

Dosis- Berechnungsprogramme für die Nuklearmedizin und die Radio-Onkologie

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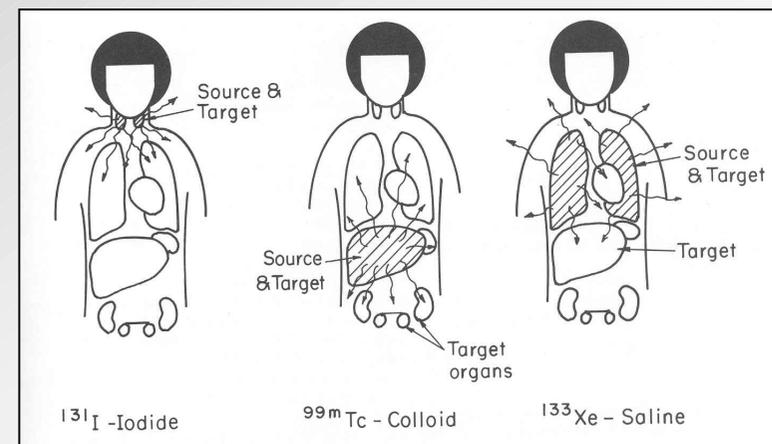
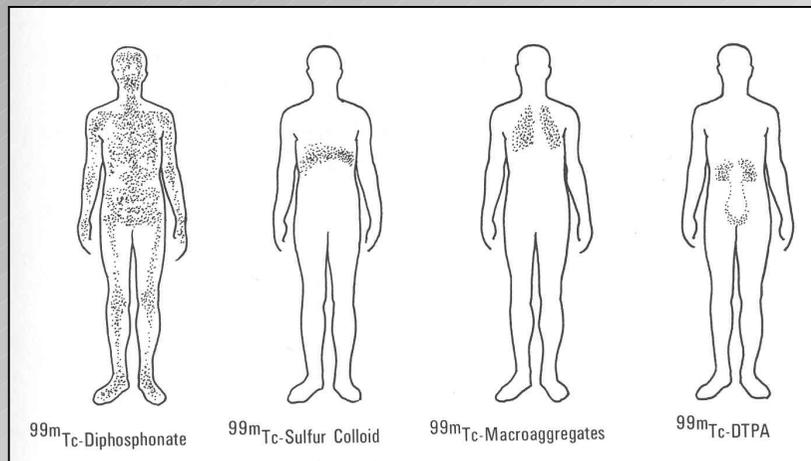
Nuklearmedizin (Input)

Dosisberechnung mit **Computer-Programm MIRDose3**



Parameter für Dosisberechnung (NM):

- verwendetes Radio-Nuklid
- Verteilung des Radio-Nuklids im Körper
- Verweilzeiten τ (residence times) in den Organen



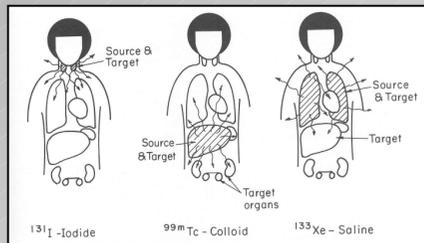
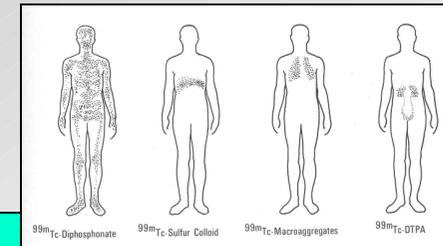
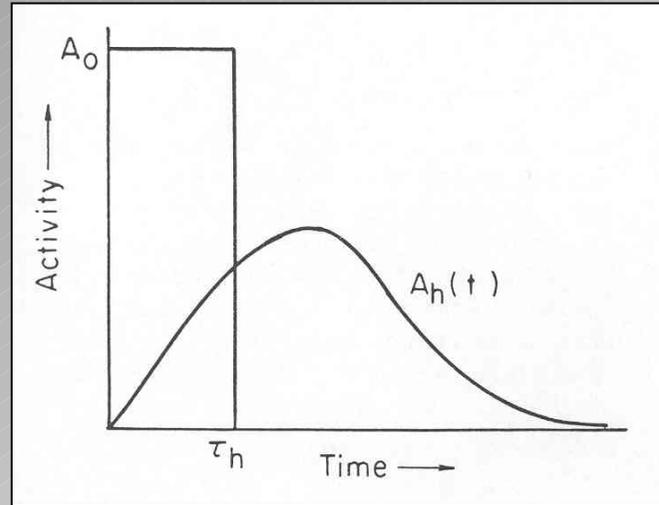
Nuklearmedizin (τ und S-Matrix)

