



# HDR - Sources CO60 vs IR192

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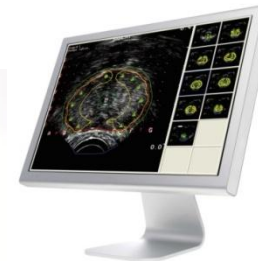
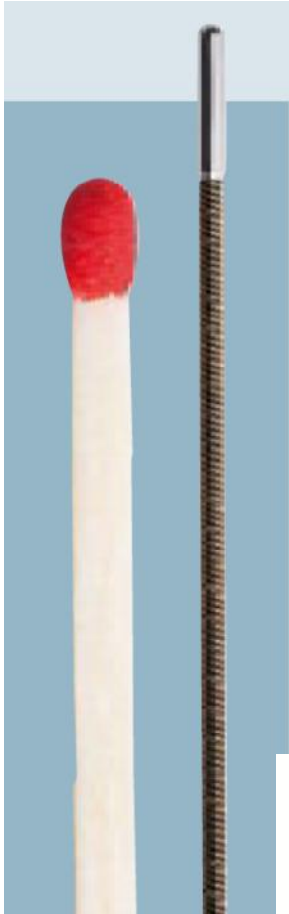
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## Eckert & Ziegler BEBIG

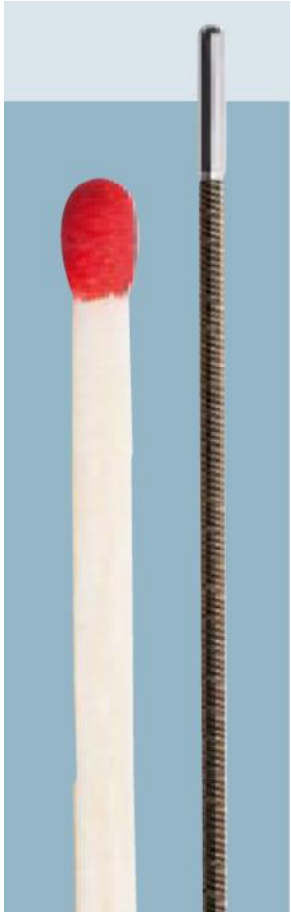
### Global Provider of the Complete Brachytherapy Portfolio

- HDR (high dose rate) afterloading systems
- Permanent LDR (low dose rate) implants (“seeds”) for prostate brachytherapy
- Eye applicators for the therapy of ophthalmic tumors





## MultiSource® and SagiNova®: Co60 or IR192 Afterloading system



### MultiSource®

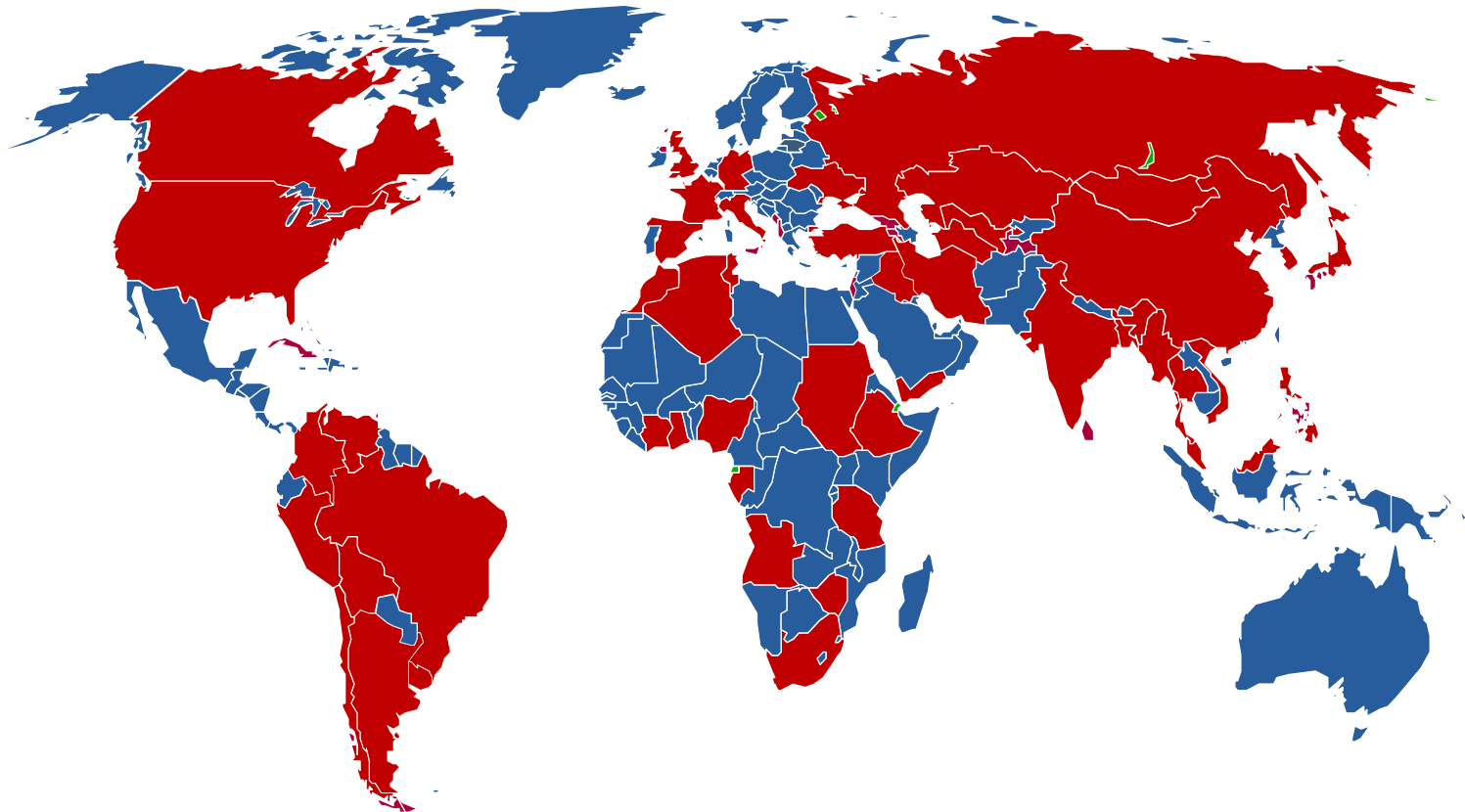
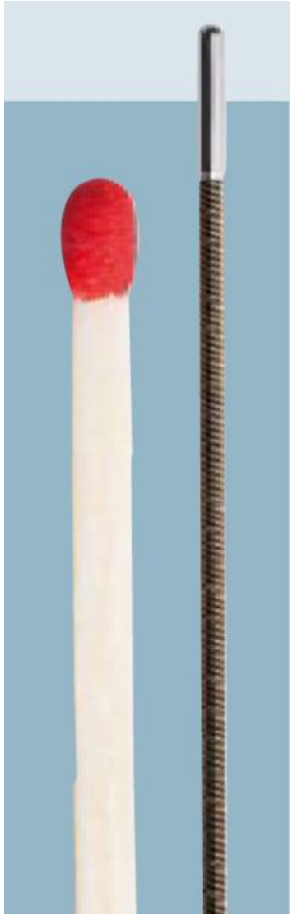
- For use with conventional Ir-192 or particularly durable Co-60 source
- integrated In-Vivo Dosimetry (on demand)
- Digital source position verification
- 40 Channel Support even for complex implants

