



Definição do Volume Alvo e considerações para os físicos no planejamento de SBRT / Radiocirurgia de metástase óssea em vértebra

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REALIZAÇÃO



SBRT
SOCIEDADE BRASILEIRA
DE RADIOTERAPIA

GERENCIAMENTO



AGÊNCIA OFICIAL



Declaração de Conflito de Interesse

Sem conflito de interesse

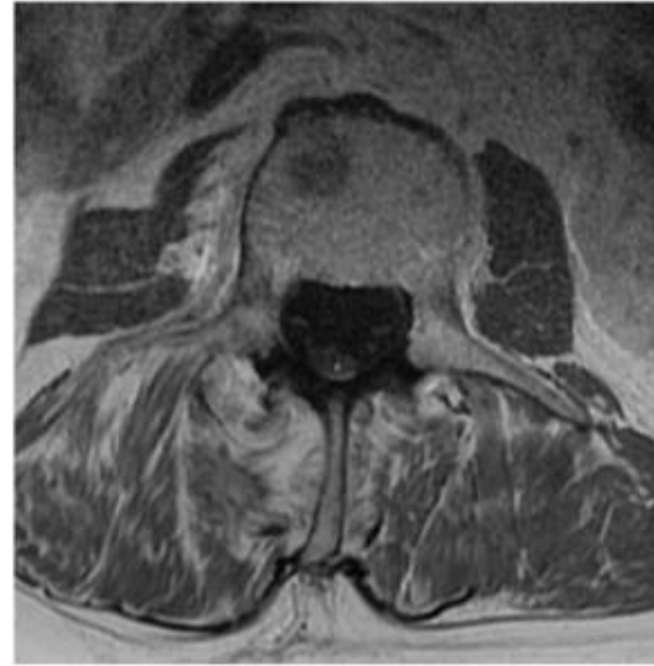
Exigência da RDC Nº 96/08 da ANVISA



Painel

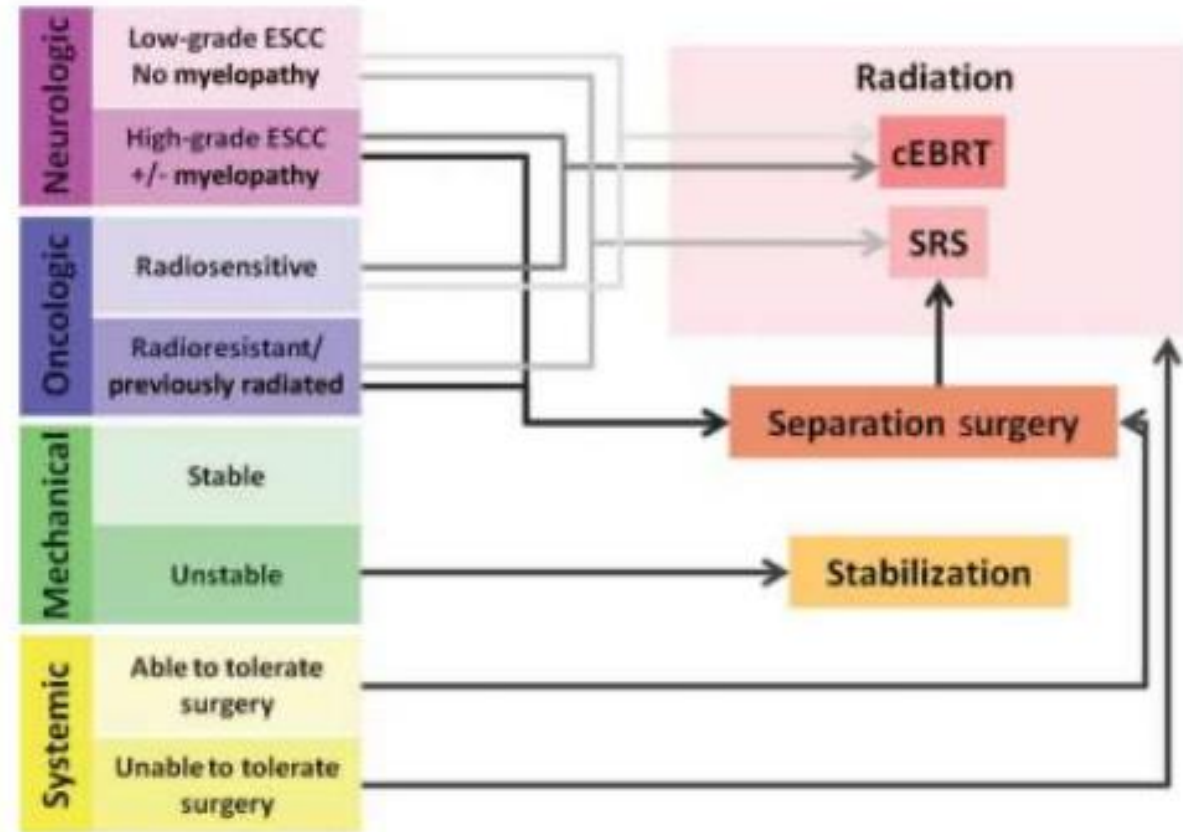
1. Indicação, classificações
2. Resultados
3. Contornos
4. Avaliação de plano
5. OAR/ Toxicidades

Como indicar?



