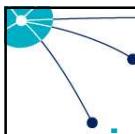




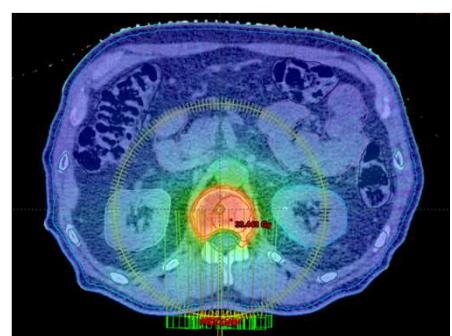
**SBRT voor (para)spinale metastasen**

**Frederik Vandaele**  
**Radiotherapie-Oncologie**  
**Iridium Kankernetwerk**  
**Antwerpen, België**

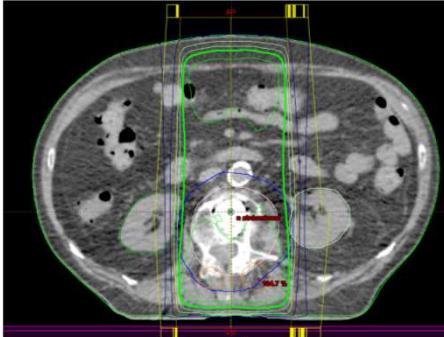


**inhoud**

1. waarom sbrt voor spine?
2. patiënten selectie
3. techniek
4. resultaten
5. toxiciteit



**conventionele RT voor wervelmetastasen**

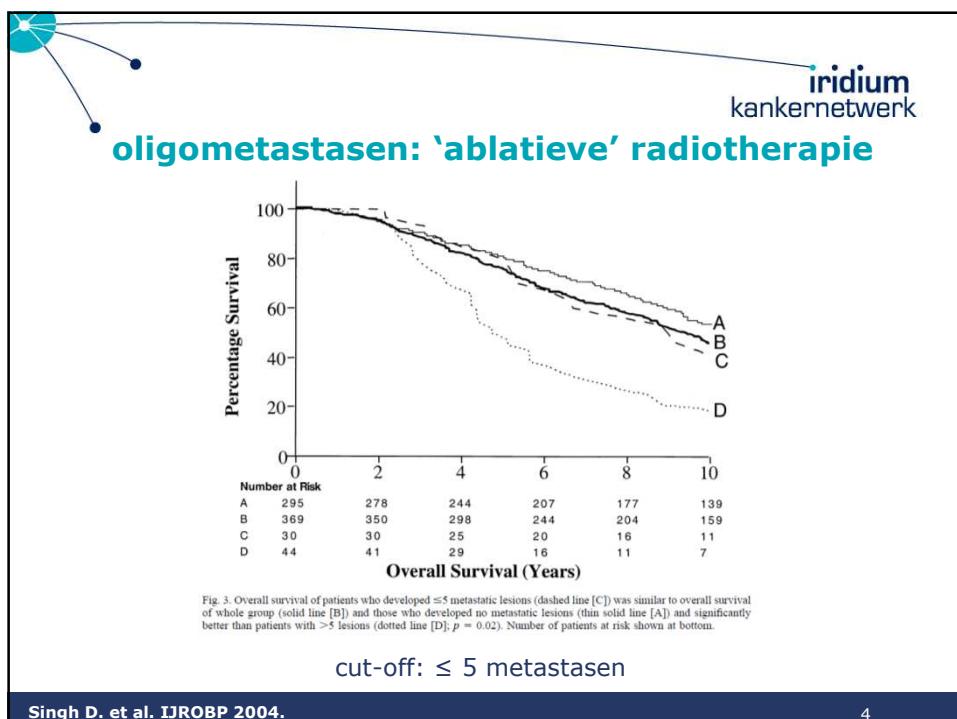


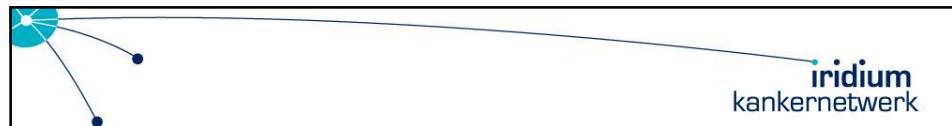
- 1x8 Gy standaard
- pijn respons: 70%
- complete pijn respons :25-40%
- Pijn controle na 3-6 mnd: 35%
- herbestraling: 20%

2 velden : AP-PA.

**Chow E et al. J Clin Oncol 2007.**

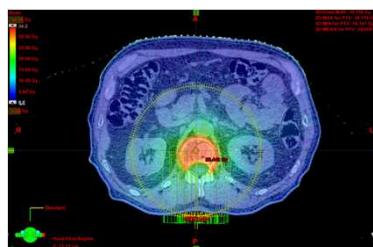
3





## waarom spinale SBRT ?

- \* lange levensverwachting/ oligoM+
  1. langdurige lokale controle en pijncontrole
  2. betere overleving?
- \* minder radiotherapiegevoelige tumoren
- \* herbestralingen