$$D_t = \tilde{A} \cdot S_{t \leftarrow s}$$

$$\tilde{A} = \int_0^{\infty} A(t) \cdot dt$$

$$\tau = \frac{\tilde{A}}{A_0}$$

$$D_t = A_0 \cdot S_{t \leftarrow s} \cdot \tau$$



A_0 = applizierte Aktivität
 $A(t)$ = Aktivität im Quellorgan [MBq] zur Zeit t
 \tilde{A} = totale Anzahl Zerfälle im Quellorgan
 $S_{t \leftarrow s}$ = Dosis im Zielorgan pro Zerfall im Quellorgan [mGy/(MBq · s)]
 τ = residence time

Nuklearmedizin (τ , Biokinetik)

Tc
43
Phosphonates

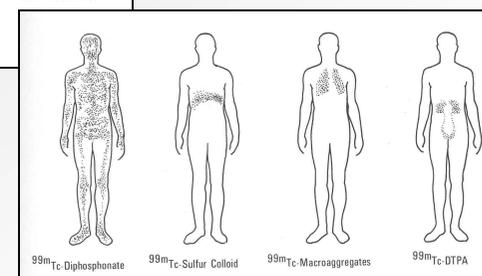
BIOKINETIC MODELS AND DATA

Biokinetic Data

Organ (S)	F_s	T	a	\tilde{A}_s/A_0
(1) Normal uptake and excretion				
Total body (excluding bladder contents)	1.0	0.5 hr 2 hr 3 d	0.3 0.3 0.4	4.06 hr
Bone	0.5	0.25 hr 2 hr 3 d	-1.0 0.3 0.7	3.01 hr
Kidneys	0.02	0.5 hr 2 hr 3 d	0.3 0.3 0.4	7.5 min
Bladder contents	1.0			1.15 hr
(2) High bone uptake and/or severely impaired kidney function				
Total body	1.0	∞	1.0	8.69 hr
Bone	0.7	0.25 hr ∞	-1.0 1.0	5.84 hr



$$D_t = A_0 \cdot S_{t \leftarrow s} \cdot \tau$$



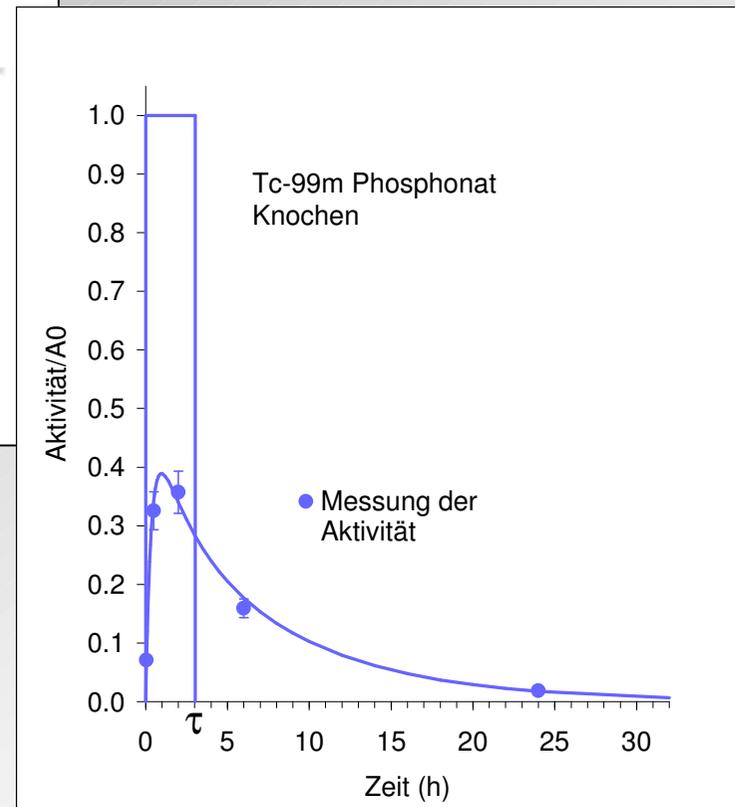
Nuklearmedizin (τ , Biokinetik)