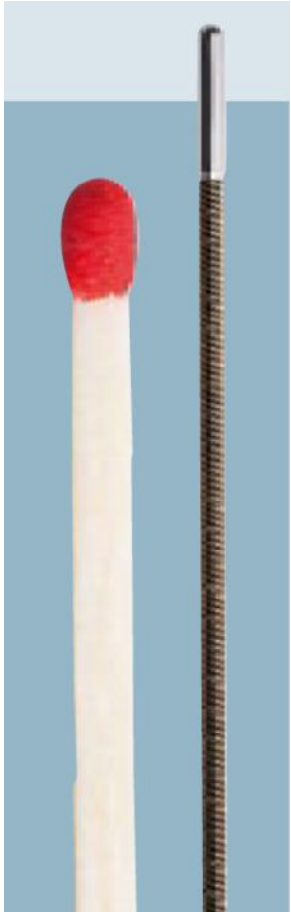
### SagiNova®

- MultiSource® features and **additionally**:
  - ✓ QAssist™ supports quality assurance responsibilities
  - ✓ Remote support for short response time
  - ✓ 50 Channel Support even for the most complex implants



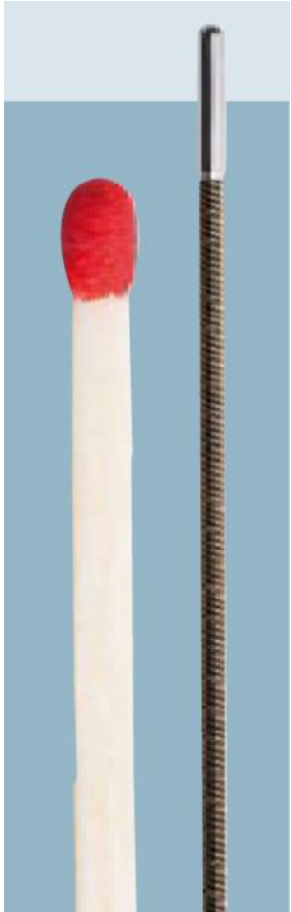
**More than 300 installed Systems in more than 50 Countries**  
**Most using Co60 sources**





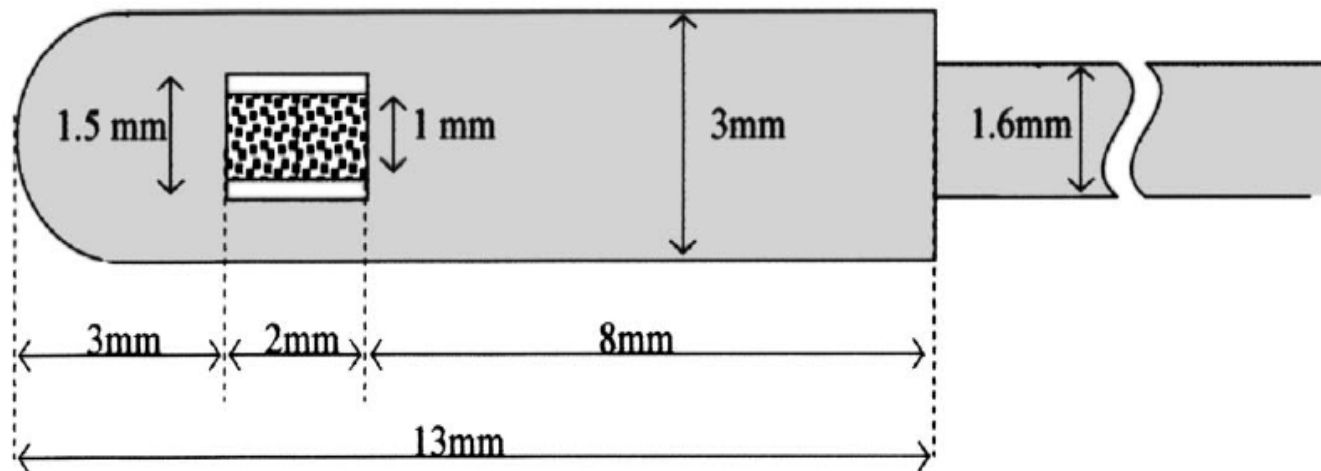
## Important parameter for a HDR source

- **Doserate : must be in the HDR-Doserate range**
  - Biological effects
  - Treatment time
- **Dimension : as small as possible**
  - For interstitial and intraop treatment
  - small applicators
- **Dose - distribution :**
  - strong dose gradient
  - high dose to target volume but low dose to OAR

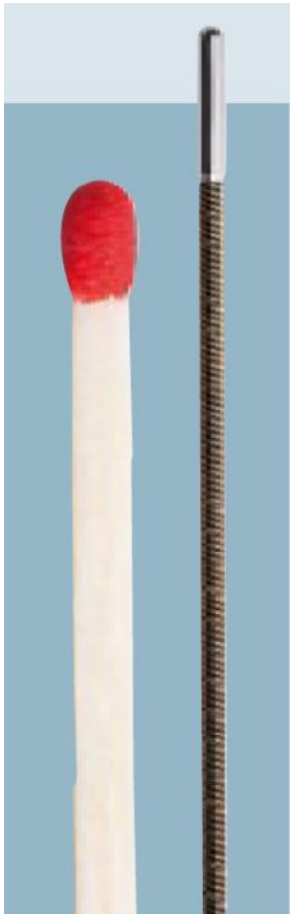


Is the source larger?

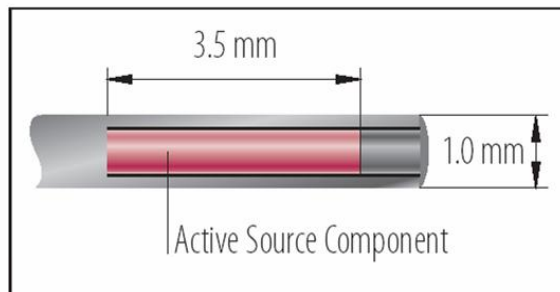
Previous Co60 sources; last century







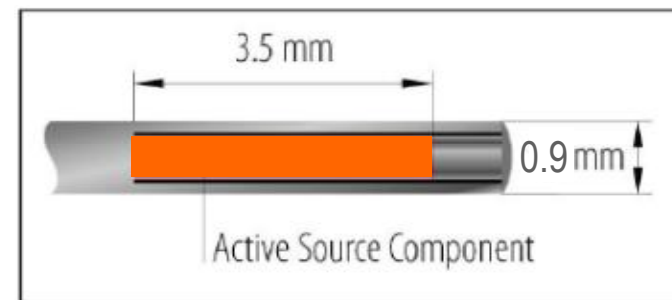
**BEBIG's expertise in manufacturing miniaturized sealed sources lead to the development of a highly active miniaturized Co-60 source**



Miniaturized Co-60 Source  
Co-60 Source (Co0.A86)

- 100.000 source transfers
- use for 5 years

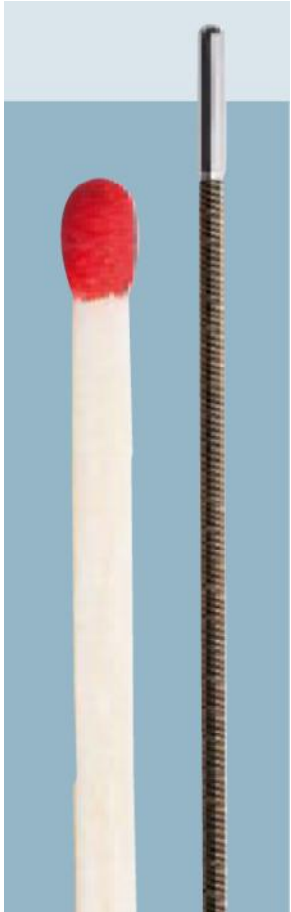
**Co-60 Sources are not large anymore**



Ir-192 Source  
Ir-192 Source (Ir2.A85-2)

- 25.000 source transfers
- use for 3 ,4 (5) month

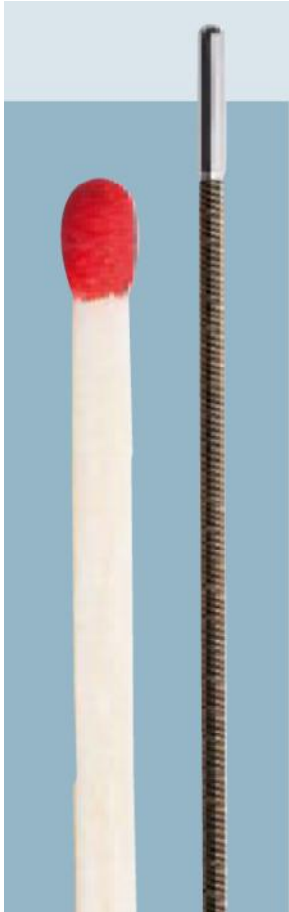
**Co-60 source is suitable for all BT applications**



