [mSv]
2.96 ± 0.14	2.55 ± 0.57
2.64 ± 0.12	2.41 ± 0.59
2.40 ± 0.11	2.30 ± 0.47



Measurement of the local dose H‘(0,07,Ω) at the boxes before and after the therapy

- measurements of three boxes after application (black)
- not used box with 420MBq (red)



TLD position	dose in 10 minutes [mSv]	dose rate [mSv/h]
inside outside	21.39 ± 3.76 0.15 ± 0.04	128.35 0.93
inside **outside**	**1.18 ± 0.25** **0.05 ± 0.03**	**7.06** **0.33**

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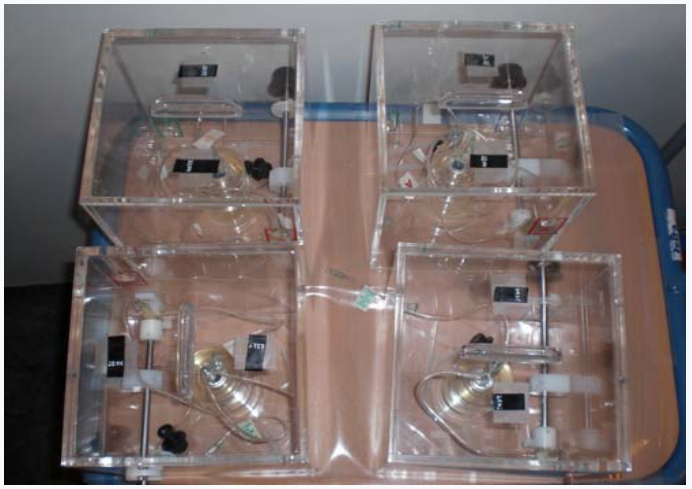

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summary

- Doses while preparation in laboratory approx. 1 mSv
- Doses during the application from approx. 1 till 2 mSv, high doses on the eyes up to 1 mSv
- Really high dose rate during the disposal of the tubular system up to 130 mSv/h
- No risk of incorporation