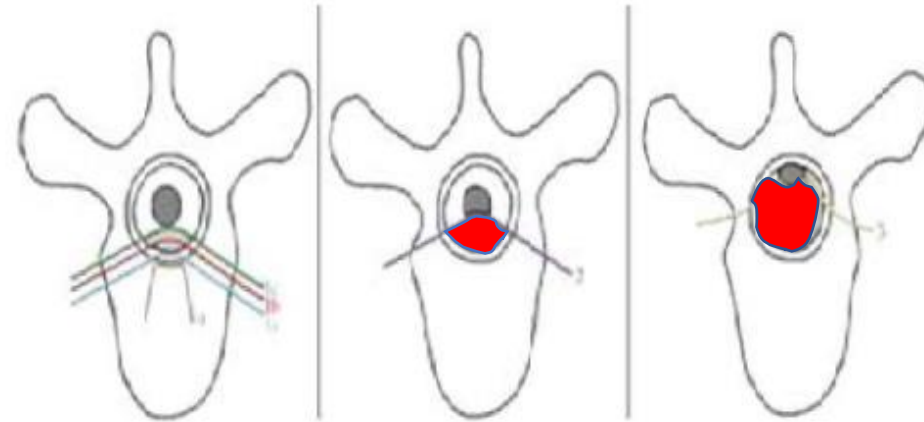
NOMS – Framework de Avaliação

- Neurológico
- Oncológico
- Mecânico
- Sistêmico

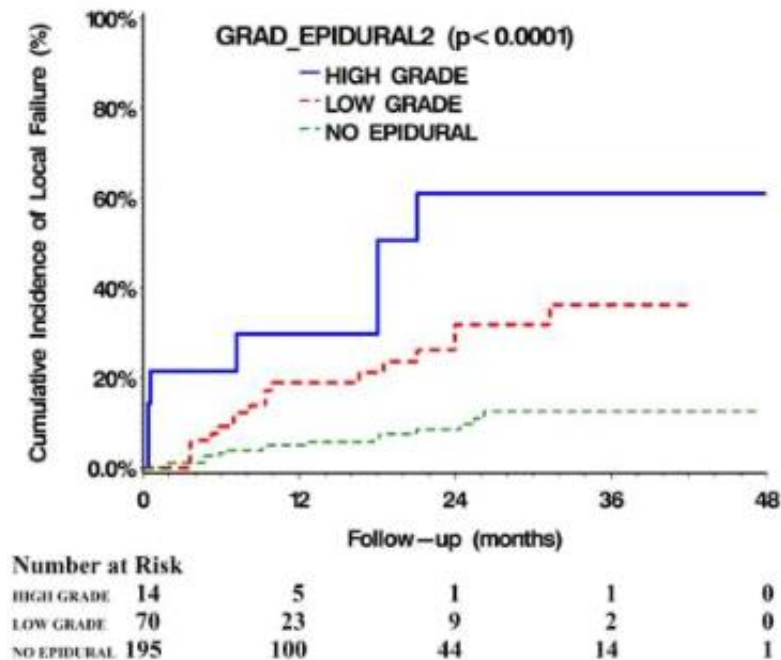


(N) Bilsky – Graduação Epidural

Bilsky Grade	Description
0	No epidural disease
1a	Epidural impinging the thecal sac but without deformation
1b	Epidural disease deforming the thecal sac but not the spinal cord
1c	Epidural disease deforming the thecal sac and spinal cord contact
2	Epidural spinal cord compression with CSF visible
3	Epidural spinal cord compression and no CSF visible



(N) Extensão Dç epidural – Controle Local

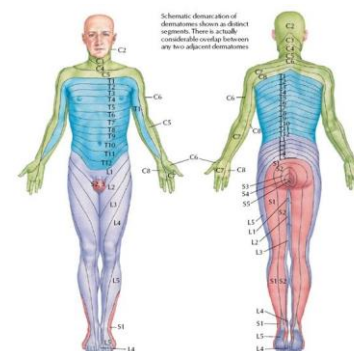


24Gy em 2fx

ASIA – American Spinal Injury Association Impairmeny Scale

Quadro II — Classificação da ASIA

Grau	Descrição
A	Completo: ausência de função sensitiva e motora, inclusive nos segmentos sacrais S ₄ -S ₅
B	Incompleto: função sensitiva preservada e ausência de função motora abaixo do nível neurológico, inclusive nos segmentos sacrais S ₄ -S ₅
C	Incompleto: função motora preservada abaixo do nível da lesão e mais da metade dos músculos abaixo do nível neurológico tem grau de função motora inferior a 3
D	Incompleto: função motora preservada abaixo do nível da lesão e pelo menos metade dos músculos abaixo do nível neurológico tem grau de função motora igual ou superior a 3
E	Normal: função motora e sensitiva normais



Classificação de Frankel

- Frankel A: lesão sensitiva e motora completa distal ao nível da lesão;
- Frankel B: paralisia motora completa, com alguma sensibilidade preservada distal ao nível da lesão;
- Frankel C: presença de alguma força motora, porém sem função prática;
- Frankel D: força motora efetiva distal ao nível de lesão, porém com algum grau de deficiência.
- Frankel E: o paciente não tem alterações neurológicas.

MUSCLE GRADING

- 0 total paralysis
- 1 palpable or visible contraction
- 2 active movement, full range of motion, gravity eliminated
- 3 active movement, full range of motion, against gravity
- 4 active movement, full range of motion, against gravity and provides some resistance
- 5 active movement, full range of motion, against gravity and provides normal resistance
- 5* muscle able to exert, in examiner's judgement, sufficient resistance to be considered normal if identifiable inhibiting factors were not present

NT not testable. Patient unable to reliably exert effort or muscle unavailable for testing due to factors such as immobilization, pain on effort or contraction.

ASIA IMPAIRMENT SCALE

- ☐ **A = Complete:** No motor or sensory function is preserved in the sacral segments S4-S5.
- ☐ **B = Incomplete:** Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-S5.
- ☐ **C = Incomplete:** Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3.
- ☐ **D = Incomplete:** Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more.
- ☐ **E = Normal:** Motor and sensory function are normal.