*Why only 2 Ci ?*

*Is the „treatment time“ longer ?*

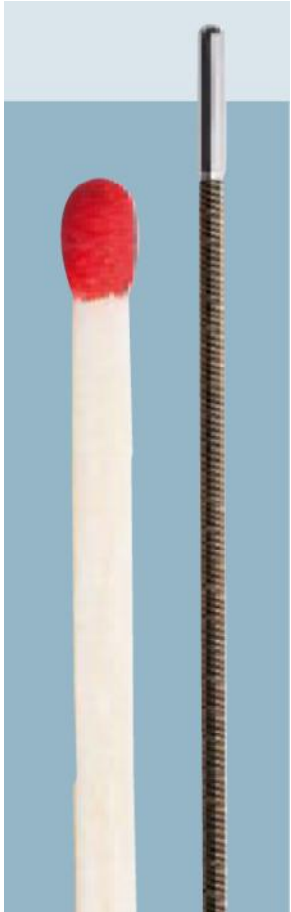




# Source Specifications

	Cobalt-60	Iridium-192
ISO Classification 2919-1998	C 65444	C 63333
Half-life	5,27 years	73,8 days
Physical-Chemical form	solid, metal	solid, metal
Source activity	74 GBq $\pm$ 10%	370 GBq + 30%; -10%
Outer dimensions of the source:		
Diameter	1 mm	0,9 mm
Total length of the wire:	2180 mm	2180 mm
Dimensions of active part		
Diameter:	0,5 mm	0,6 mm
Length:	3,5 mm	3,5 mm
Working life	max 100.000 source transfers or 5 years	max 25.000 source transfers or 4 months

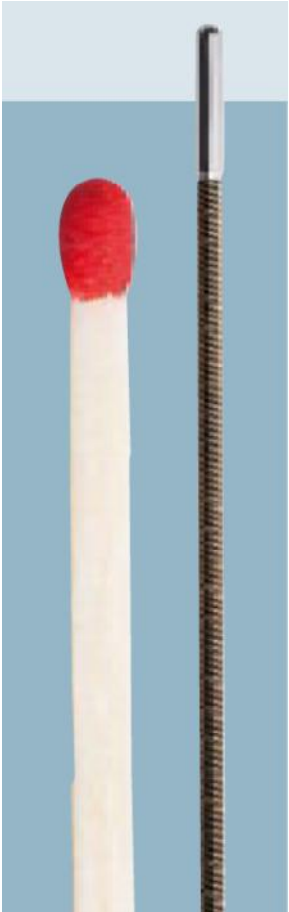
## Physical Data



The air kerma-rate-constant is almost three times higher for Co-60 than for Ir-192

Nuclide	$\bar{E}$ (MeV)	$T_{1/2}$	(Ci/g)	$\Gamma$ ( $\mu\text{Gy m}^2$ $\text{GBq}^{-1} \text{h}^{-1}$ )	$d_{1/10}^{(1)}$ (lead)	$d_{1/10}$ (concrete)
	mean energy	half-life	specific activity	air kerma-rate constant	tenth value layer	tenth value layer
Co-60	<b>1.253</b>	<b>5,27a</b>	330	<b>309</b>	4,8cm	32cm
Ir-192	0.38	73,8d	450	108	1,2cm	23cm

**Co-60 vs. Ir-192:  
factor 2.86**



Reference Air Kerma Rate 24 mGy/h

Dose-rate in:

1 cm ~240 Gy/h

2 cm ~ 60 Gy/h

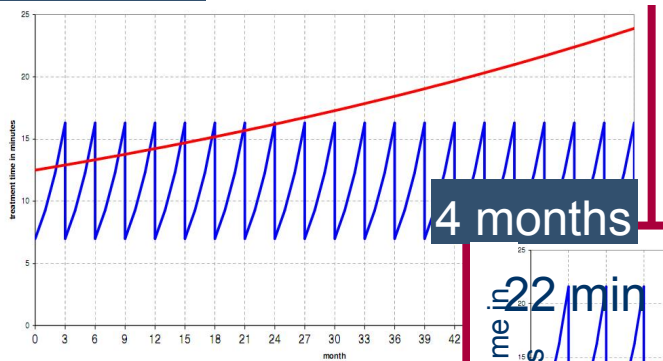
Gec-Estro HDR Definition :

HDR if Dose-Rate > 12 Gy/h

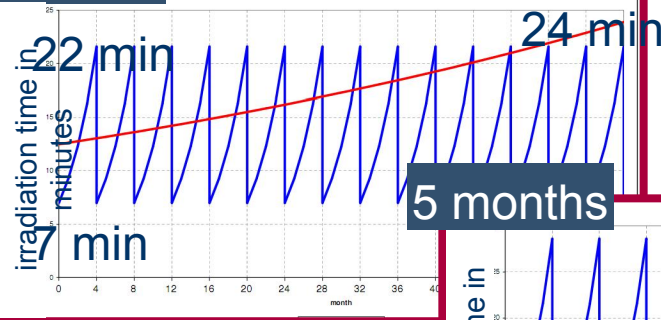
## Irradiation time

3 months

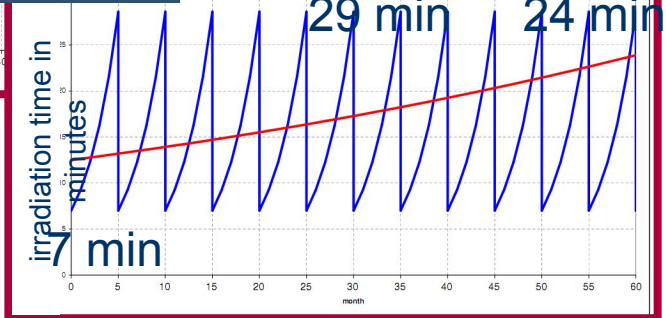
displayed for 60 months / 5 years



4 months

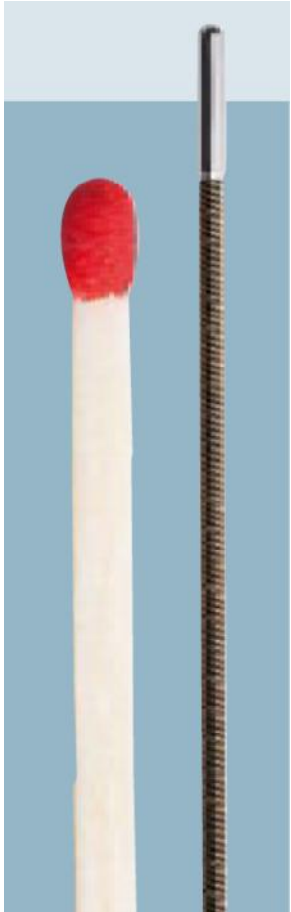


5 months



comparison Co-60 vs. Ir-192 depends significantly  
on the frequency of Ir-192 source changes (3, 4 or 5 months)