5



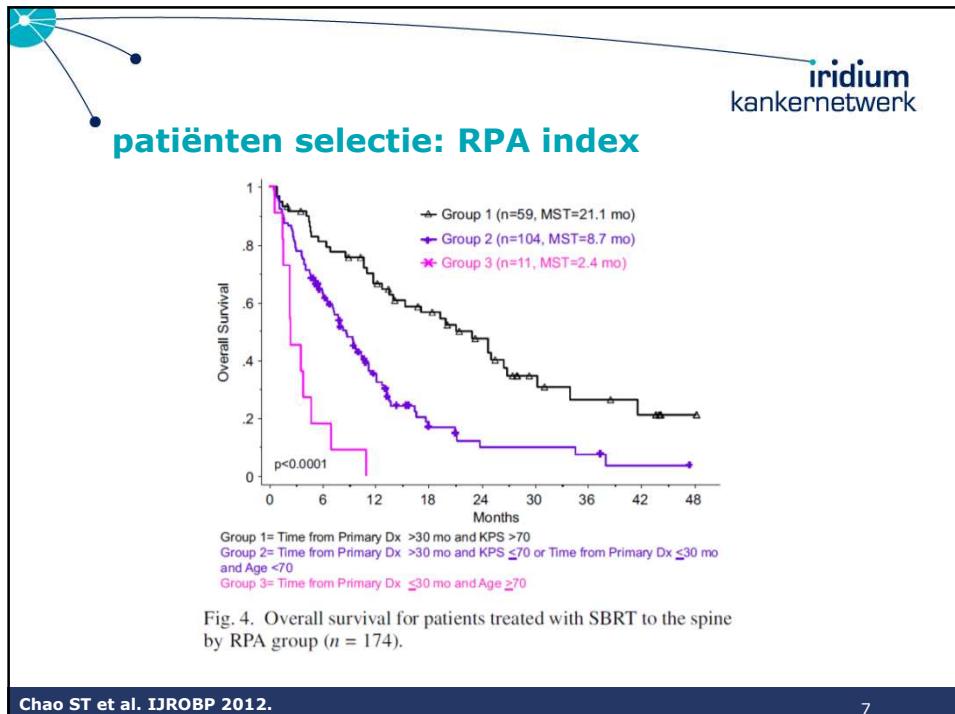
## patiënten selectie

factoren die overleving voorspellen

- algemene conditie
- leeftijd
- histologie
- viscerale M+
- aantal M+
- grootte M+
- ziekteverloop/-interval

Mizumoto M et al. Cancer 2008.

6



- 
- patiënten selectie: nationale richtlijnen**
- RPA index Classe I
    - diagnosis >30 maand en
    - Karnofsky ≥ 70
  - ≤3 wervels
  - massa ≤ 5 cm
  - myelumcompressie: ≥3 mm ruimte tss letsel en myelum
  - geen wervelinstabiliteit, vooraf bestaande fractuur, > 50% wervelindeuking
- Ost P et al. BJMO 2015.
- 8

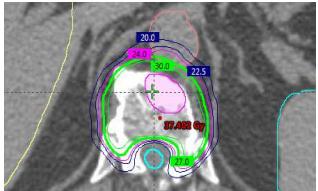
**houding:**



(a) (b) (c)

**Fig. 1.** Spine SBRT immobilization devices: (a) evacuated cushion, (b) vacuum body fixation device, and (c) thermoplastic S-frame mask.

- ruglig
- hoge rug/cervicaal: masker
- lage rug/lumbaal:
  - vacuüm kussen
  - semirigide fixatie

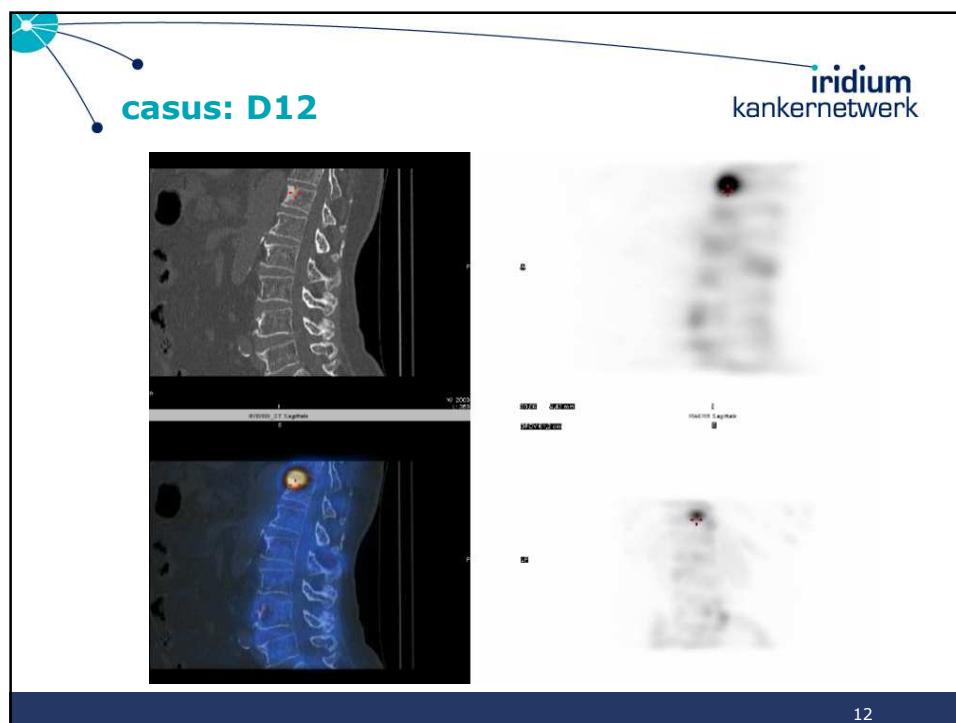
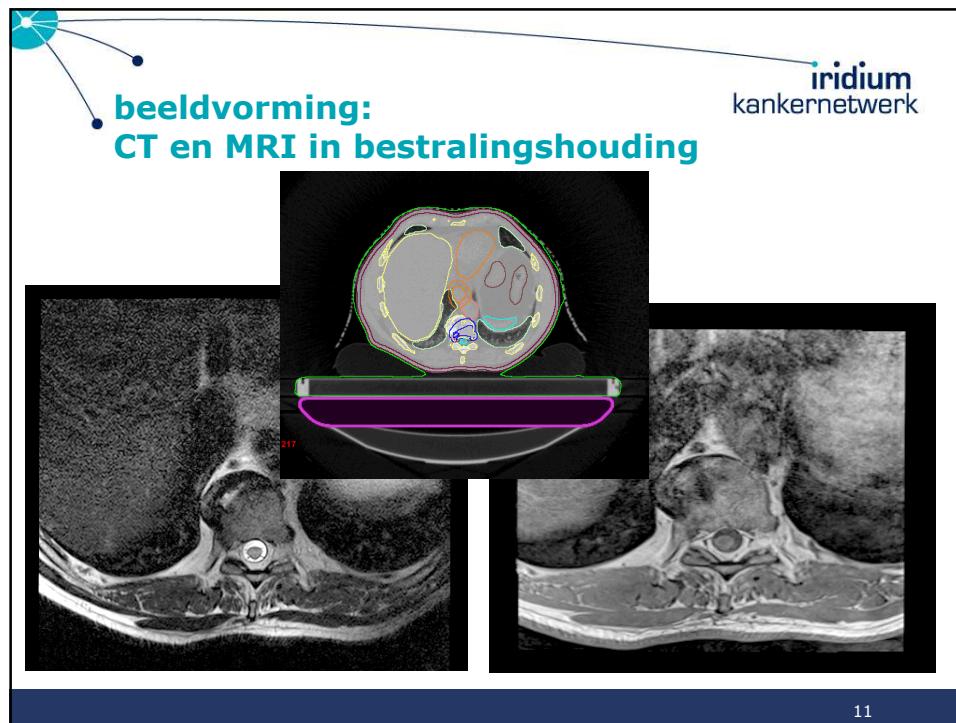