CLINICAL SYNDROMES (OPTIONAL)

- ☐ Central Cord
☐ Brown-Sequard
☐ Anterior Cord
☐ Conus Medullaris
☐ Cauda Equina

STEPS IN CLASSIFICATION

The following order is recommended in determining the classification of individuals with SCI.

1. Determine sensory levels for right and left sides.
2. Determine motor levels for right and left sides.
Note: In regions where there is no myotome to test, the motor level is presumed to be the same as the sensory level.
3. Determine the single neurological level.
This is the lowest segment where motor and sensory function is normal on both sides, and is the most cephalad of the sensory and motor levels determined in steps 1 and 2.
4. Determine whether the injury is Complete or Incomplete (sacral sparing).
If voluntary anal contraction = No AND all S4-S5 sensory scores = 0 AND any anal sensation = No, then injury is COMPLETE. Otherwise injury is incomplete.
5. Determine ASIA Impairment Scale (AIS) Grade:
 Is injury Complete? If YES, AIS=A Record ZPP (For ZPP record lowest dermatome or myotome on each side with some (non-zero score) preservation)
 Is injury motor incomplete? If NO, AIS=B (Yes=voluntary anal contraction OK motor function more than three levels below the motor level on a given side.)
 Are at least half of the key muscles below the (single) neurological level graded 3 or better?
 NO → AIS=C YES → AIS=D

If sensation and motor function is normal in all segments, AIS=E

Note: AIS E is used in follow up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.

STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

ISCOS

Date/Time of Exam _____

MOTOR

KEY MUSCLES (scoring on reverse side)

C5	☐	☐	Elbow flexors
C6	☐	☐	Wrist extensors
C7	☐	☐	Elbow extensors
C8	☐	☐	Finger flexors (distal phalanx of middle finger)
T1	☐	☐	Finger abductors (little finger)

UPPER LIMB TOTAL (MAXIMUM) ☐ + ☐ = (25) (25) (50)

Comments:

L2	☐	☐	Hip flexors
L3	☐	☐	Knee extensors
L4	☐	☐	Ankle dorsiflexors
L5	☐	☐	Long toe extensors
S1	☐	☐	Ankle plantar flexors

LOWER LIMB TOTAL (MAXIMUM) ☐ + ☐ = (25) (25) (50)

SENSORY

KEY SENSORY POINTS

0 = absent
1 = impaired
2 = normal
NT = not testable

Any anal sensation (Yes/No) ☐ ☐

PIN PRICK SCORE (max: 112)
 LIGHT TOUCH SCORE (max: 112)

NEUROLOGICAL LEVEL:
 The most caudal segment with normal function

COMPLETE OR INCOMPLETE? ☐
 Incomplete = Any sensory or motor function in S4-S5

ASIA IMPAIRMENT SCALE:

ZONE OF PARTIAL PRESERVATION:
 Caudal extent of partially innervated segments

SENSORY MOTOR:

R	L
SENSORY	SENSORY
MOTOR	MOTOR

• Key Sensory Points

(O) Radio Sensibilidad

Study	Lymphoma, Seminoma, Myeloma	Breast	Prostate	Sarcoma	Melanoma	Gastrointestinal	NSCLC	Renal
Gilbert <i>et al</i> ¹⁰³	F	U	U	U	U	U	U	U
Maranzano <i>et al</i> ⁷⁹	F	F	F	U	U	U	U	U
Rades <i>et al</i> ^{20,43}	F	I	I	I	U	I	U	I
Rades <i>et al</i> ⁵⁸	F	F	F	U	U	U	U	U
Katagiri <i>et al</i> ⁴⁹	F	F	F	U	U	U	U	U
Maranzano <i>et al</i> ²²	F	F	F	U	U	U	U	U
Rades <i>et al</i> ²³	F	I	I	I	U	I	U	I

F indicates favorable; I, intermediate; U, unfavorable.



Controle Local por Histologia

	<u>Pain control</u>	<u>Imaging</u>
RCC (n=93)	94%	87%
Breast (n=83)	96%	100%
Lung (n=80)	93%	100%
Melanoma (n=38)	96%	75%

(M) - Estabilidade

Spinal Instability in Neoplastic Disease Score (SINS)