Tc-99m Phosphonat

F_s	T	a	\tilde{A}_s/A_0
1.0	0.5 hr	0.3	4.06 hr
	2 hr	0.3	
	3 d	0.4	
0.5	0.25 hr	-1.0	3.01 hr
	2 hr	0.3	
	3 d	0.7	
0.02	0.5 hr	0.3	7.5 min
	2 hr	0.3	
	3 d	0.4	
1.0			1.15 hr



$$D_t = A_0 \cdot S_{t \leftarrow s} \cdot \tau$$



Nuklearmedizin (τ , Biokinetik)

Tc-99m Phosphonat

F_s	T	a	\tilde{A}_s/A_0
1.0	0.5 hr	0.3	4.06 hr
	2 hr	0.3	
	3 d	0.4	
0.5	0.25 hr	-1.0	3.01 hr
	2 hr	0.3	
	3 d	0.7	
0.02	0.5 hr	0.3	7.5 min
	2 hr	0.3	
	3 d	0.4	
1.0			1.15 hr



$$D_t = A_0 \cdot S_{t \leftarrow s} \cdot \tau$$

Input data for 99m-Tc-43

File Help

Elements	Nuclides	Phantoms
Scandium	94m-Tc-43	<input checked="" type="checkbox"/> Adult (70 kg)
Selenium	95-Tc-43	<input type="checkbox"/> 15-year-old (57 kg)
Silver	95m-Tc-43	<input type="checkbox"/> 10-year-old (32 kg)
Sodium	97m-Tc-43	<input type="checkbox"/> 5-year-old (19 kg)
Strontium	99-Tc-43	<input type="checkbox"/> 1-year-old (9.8 kg)
Sulfur	99m-Tc-43	<input type="checkbox"/> Newborn (3.4 kg)
Tantalum		<input type="checkbox"/> Adult Female - Nonpregnant
Technetium		<input type="checkbox"/> 3-month Pregnant Woman
Tellurium		<input type="checkbox"/> 6-month Pregnant Woman
		<input type="checkbox"/> 9-month Pregnant Woman

Residence Times (hr)

<input type="checkbox"/> Adrenals	.13	<input checked="" type="checkbox"/> Kidneys	<input type="checkbox"/> Testes
<input type="checkbox"/> Brain		<input type="checkbox"/> Liver	<input type="checkbox"/> Thymus
<input type="checkbox"/> Breasts		<input type="checkbox"/> Lungs	<input type="checkbox"/> Thyroid
<input type="checkbox"/> Gallbladder Contents		<input type="checkbox"/> Muscle	1.15 <input checked="" type="checkbox"/> Urin. Bl. Contents
<input type="checkbox"/> LLI Contents		<input type="checkbox"/> Ovaries	<input type="checkbox"/> Uterus
<input type="checkbox"/> SI Contents		<input type="checkbox"/> Pancreas	<input type="checkbox"/> Fetus
<input type="checkbox"/> Stomach Contents		<input type="checkbox"/> Red Marrow	<input type="checkbox"/> Placenta
<input type="checkbox"/> ULI Contents	3.01	<input checked="" type="checkbox"/> Cortical Bone	4.06 <input checked="" type="checkbox"/> Remainder of Body
<input type="checkbox"/> Heart Contents		<input type="checkbox"/> Trabecular Bone	
<input type="checkbox"/> Heart Wall		<input type="checkbox"/> Spleen	

Use ICRP 30 GI tract model? Yes

Use Dynamic Bladder Model? Yes

Select All Clear All

Nodule Module

Sphere Size:

Sphere Diameter:

Report

Self-dose S-value:

Control Panel

Calculate Doses S-Value Table

Label for Program Output:

Nuklearmedizin (S-Matrix)

File View Help

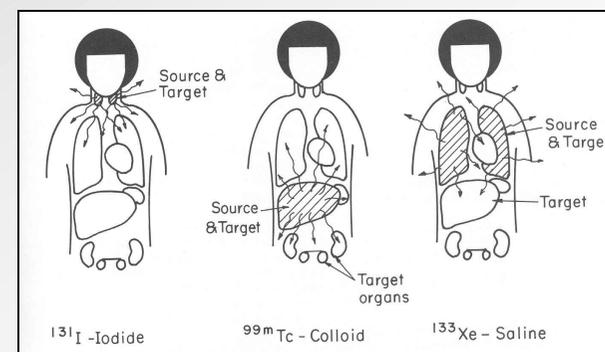
S-Values for the REFERENCE ADULT for 99m-Tc-43 (mGy/MBq-s) 04-01-2005