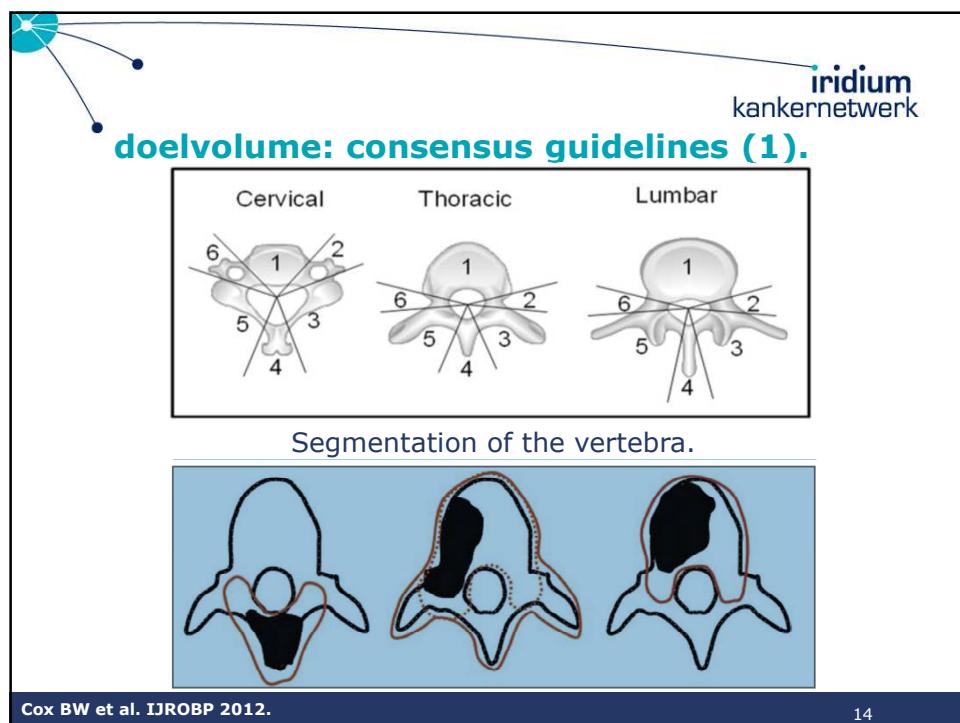
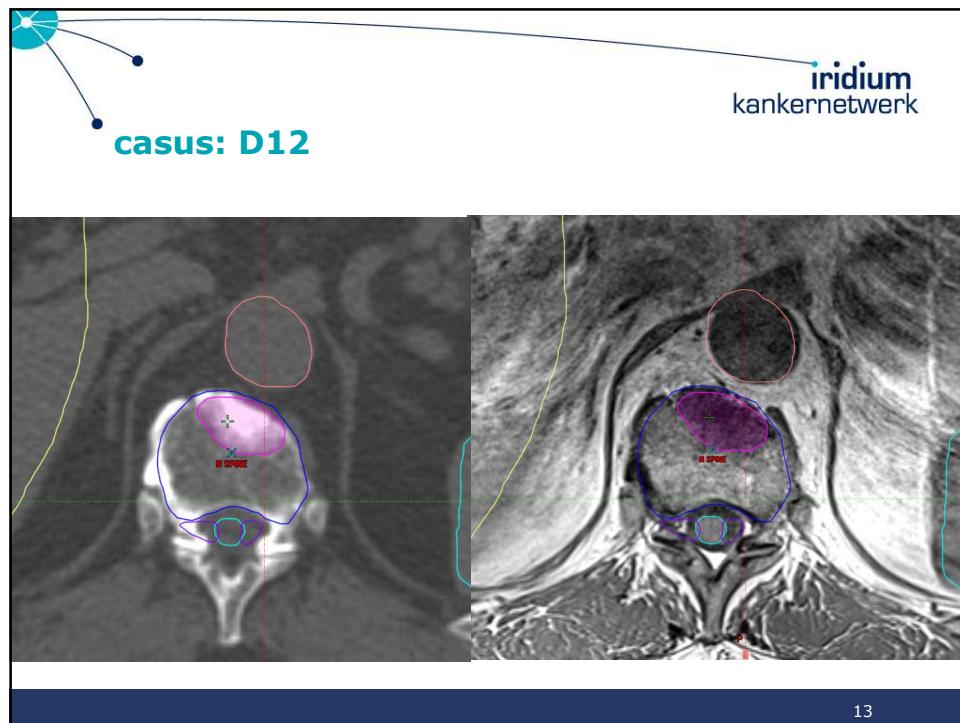
Li W et al. IJROBP 2011. 9