## Nearly the same total treatment time for Ir-192 and Co-60

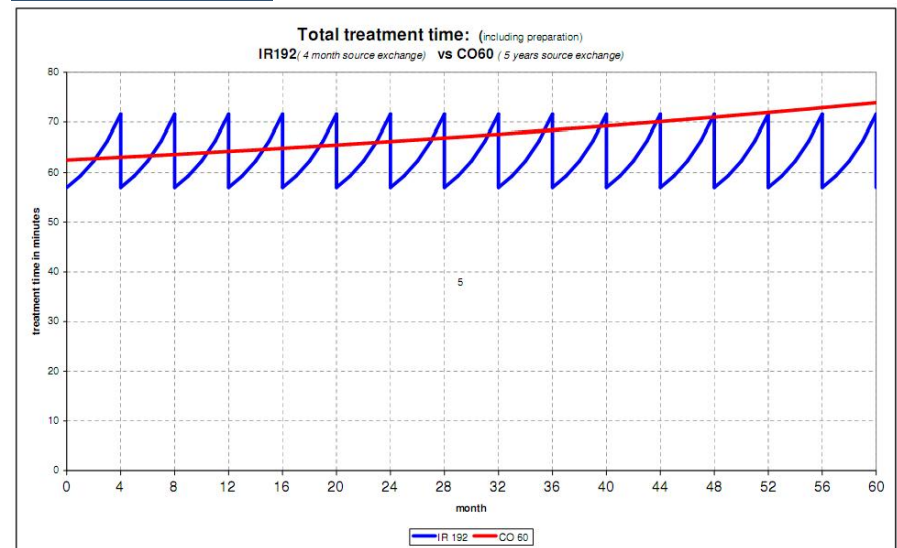


### Adding all steps up

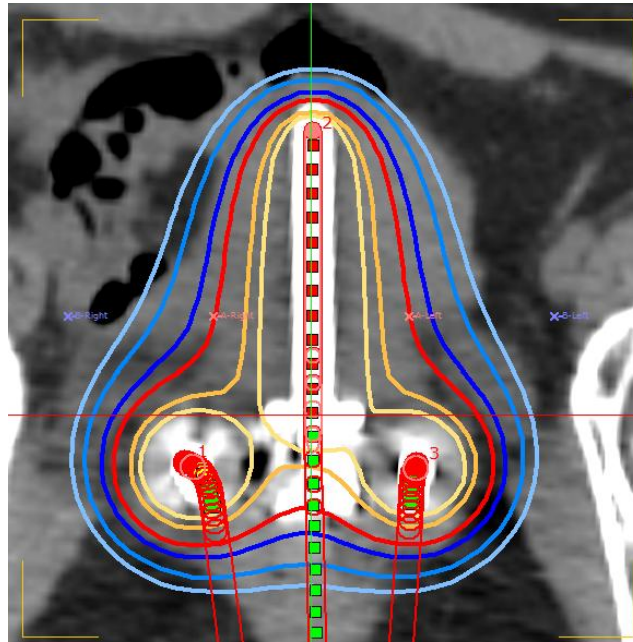
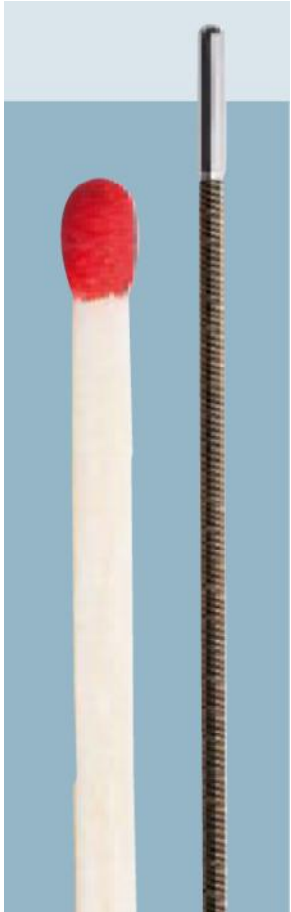
- prepare the patient
- take images /Ct/Films)
- finalize the plan
- irradiate the patient
- final procedures

4 months

Total Treatment Time



## Sample treatment time Ir-192 vs Co-60



### IR192 (2 month)

- 22,8 mGy/h → 207 GBq
- ~ 11 Min

### Cervix cancer

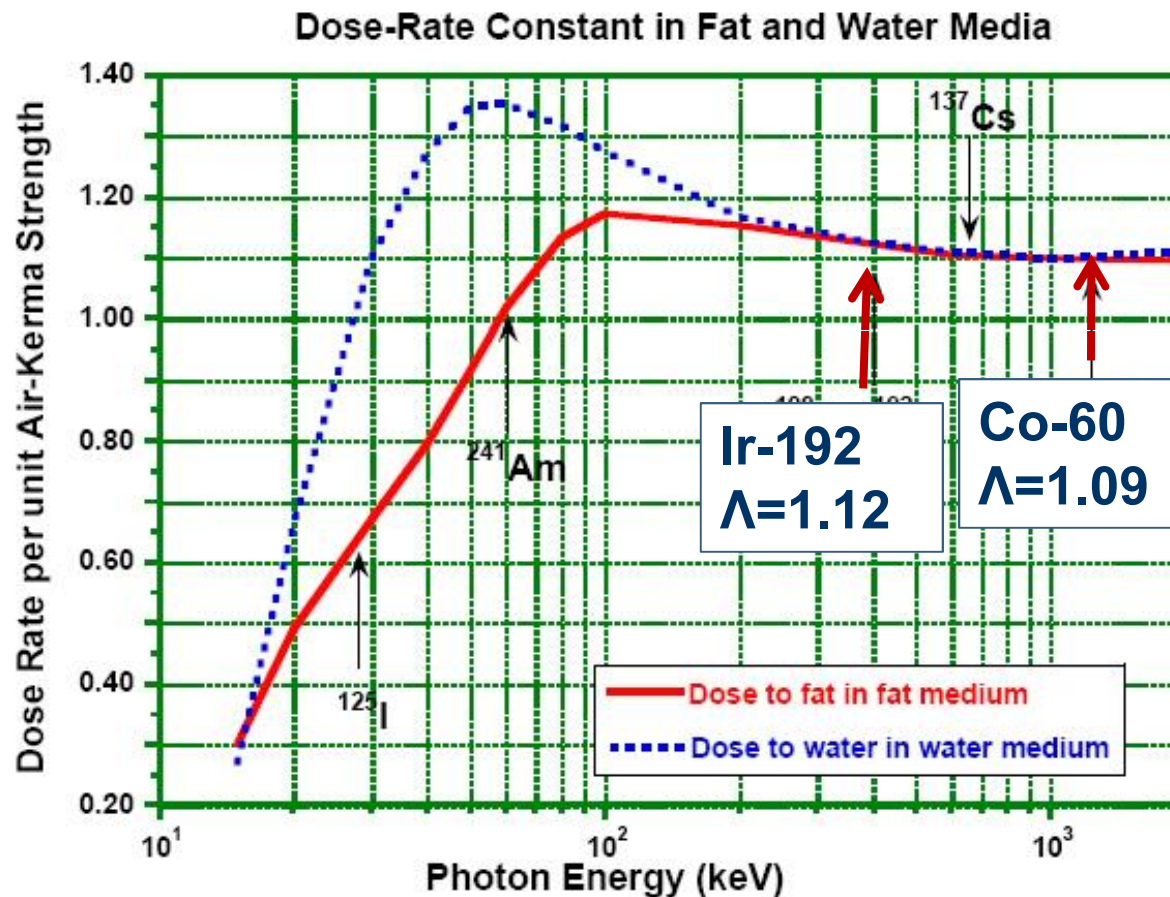
- Fletcher Applicator
- Standard loading
- 5 Gy to Manchester A point