TARGET	Adrenals	Brain	Breasts	Gall BI Cont	LLI Cont
Adrenals	1.58E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Brain	0.00E+00	1.81E-06	0.00E+00	0.00E+00	0.00E+00
Breasts	0.00E+00	0.00E+00	7.34E-06	0.00E+00	0.00E+00
Gallbladder Wall	0.00E+00	0.00E+00	0.00E+00	2.31E-05	0.00E+00
LLI Wall	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.01E-06
Small Intestine	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Stomach	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
ULI Wall	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Heart Wall	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Kidneys	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Liver	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Lungs	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Muscle	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ovaries	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pancreas	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Red Marrow	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bone Surfaces	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Skin	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Spleen	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Testes	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Thyroid	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Back to Input Form



$$D_t = A_0 \cdot S_{t \leftarrow s} \cdot \tau$$



Nuklearmedizin (Resultat)

Dosisberechnung mit **Computer-Programm MIRD0SE3**



File View Help

Radiation Dose Estimates for the REFERENCE ADULT for 99m-Tc-43

TARGET ORGAN	Total mGy/MBq	Dose rad/mCi	Primary Contributor	Contribution	Secondary Contributor	Contribution
Spleen	5.44E-04	2.01E-03	Rem. Body	100.0%		0.0%
Testes	5.44E-04	2.01E-03	Rem. Body	100.0%		0.0%
Thymus	5.44E-04	2.01E-03	Rem. Body	100.0%		0.0%
Thyroid	5.44E-04	2.01E-03	Rem. Body	100.0%		0.0%
Urin Bladder	2.55E-02	9.45E-02	Urinary BI	98.9%	Rem. Body	1.1%
Uterus	5.44E-04	2.01E-03	Rem. Body	100.0%		0.0%
Total Body	9.34E-04	3.46E-03	Rem. Body	54.8%	Cort Bone	40.5%
EDE	3.09E-03	1.14E-02	Remainder	60.6%	Bone	27.6%
ED	2.19E-03	8.10E-03	Urin. Bladder	58.3%	Bone	13.0%
EDE/ED units:	mSv/MBq	rem/mCi				

SOURCE ORGAN	Residence Time (hr)
Kidneys	1.30E-01
Cort Bone	3.01E+00
Urinary BI Cont	1.15E+00
Remainder	4.06E+00

Dynamic Bladder Model? Yes No

ICRP 30 GI Model? Yes No

Activity in cortical and/or trabecular bone distributed on bone surfaces.

Back to Input Form

Tc-99m Phosphonat

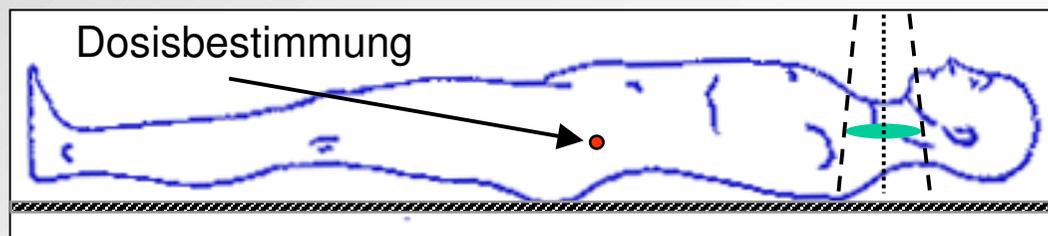
$$D_{\text{Organ}} = A \cdot f_{\text{Organ}}$$

$$E = A \cdot f_{\text{ED}}$$

Radio-Onkologie (Input)

Parameter für Dosisbestimmung (RT):

- Bestrahlungsgerät
- Zielvolumen
- Patientenpositionierung, -lage
- Gantrywinkel
- Fokus-Oberflächen-Distanz für jedes Feld
- Feldgrösse
- Keilfilter, Tischplatte
- Anzahl Monitoreinheiten
- individuelle Bestrahlungspläne



Radio-Onkologie (Resultate)

Dosisberechnung mit **Computer-Programm PeriDose**



PeriDose

File Help

Patient's name: Total uncertainty: cGy

Number of Beams: Total Peripheral Dose: cGy Total leakage and external scatter: cGy