**houding:**




[www.iridiumkankernetwerk.be](http://www.iridiumkankernetwerk.be) 10





**doelvolume: consensus guidelines (2).**

**Table 3** Guidelines for spinal SRS bony CTV delineation

GTV involvement	ISRC GTV anatomic classification	ISRC bony CTV recommendation	CTV description
Any portion of the vertebral body	1	1	Include the entire vertebral body
Lateralized within the vertebral body	1	1, 2	Include the entire vertebral body and the ipsilateral pedicle/transverse process
Diffusely involves the vertebral body	1	1, 2, 6	Include the entire vertebral body and the bilateral pedicles/transverse processes
GTV involves vertebral body and unilateral pedicle	1, 2	1, 2, 3	Include entire vertebral body, pedicle, ipsilateral transverse process, and ipsilateral lamina
GTV involves vertebral body and bilateral pedicles/transverse processes	3	2, 3, 4	Include entire vertebral body, bilateral pedicles/transverse processes, and bilateral laminae
GTV involves unilateral pedicle	2	2, 3 ± 1	Include pedicle, ipsilateral transverse process, and ipsilateral lamina, ± vertebral body
GTV involves unilateral lamina	3	2, 3, 4	Include lamina, ipsilateral pedicle/transverse process, and spinous process
GTV involves spinous process	4	3, 4, 5	Include entire spinous process and bilateral laminae

*Abbreviations:* CTV = clinical target volume; GTV = gross tumor volume; ISRC = International Spine Radiosurgery Consortium.

doelvolume gebaseerd op aangetaste segmenten.

Cox BW et al. IJROBP 2012.

15

**doelvolume: PTV marge**

Antwerpen: PTV marge 3mm rond doelvolume (CTV).

16



**dosis & fractionatie**

	1 fraction	3 fractions	5 fractions
Suggested total dose range	16 - 20 Gy	21 - 30 Gy	25 - 30 Gy

Ost P et al. BJMO 2015.

**Iridium:**  
3x 10 Gy , 3x per week

- >90% PTV krijgt  $\geq 27$  Gy.
- dosisvoorschrift 80% isodose.
- mergdosis constraint heeft prioriteit
- eventueel onderdosage zo nodig