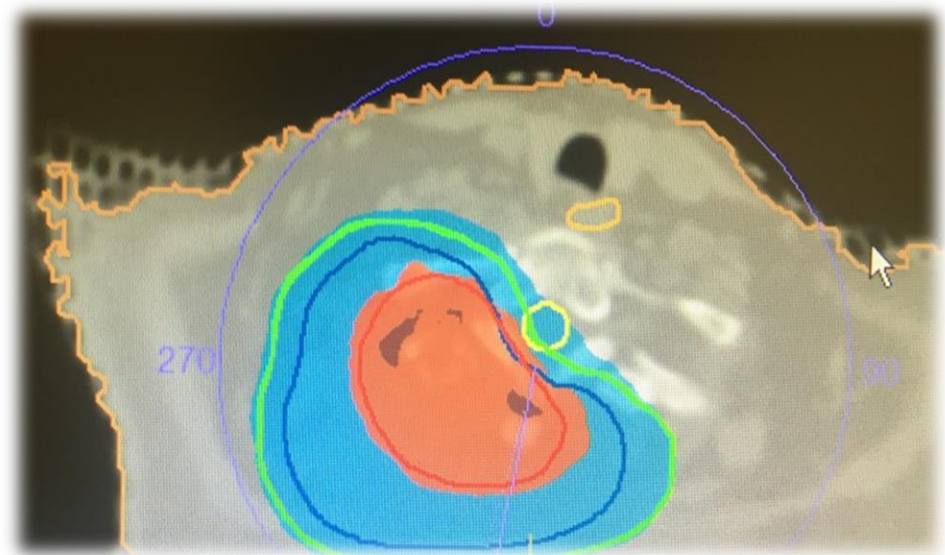
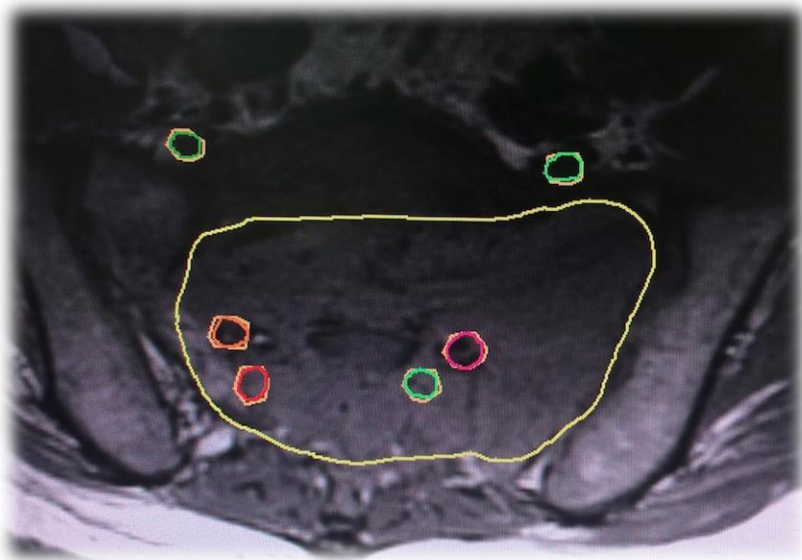
Element of SINS	Score
Location	
Junctional (occiput-C2, C7-T2, T11-L1, L5-S1)	3
Mobile spine (C3-C6, L2-L4)	2
Semi-rigid (T3-T10)	1
Rigid (S2-S5)	0
Pain relief with recumbency and/or pain with movement/loading of the spine	
Yes	3
No (occasional pain but not mechanical)	1
Pain free lesion	0
Bone lesion	
Lytic	2
Mixed (lytic/blastic)	1
Blastic	0
Radiographic spinal alignment	
Subluxation/translation present	4
De novo deformity (kyphosis/scoliosis)	2
Normal alignment	0
Vertebral body collapse	
>50% collapse	3
<50% collapse	2
No collapse with >50% body involved	1
None of the above	0
Posterolateral involvement of the spinal elements (facet, pedicle or CV joint fracture or replacement with tumor)	
Bilateral	3
Unilateral	1
None of the above	0

- **Estável: 0-6**
- **Potencialmente Instável: 7-12**
- **Instável: >12**

(S) Doença Sistêmica

- Manejo adequado depende do prognóstico e sobrevida estimada
 - Biologia tumoral
 - Extensão da doença
 - Comorbidades
 - Terapias sistêmicas disponíveis

Funciona?



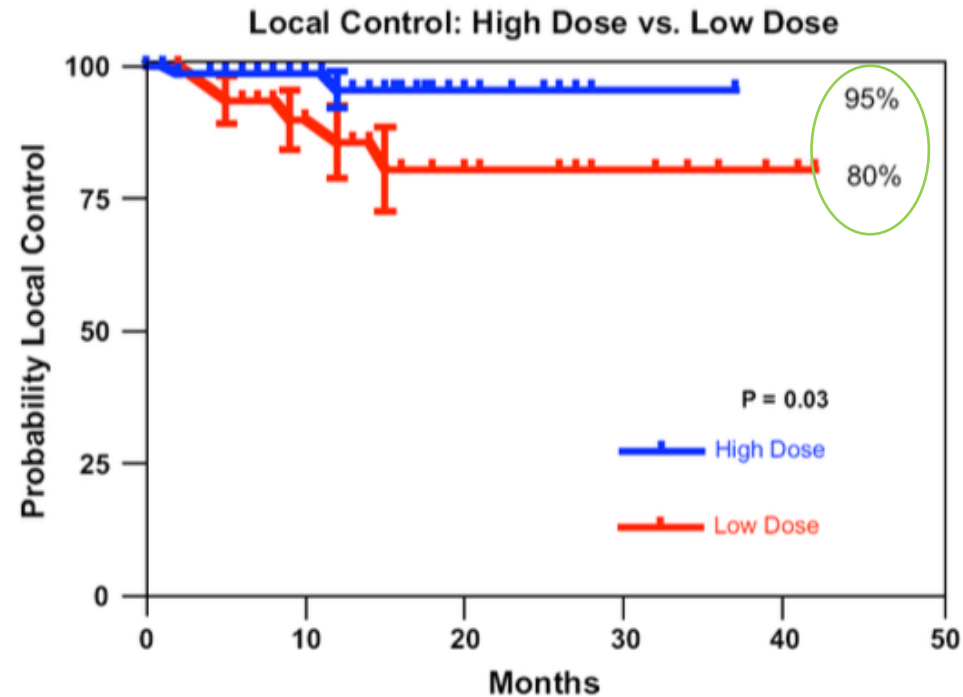
Cirurgia → RT Externa (paliativa)

- 101 pctes/106 metástases
- Cirurgia (agressiva):
 - Parcial (48%) ou completa (43%)
 - EBRT adjuvante 100%
 - Controle local:
 - 40% 6 meses
 - 30% 1 ano
 - 4% 4 anos
 - Preditor de recorrência: Histologia