Beam 1

Energy: MV Co-60 X-Rays (Apply to all beams)

Field Description:

IMRT Orthogonal Tangential

Wedge Used

Isocentric technique

Wedge properties

Wedge Type: External Internal

Wedge given dose at dmax: cGy

Isocentric properties

Source Axis Distance: cm Depth Isocenter: cm

Field Size: x cm²

Distance center of field to PD-point: cm

Patient thickness along beam axis: cm

Depth of PD-point in beam direction: cm

Open beam given dose at dmax: cGy

Monitor units: MU's

Shielding blocks used

Part of beam shielded

< 1/6 1/5 1/3

1/6 1/4 1/2

The ray-line "source-to-PD-point" is intercepted by the couch

Peripheral dose for this beam: cGy Leakage and external scatter for this beam: cGy

0.9% **30 · 18 mGy = 540 mGy**

Organdosis

- Streuung im Körper
- Leckstrahlung
- äussere Streuung

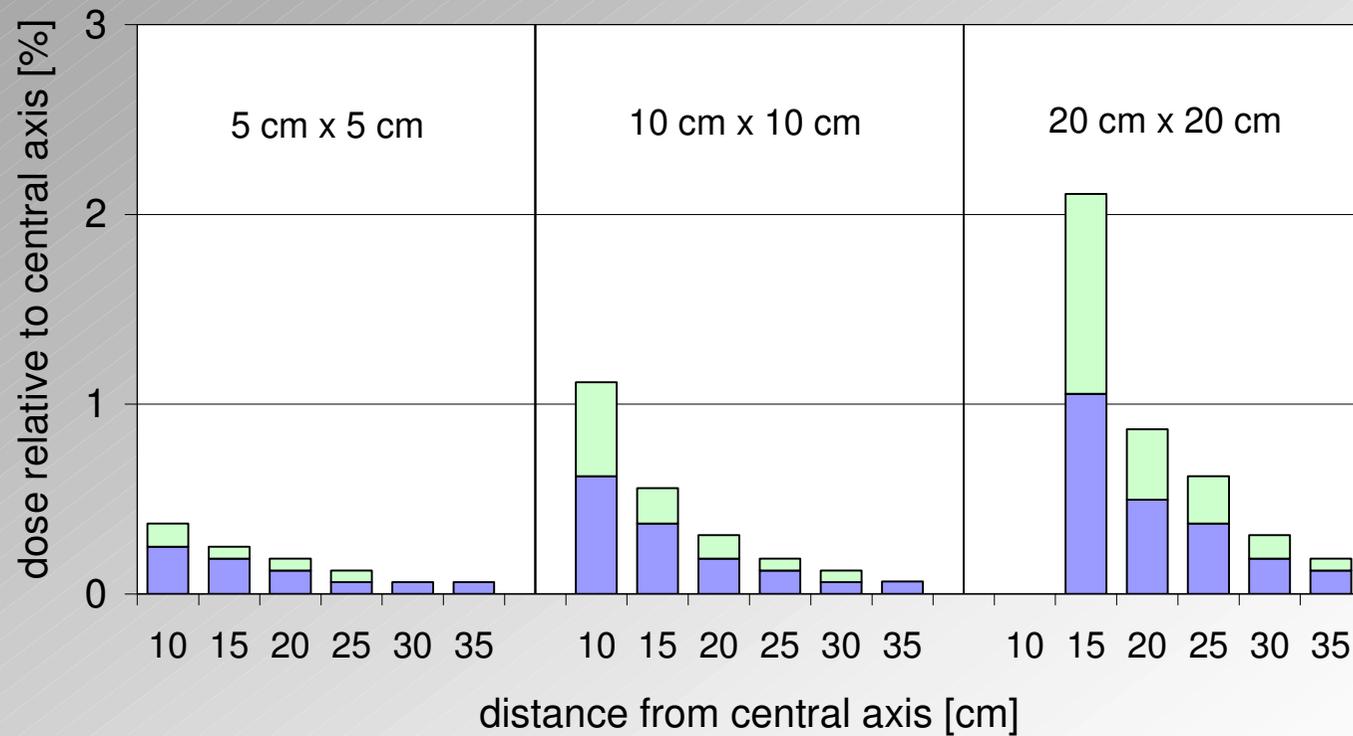
Radio-Onkologie (Resultate)