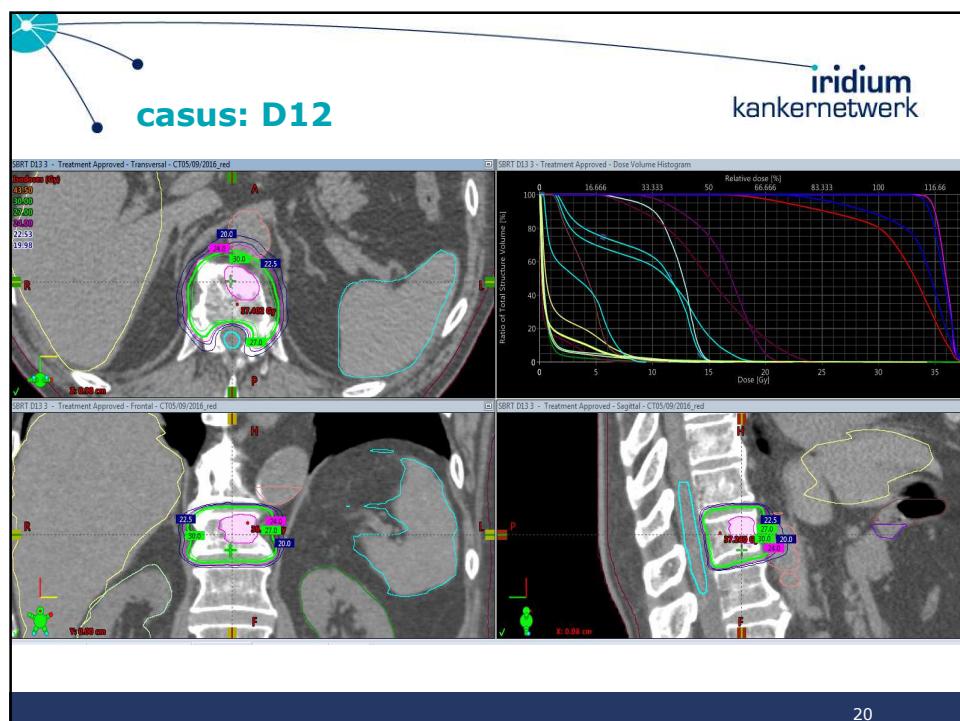
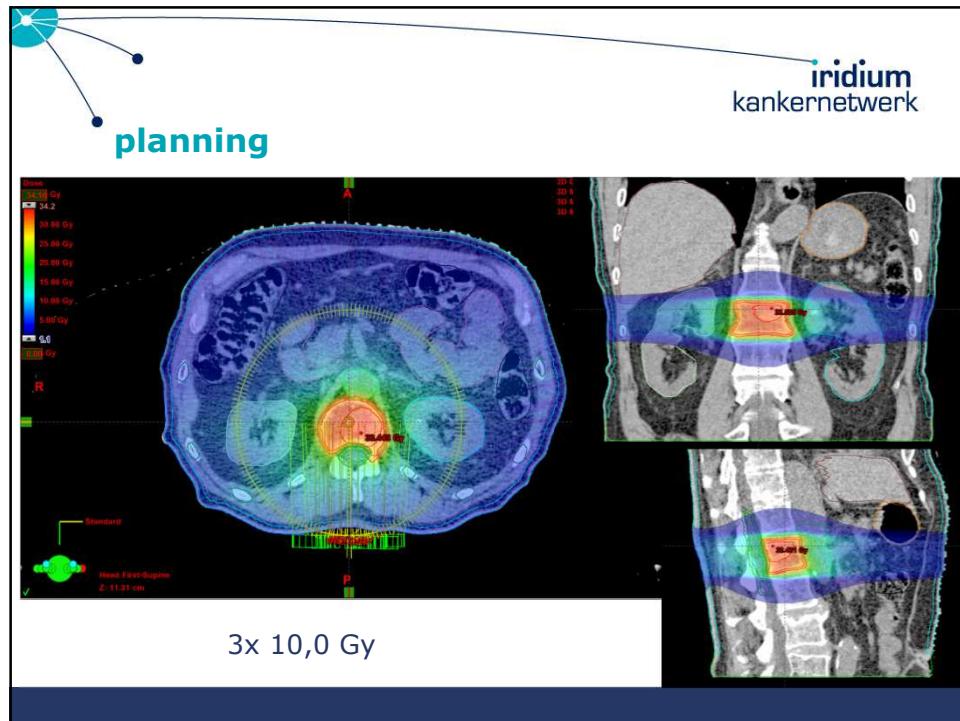
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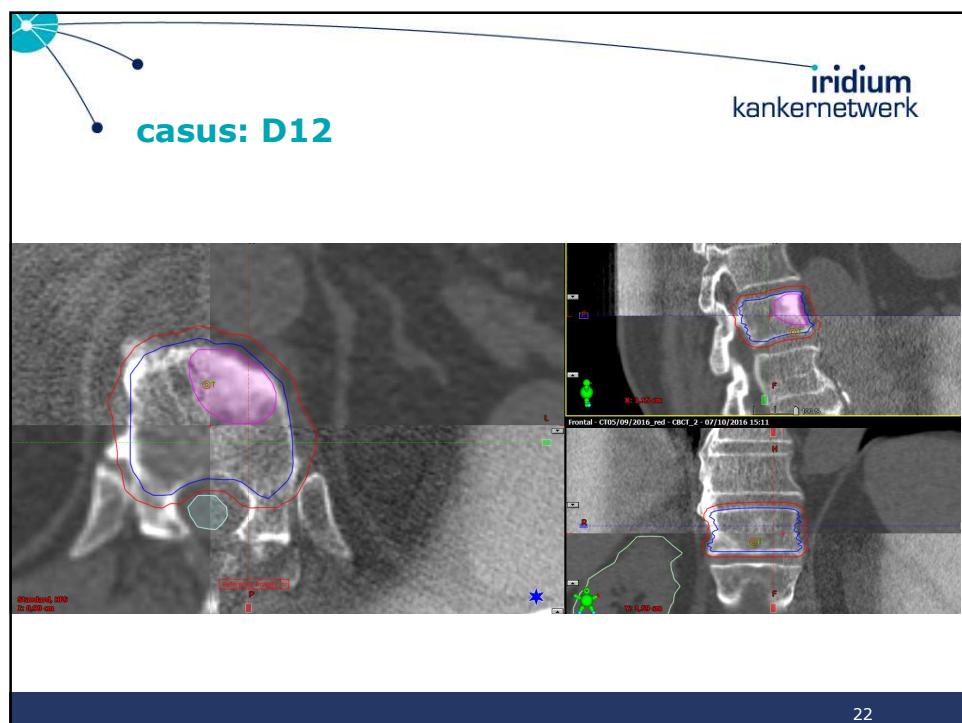
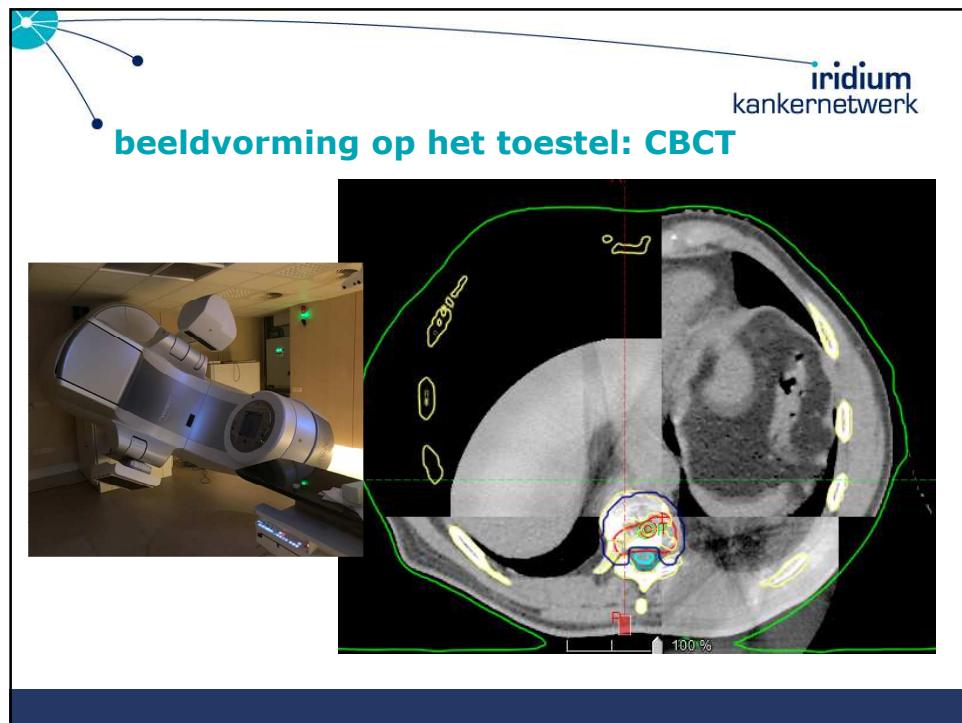