SBAR - Dose e Controle Local - MSKCC

n=103
2003-2006
18-24 Gy x 1

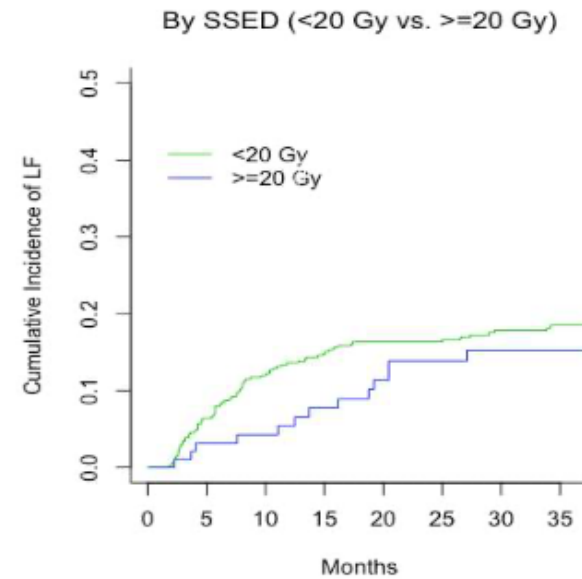
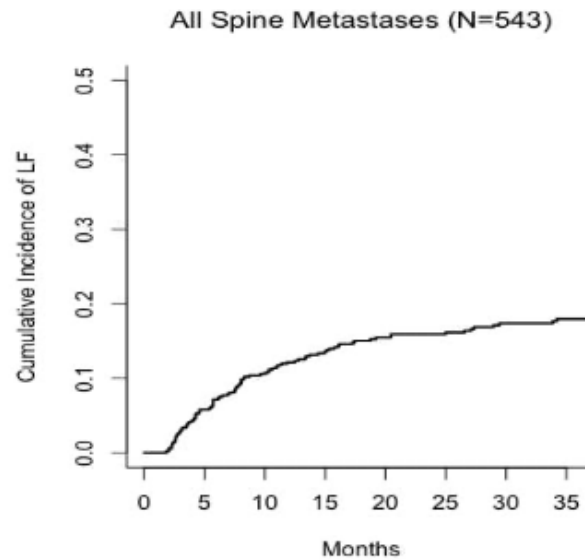


24 Gy
<24 Gy

SBAR - Dose e Controle Local - Stanford

- Stanford
- n=543 lesions

Local Failure	Overall	<20 Gy	≥20 Gy
1 Year	12%	14%	5%

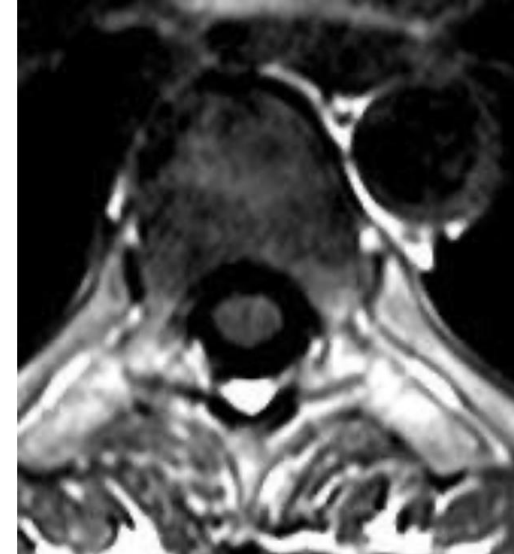


SBAR - Dose e Controle Local

- MDACC n=332 1 year LC **88%**
- Sunnybrook n=279 1 year LC **90%**

SABR - Controle Local Grandes Massas

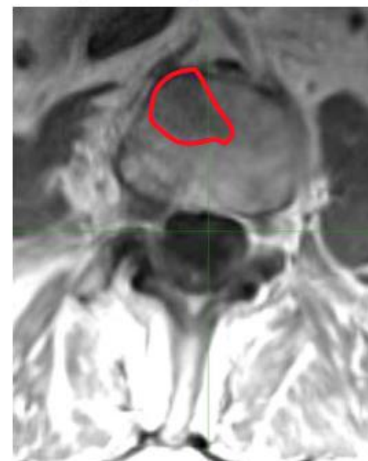
- 1 year LC: 45.7% vs. 86.3%
- 2 year LC: 38.9% vs. 75.9%