### Co60 (1 years)

- 18,5 mGy/h → 56,9 GBq
- ~ 11 Min



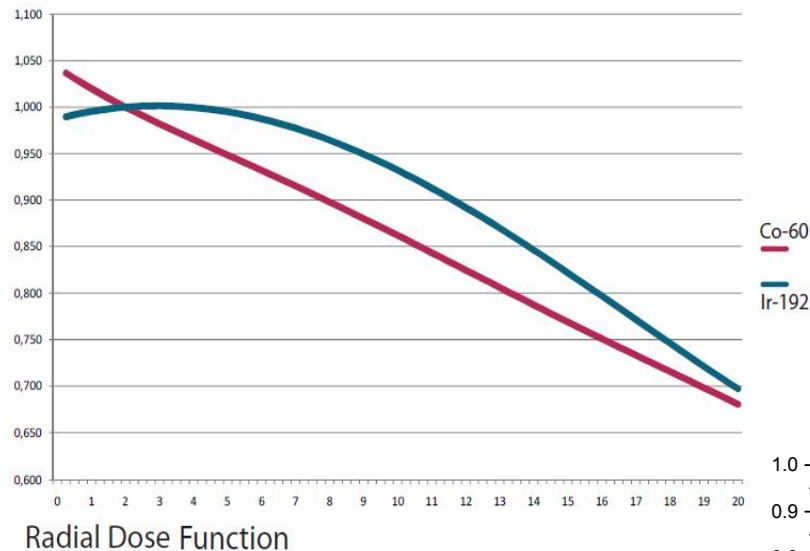
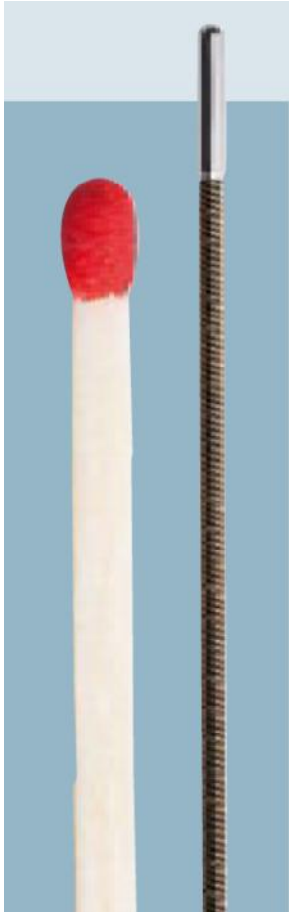
Beyond 200 keV all Isotopes show similar absorption in tissue



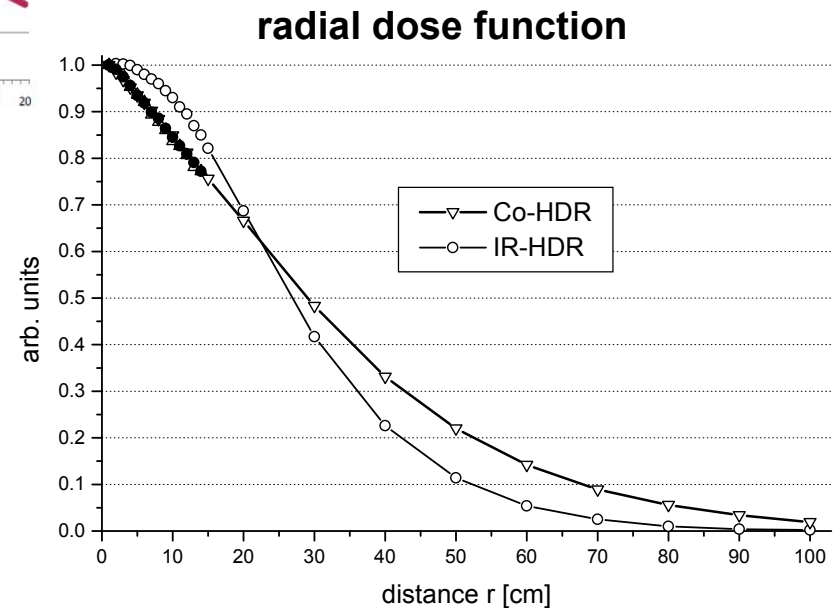
2005, Jeff Williamson

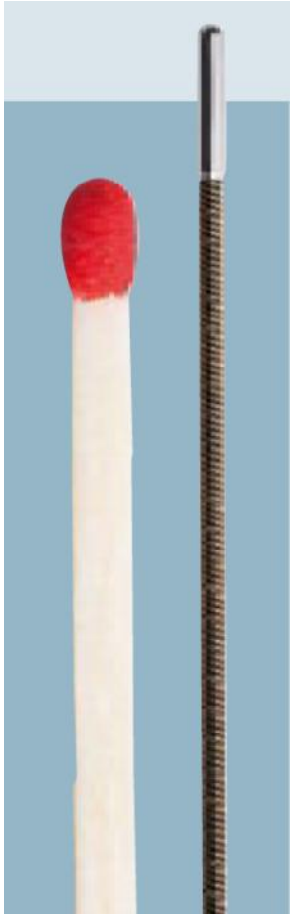


Dose at the OAR even lower for Co-60 than for Ir-192

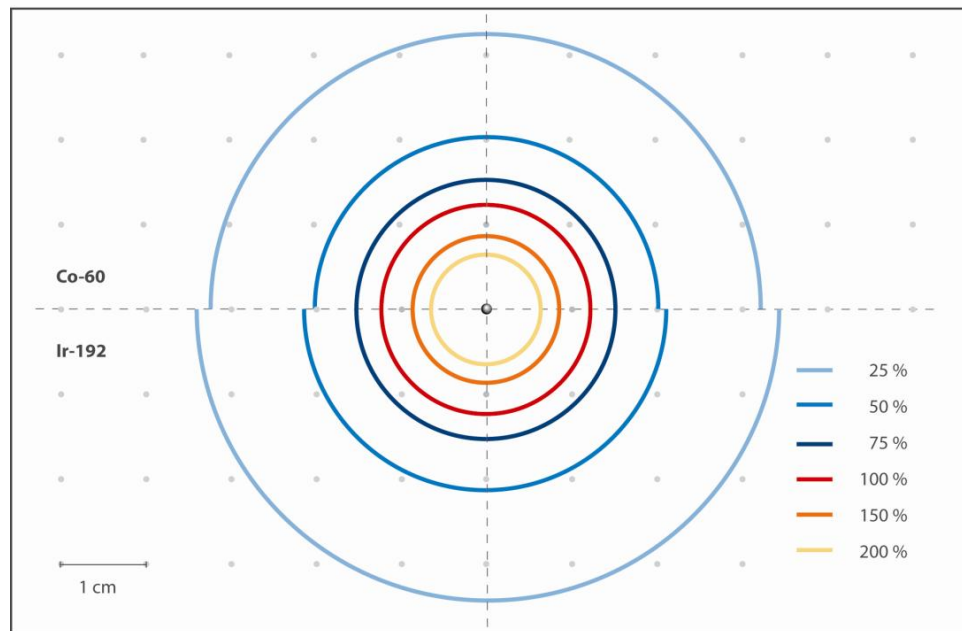


\* normalized to the dose rate at 2 cm distance  
(Manchester A point)