**OAR constraints**

Serial tissue	Max critical volume above threshold	One fraction		Three fractions		Five fractions	
		Threshold dose (Gy)	Max point dose (Gy)*	Threshold dose (Gy) / Max point dose (Gy)	Threshold dose (Gy)	Max point dose (Gy)	Threshold dose (Gy)
Optic pathways	< 0.2 cc	8	20	(20.0 L : 5 Gy/Hr)	22.4 L : 6 Gy/Hr	28 L : 5 Gy/Hr	30 L : 1 Gy/Hr
Cervix		3	10	18 L : 6 Gy/Hr	22.2 L : 6 Gy/Hr	28 L : 5 Gy/Hr	30 L : 1 Gy/Hr
Breast(s) (not involving)	< 0.5 cc	10	19	18 L : 6 Gy/Hr	22.2 L : 6 Gy/Hr	28 L : 5 Gy/Hr	30 L : 1 Gy/Hr
Spinal cord and medulla	< 0.5 cc	10	14	18 L : 6 Gy/Hr	22.2 L : 7 Gy/Hr	28 L : 5 Gy/Hr	30 L : 1 Gy/Hr
Spinal cord (subarachnoid)	< 1.2 cc	7	14	12.2 L : 6 Gy/Hr	17.2 L : 6 Gy/Hr	22.2 L : 7 Gy/Hr	28 L : 5 Gy/Hr
Spinal cord subarachnoid	< 1.0% cc	10	14	18 L : 6 Gy/Hr	22.2 L : 7 Gy/Hr	28 L : 5 Gy/Hr	30 L : 1 Gy/Hr
Cauda equina	< 5 cc	14	16	23.0 L : 7 Gy/Hr	24 L : 9 Gy/Hr	30 L : 6 Gy/Hr	32 L : 1 Gy/Hr
Spinal piaevs	< 5 cc	14.4	16	22.5 L : 8 Gy/Hr	24 L : 9 Gy/Hr	30 L : 6 Gy/Hr	32 L : 1 Gy/Hr
Esophagus*	< 5 cc	11.0	25.4	13.7 L : 6 Gy/Hr	25.2 L : 9 Gy/Hr	15.5 L : 4 Gy/Hr	25 L : 7 Gy/Hr
Brachial plexus	< 5 cc	14	17.5	20.6 L : 6 Gy/Hr	24 L : 9 Gy/Hr	27 L : 5 Gy/Hr	30.5 L : 1 Gy/Hr
Horn and periosteum	< 25 cc	16	22	24 L : 9 Gy/Hr	29 L : 12 Gy/Hr	32 L : 6 Gy/Hr	39 L : 1 Gy/Hr
Great vessels	< 200 cc	31	37	39 L : 13 Gy/Hr	49 L : 15 Gy/Hr	52 L : 9 Gy/Hr	58 L : 1.5 Gy/Hr
Trachea and large bronchi*	< 4 cc	10.0	20.2	15 L : 5 Gy/Hr	19 L : 10 Gy/Hr	16.5 L : 3 Gy/Hr	40 L : 1 Gy/Hr
Bronchi and smaller airways	< 0.5 cc	12.4	13.3	14.9 L : 6 Gy/Hr	23.1 L : 8 Gy/Hr	21.1 L : 4 Gy/Hr	32 L : 1 Gy/Hr
Kid	< 1.0 cc	22	30	24.8 L : 7 Gy/Hr	36.9 L : 12 Gy/Hr	35 L : 7 Gy/Hr	40 L : 1 Gy/Hr
Skin	< 300 cc	23	26	30 L : 10 Gy/Hr	39 L : 11 Gy/Hr	35.5 L : 7 Gy/Hr	35.5 L : 1 Gy/Hr
Stomach	< 300 cc	11.2	12.6	16.5 L : 6 Gy/Hr	22.2 L : 7 Gy/Hr	38 L : 4 Gy/Hr	38 L : 1 Gy/Hr
Esophagus*	< 5 cc	11.2	12.6	16.5 L : 6 Gy/Hr	22.2 L : 7 Gy/Hr	38 L : 4 Gy/Hr	38 L : 1 Gy/Hr
Esophagus (lumen)	< 0.5 cc	11.2	12.6	16.5 L : 6 Gy/Hr	22.2 L : 7 Gy/Hr	38 L : 4 Gy/Hr	38 L : 1 Gy/Hr
Esophagus (lumen)*	< 5 cc	11.0	12.6	17.2 L : 6 Gy/Hr	23.2 L : 7 Gy/Hr	35.5 L : 4 Gy/Hr	38 L : 1 Gy/Hr
Esophagus (lumen)	< 0.5 cc	11.0	12.6	17.2 L : 6 Gy/Hr	23.2 L : 7 Gy/Hr	35.5 L : 4 Gy/Hr	38 L : 1 Gy/Hr
Esophagus (lumen)*	< 5 cc	11.0	12.6	17.2 L : 6 Gy/Hr	23.2 L : 7 Gy/Hr	35.5 L : 4 Gy/Hr	38 L : 1 Gy/Hr
Colon*	< 30 cc	14.0	16.4	24 L : 8 Gy/Hr	36.2 L : 10 Gy/Hr	36 L : 5 Gy/Hr	38 L : 1 Gy/Hr
Rectum (sigmoid)*	< 30 cc	14.0	16.4	24 L : 8 Gy/Hr	36.2 L : 10 Gy/Hr	36 L : 5 Gy/Hr	38 L : 1 Gy/Hr
Bladder + prostate + rectal	< 10 cc	11.0	16.4	16.8 L : 6 Gy/Hr	36.2 L : 10 Gy/Hr	18.2 L : 4 Gy/Hr	38 L : 1 Gy/Hr
Penis bulb	< 5 cc	14	16	21.0 L : 7 Gy/Hr	42 L : 14 Gy/Hr	30 L : 6 Gy/Hr	50 L : 10 Gy/Hr
Penile heads (left and right)	< 10 cc	14	16	21.0 L : 7 Gy/Hr	42 L : 14 Gy/Hr	30 L : 6 Gy/Hr	50 L : 10 Gy/Hr
Renal hilum / vascular trunk	< 2/3 volume	10.0	18.6			22 L : 5 Gy/Hr	