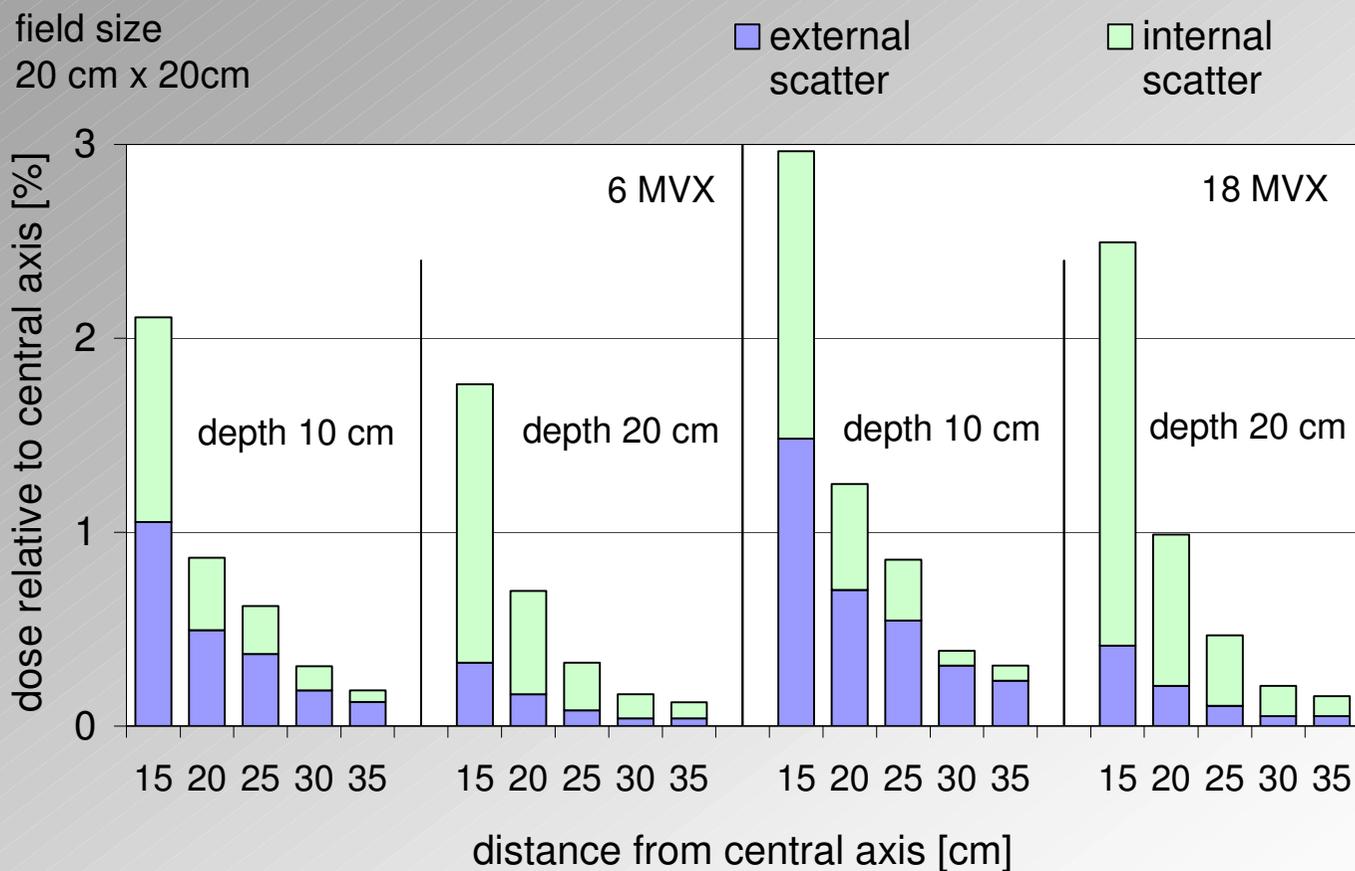
6 MVX
depth 10 cm

external scatter

internal scatter



Radio-Onkologie (Resultate)



Letztes Dia

Nuklearmedizin:

- Berechnung **aufwändig**
- **Biokinetik** muss erfasst werden

Radio-Onkologie:

- **Messung** im Allgemeinen nötig für konkrete Situation
- **Achtung:**
Berechnung **nicht** mit Therapie-Planungs-System,
da optimiert für Dosen $> 3\%$ der Herddosis