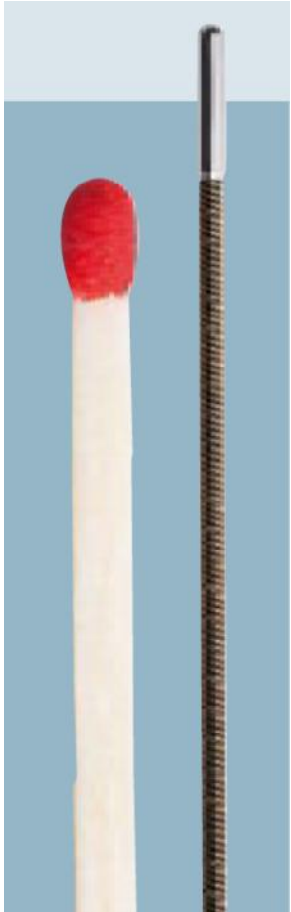


## Dose at the OAR even little bit lower for Co-60 than for Ir-192



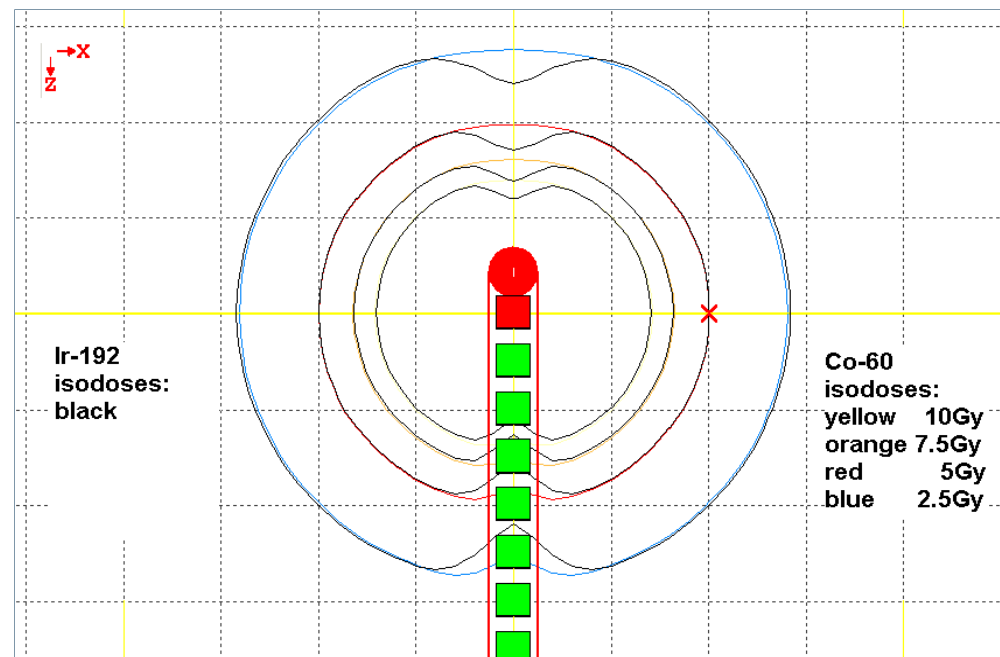
Radiation in tissue: isodose comparison between Co-60 and Ir-192

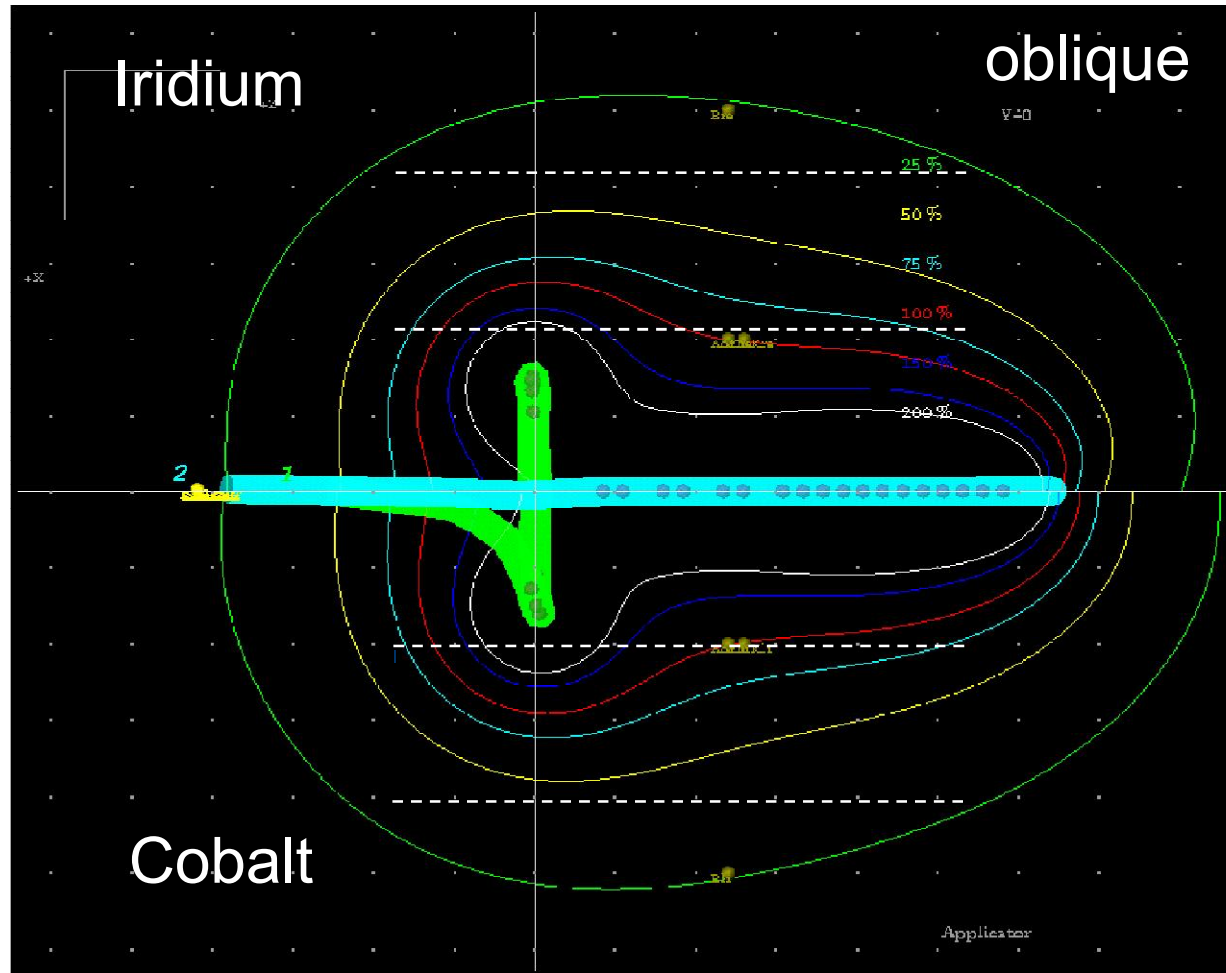
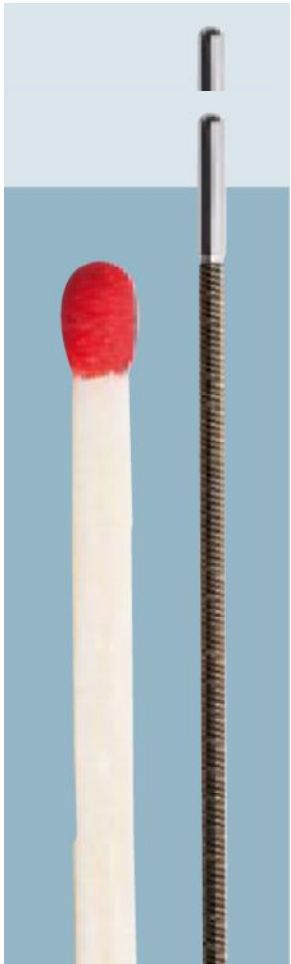
- Comparable dose distribution of Co-60 and Ir-192: Vaginal applicator