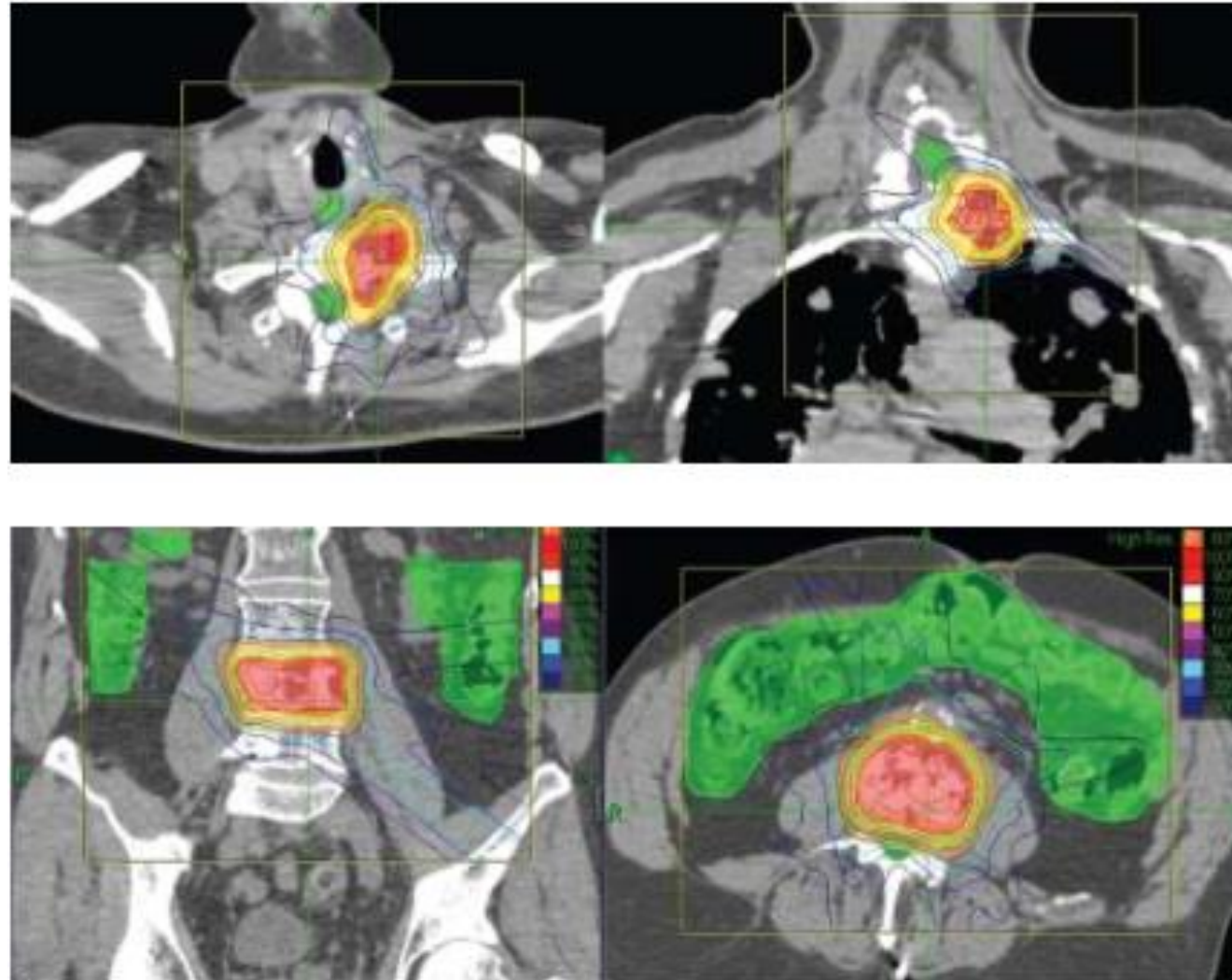
SBAR - Revisão Sistemática

- ISRS Systematic Review
- 14 articles 1024 spinal lesions
- Median OS: 15-19 months
- Local Control: **85-90% at 1 year**
- Complete pain response (only 3 studies): ~50%
- Vertebral Compression Fracture: 9%

Como fazer?



Vértebra toda vs parcial?

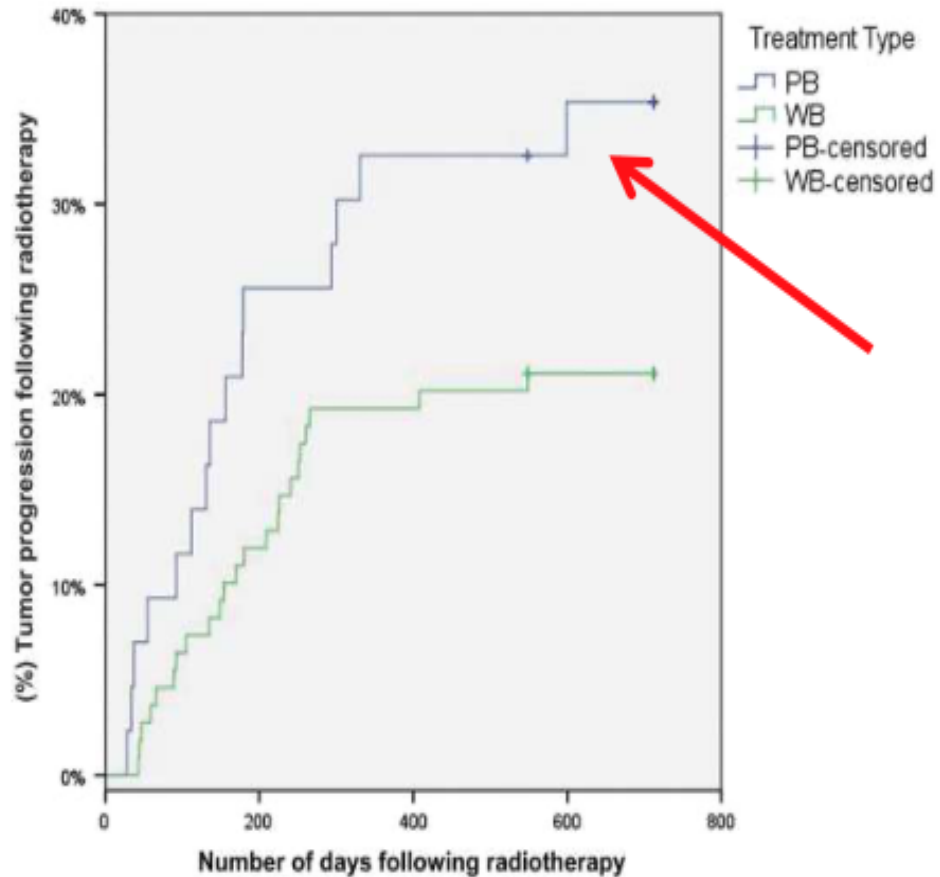


Diferenças históricas – Pré Consenso

Table 1 Differences between centers and the definition used by the Radiation Therapy Oncology Group (RTOG) phase II/III sSBRT trial (RTOG 0631)