\* Point defined as 0.005 cc or less  
Actual dose/fractionation not indicated





**resultaten**

iridium  
kankernetwerk

Study	# Pat / Tx	FU (months)	SBRT Dose	Local control
Ryu 2004 Henry Ford Hospital	49 / 61	6 – 24	1 x 10-16Gy	84% @ 1a
Gerszten 2007 Pittsburgh	49 / 65	Median 21	1 x 12.5 - 25Gy	90%
Chang 2007 M. D. Anderson	38 / -	Median 21	6 x 5Gy, 3 x 9Gy	84% @ 1a
Yamada 2008 MSKCC	93 / 103	Median 15	1 x 18 – 24Gy	90% @ 2a
Guckenberger 2009 Würzburg	14 / 16	Median 17	20 x 3Gy	89% @ 2a
Sahgal 2009 PMH / Stanford	14 / 23	Median 9	3 x 8Gy	78%
<b>80-90%</b>				

Slide courtesy of prof. dr. M. Guckenberger (UK Würzburg).

23

**toxiciteit: radiatie myelopathie**

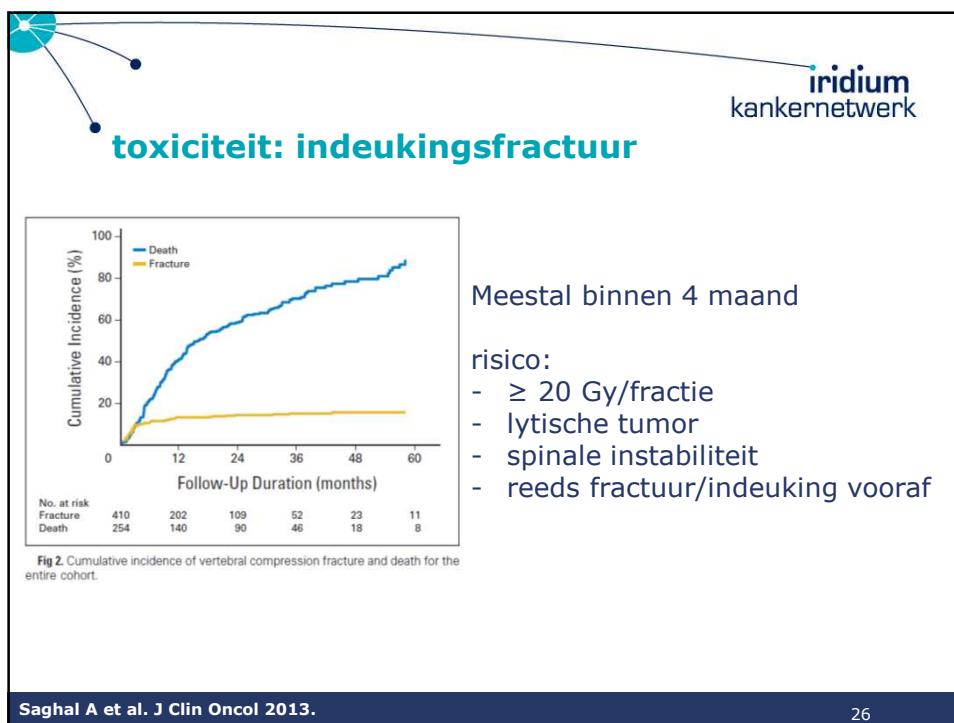
iridium  
kankernetwerk

Predicted Prob.