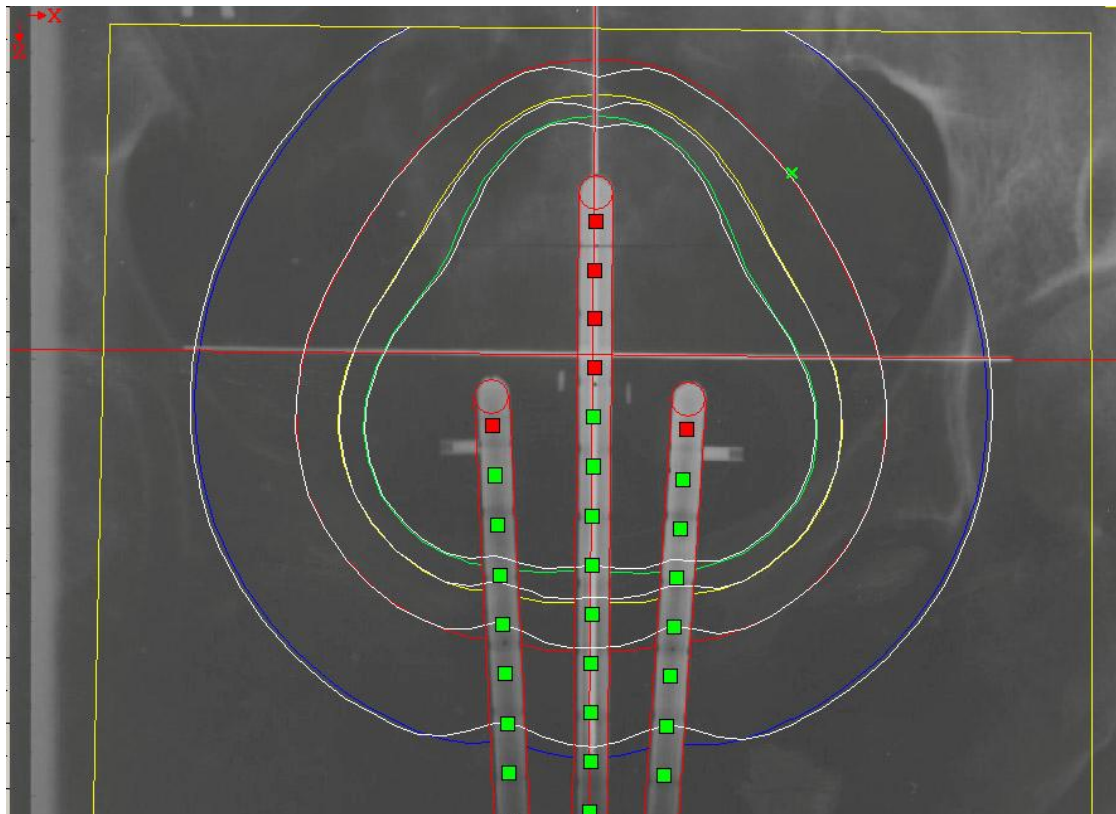
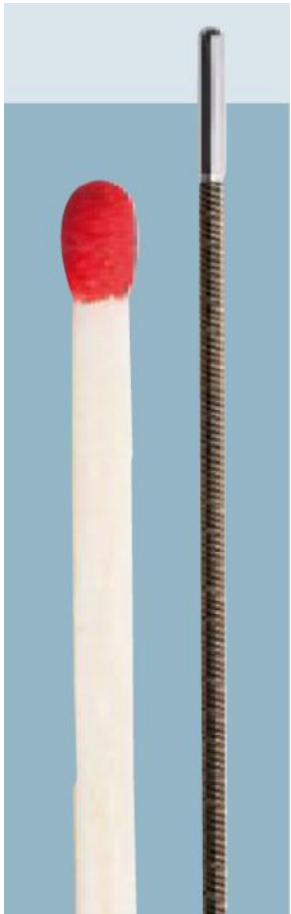
# Anisotropy

Almost no difference between Co-60 and Ir-192 except the dip in direction of the source axis



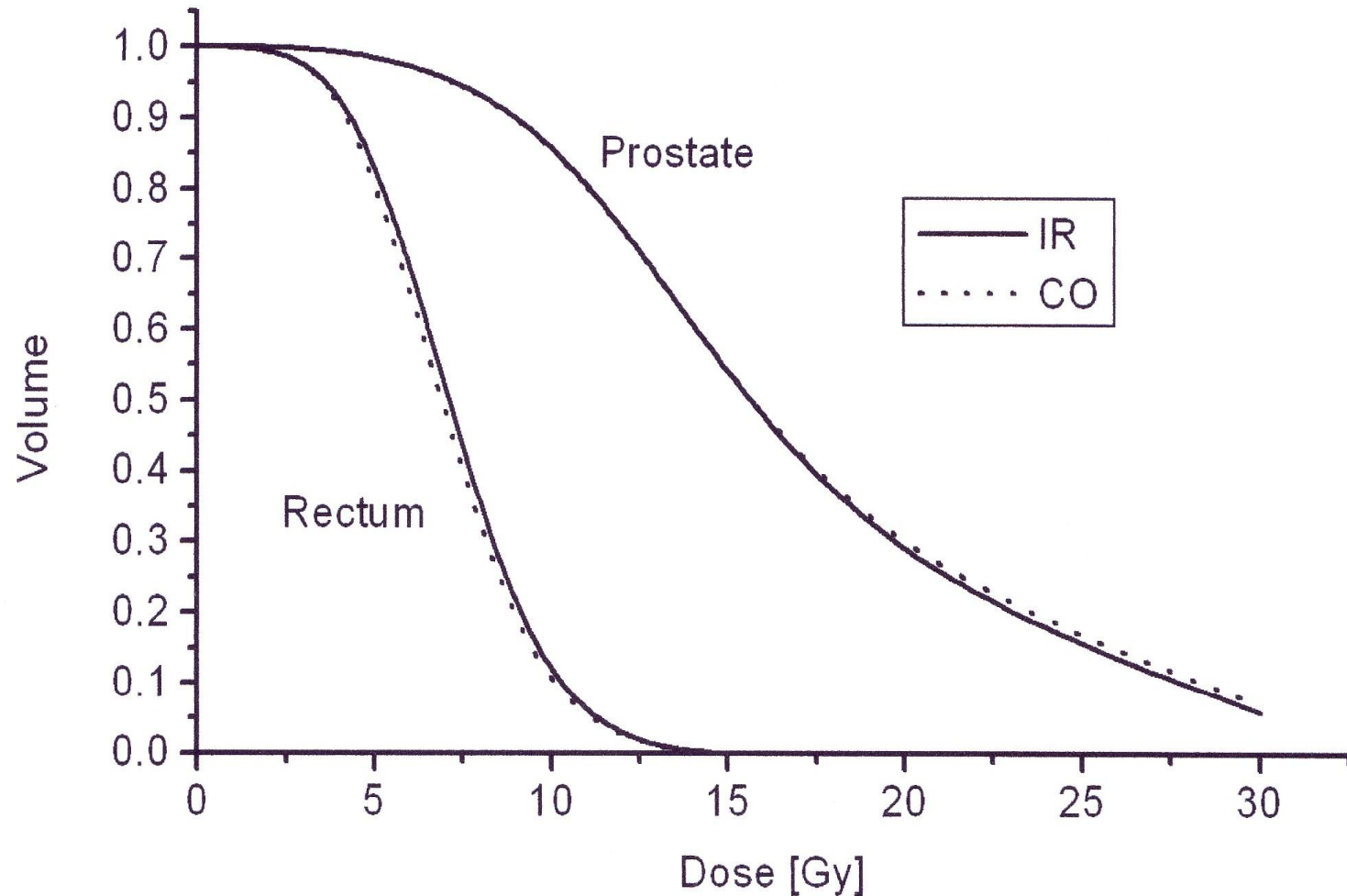
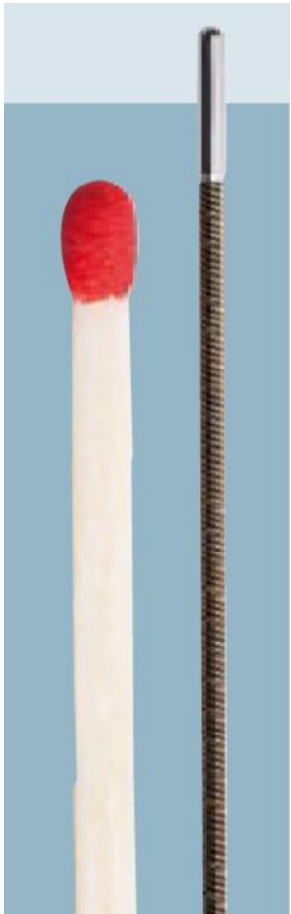


**No clinical impact of using Co-60 instead of Ir-192**



- Isodoses:
- Co-60:
  - green: 10Gy
  - yellow: 7.5Gy
  - red: 5Gy
  - blue: 2.5Gy
- Ir-192:
- all white