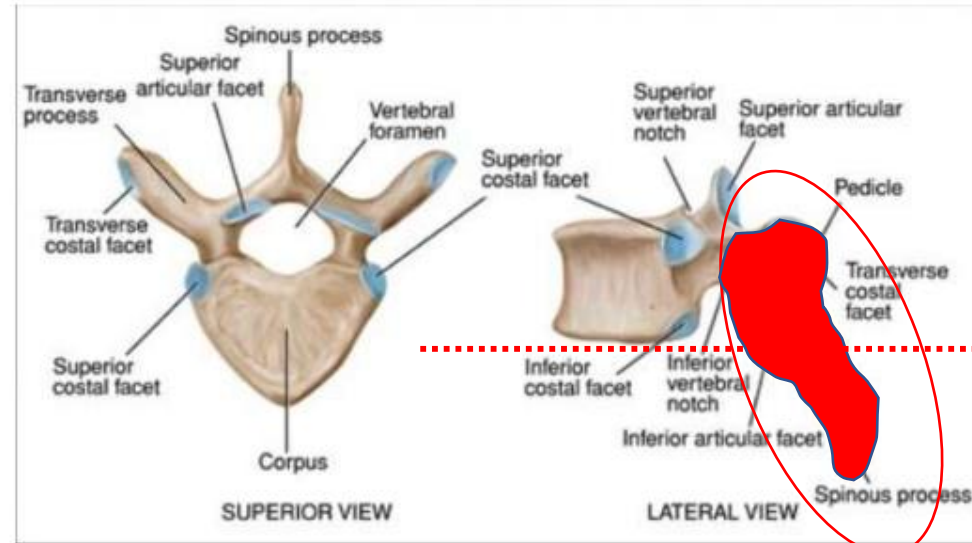
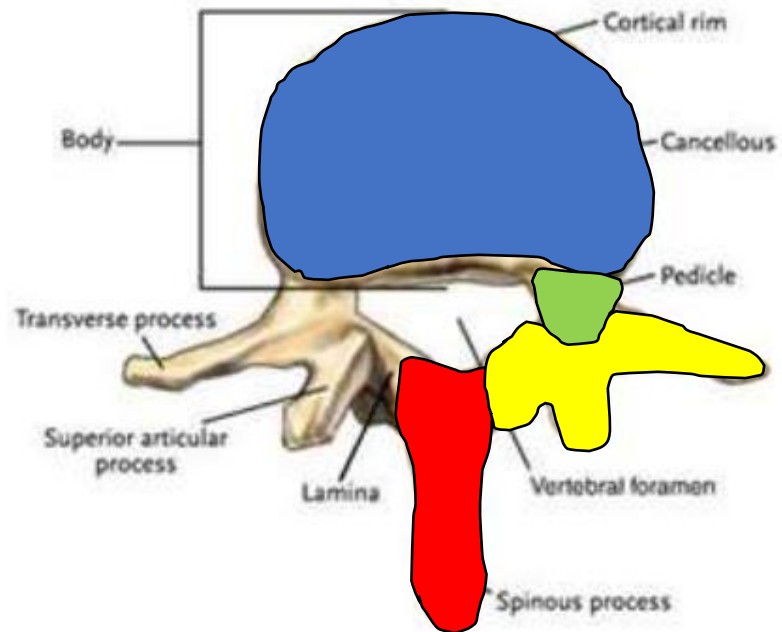
Institution	Imaging modality	Treatment unit	Planning target volume definition
Henry Ford Hospital [16]	CT/MRI fusion	Novalis (BrainLab)	Entire involved spinal segment + gross epidural/paraspinal disease
University of Heidelberg, Germany [38]	CT/MRI fusion	6/15-MV linear accelerator (Siemens)	GTV + entire vertebral body
University of Florida [21]	CT/MRI fusion	Synergy-S (Elekta)	GTV + 10-mm bone margin $\pm$ 2-mm extension beyond the bone cortex if GTV is close to the bone surface. No margins added to epidural disease GTV
RTOG 0631 [39]	CT/MRI fusion	Various	GTV $\pm$ vertebral body $\pm$ right and left pedicles (depending on GTV location)
Cleveland Clinic [23]	CT/MRI fusion	Novalis (BrainLab)	GTV $\pm$ vertebral body $\pm$ right and left pedicles (depending on GTV location)
MDACC [17]	CT	EXaCT Targeting System (Varian)	GTV + entire vertebral body + potential areas of spinal extension
MSKCC [40]	CT	EXaCT Targeting System (Varian)	GTV + 10-mm expansion except at the cord
UPMC [14]	CT	CyberKnife	GTV
Stanford [15]	CT	CyberKnife	Target lesion + 2-mm margin
UCSF [13]	CT	CyberKnife	GTV

Vértebra toda vs parcial?