Dose (Gy<sub>2/2</sub>)

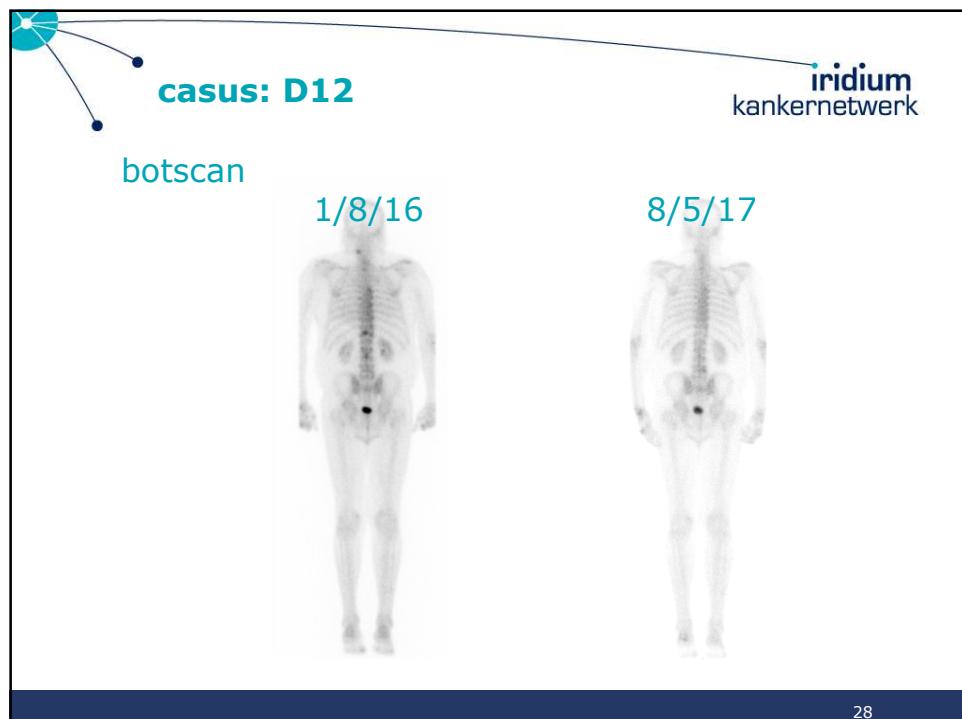
Saghala et al. IJROBP 2013.

24

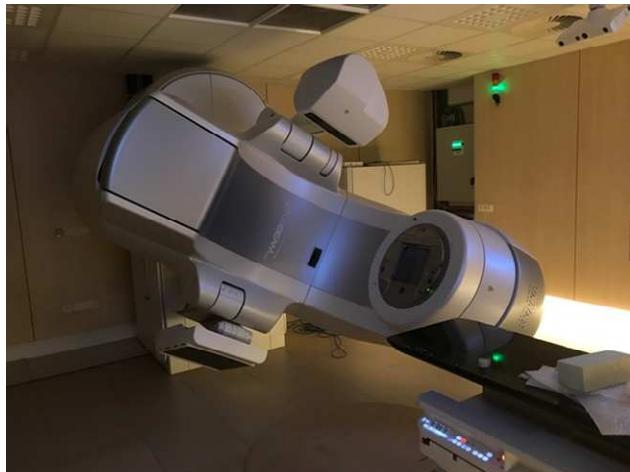




Primary	Interval	Solitary	Systemic R/	Location	Start	Dose	FUP	LC	DFS
prostate	synchronous	yes	ADT	D7	9/03/2015	7	23m	0	1
prostate	70m	yes	no	D9	11/06/2015	8	17m	0	1
prostate	14m	yes	ADT	L2	29/12/2015	9	13m	0	1
prostate	115m	yes	ADT	D9	29/12/2015	9	9m	0	0
prostate	synchronous	yes	ADT	L1	4/04/2016	8	6m	0	0
prostate	46m	yes	no	D2	19/04/2016	8	10m	0	0
thyroid	18m	oligo	no	S1	12/05/2016	8	9m	0	0
rectum	55m	yes	no	D8	4/07/2016	9	7m	0	1
prostate	synchronous	yes	ADT	D10	11/07/2016	8	5m	0	0
prostate	92m	yes	ADT	D2	13/07/2016	8	7m	0	1
breast	synchronous	yes	Tamoplex	L4	3/08/2016	9	6m	0	0
prostate	84m	yes	ADT	D12	3/10/2016	10	4m	0	0
prostate	78m	yes	ADT	L5	7/10/2016	10	3m	0	0
NPC	synchronous	oligo	no	L4	24/10/2016	9	3m	0	1
prostate	108m	yes	no	L5	15/11/2016	5,85	3m	0	0
prostate	synchronous	yes	ADT	L3	5/12/2016	9	2m	0	
prostate	synchronous	yes	ADT	L3	15/12/2016	9	1m		
prostate	synchronous	oligo	ADT	D10	23/12/2016	9	2m	0	
breast	170m	yes	AI	L3	6/01/2017	9	1m		
prostate	16m	oligo	ADT	D11	23/01/2017	9	1m		



True Beam STx (URANUS).



iridium  
kankernetwerk

29

conclusies SBRT spine

- goede lokale controle ( $\geq 80\%$ ) en pijnstilling.
- effect op overleving bij oligoM+?
- lage toxiciteit
- patiënten selecteren!
- kwaliteitscontrole radiotherapie belangrijk!

30

dank u!

- Radiation Oncology department:
  - Piet Dirix
  - Evy Bossuyt MSc
  - Lieselotte Depuydt MSc
- Radiology department:
  - Filip Deckers MD
  - Walter Van Rompaey MD
- UZ Leuven:
  - Ann Nulens MSC
  - Karen Van Beek MD

31