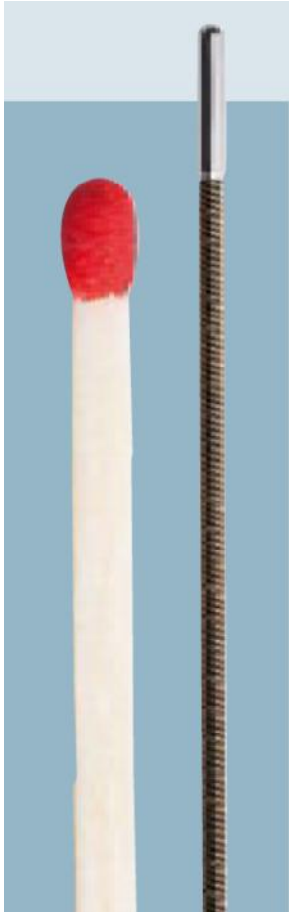
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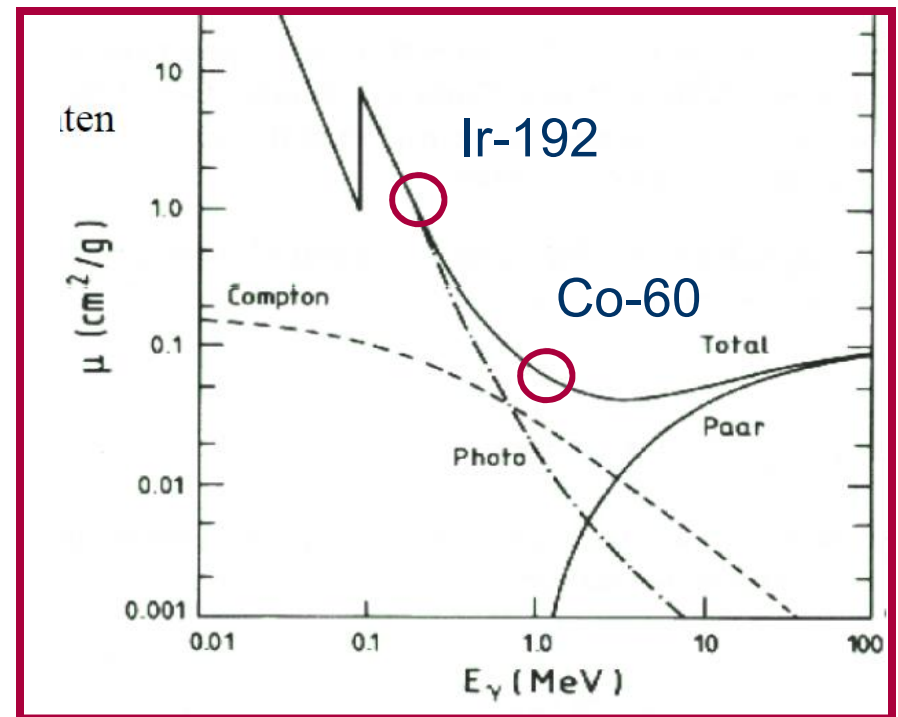
## Why more room-shielding ?



in material with higher  
density absorption  
depends much more  
on energy

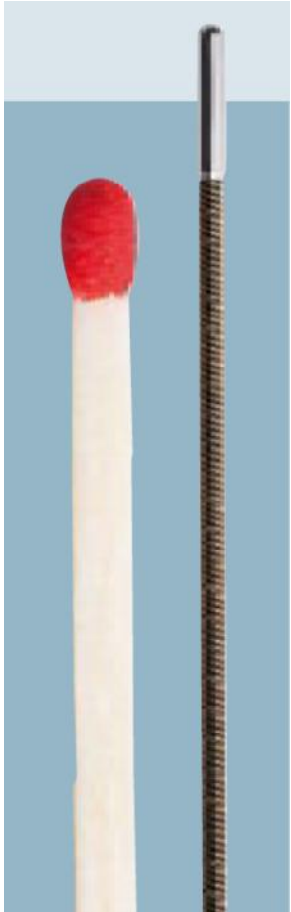
Remember for  
water/tissue absorption  
for photon-energy more  
than 200KeV is nearly  
independent from energy

### Absorption of $\gamma$ -radiation in lead



This is the reason why the room shielding has to be different.



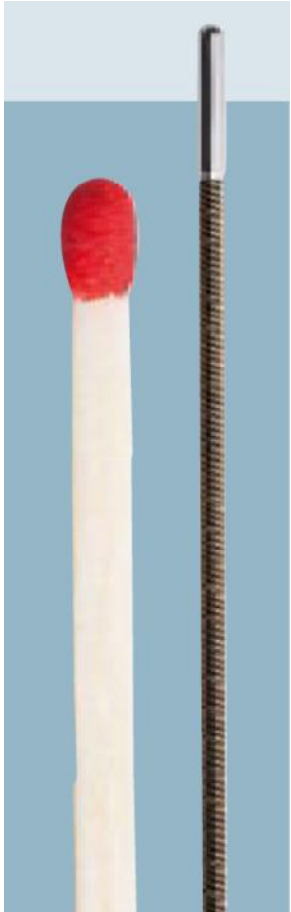


## Half life time:

- Co-60 5.3 years
- Ir-192 74 days



## Number of source



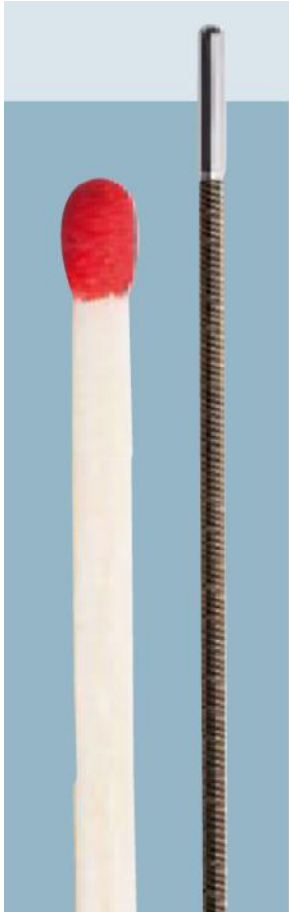
	Ir-192 (every 4 months)	Co-60 (every 5 years)
10 years	30	2
15 years	45	3

→source exchanges using Co-60 mean:

- less expenses for sources
- less QC workload
- less logistic problems, less paperwork
- no loss of treatment days



## Co60 Source Common Myths Dispelled

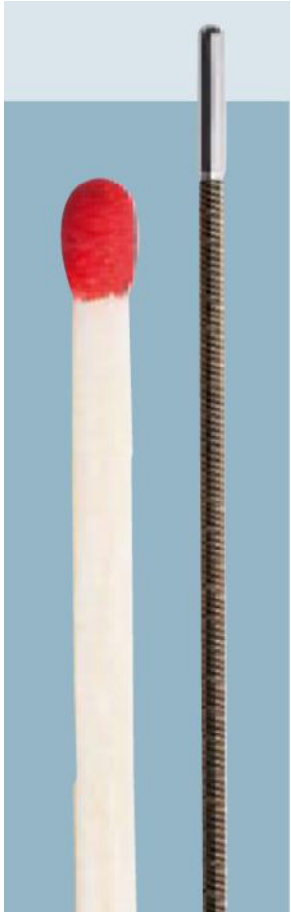


- Does higher mean energy of Co-60 gamma radiation lead to higher penetration depths and higher doses to critical organs?  
– **NO!**
  - Monte Carlo studies and experimental measurements show that this is NOT the case
- Does lower activity of Co-60 mean that treatment times with cobalt are much longer?  
– **NO!**
  - In order to determine treatment times, the air kerma rate constant is the important factor. It is 2,83 times higher for Co-60 than for Ir-192



## resume Co-60 vs IR192

- + less number of source exchanges
- +     → less problems with logistic
- +     → less paperwork
- +     → less amount of dosimetry
- +     → **less costs**
- + less pronounced dose dip
  
- = identical source geometry
- = comparable dose rate
- = comparable dose distribution
- = comparable absorption in tissue
  
- more complex radiation protection





Eckert & Ziegler BEBIG

Your full brachytherapy provider!

Thank you for your attention!



Berlin Brandenburg - Gate