**Maior controle local
Tratando todo o corpo
vertebral**

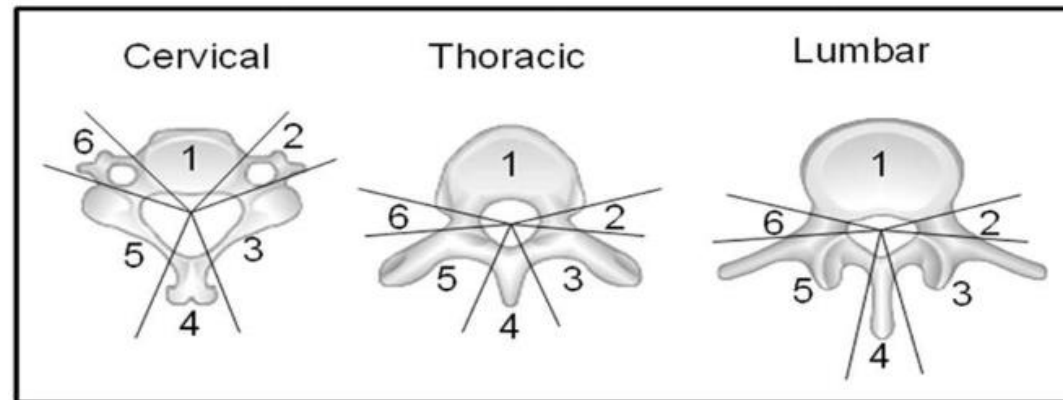
Anatomy



Consórcio Internacional de SBRT

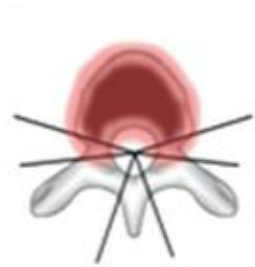
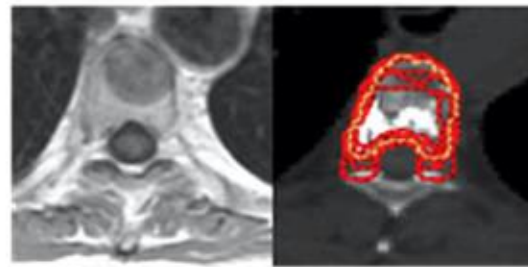
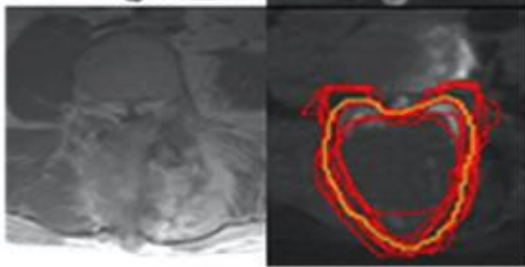
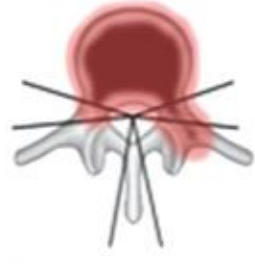
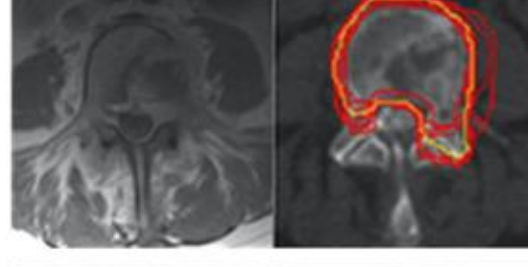
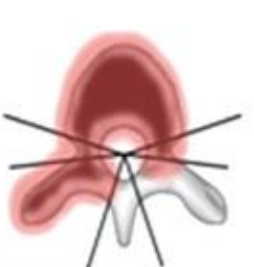
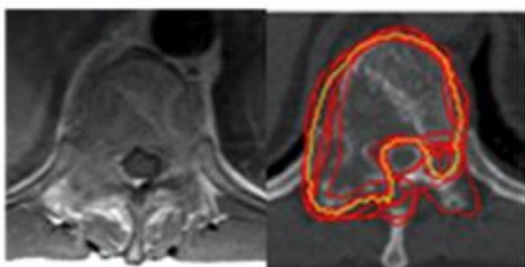
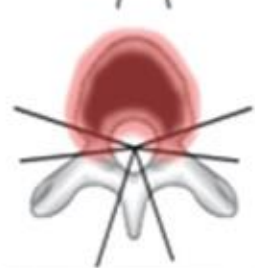
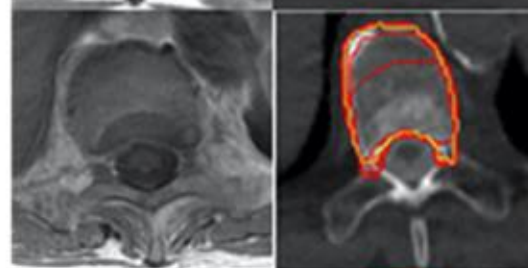
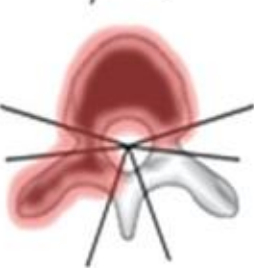
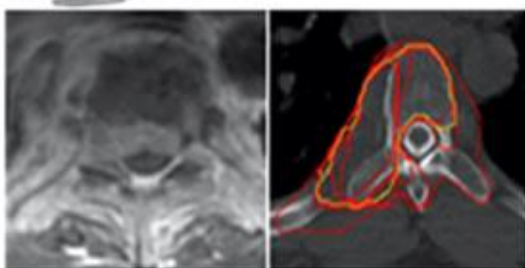
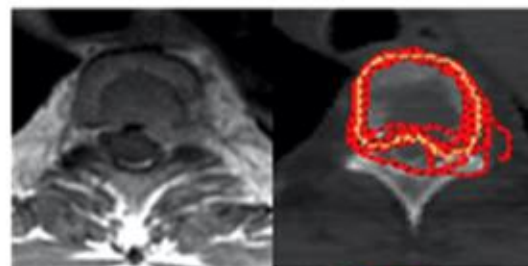
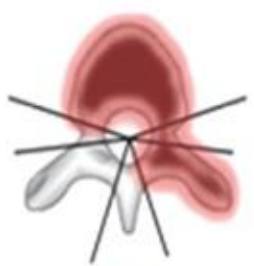
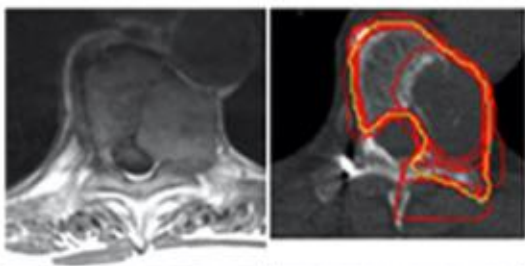
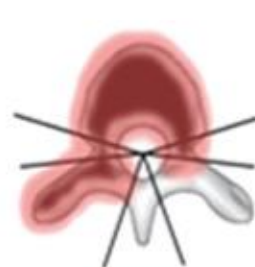
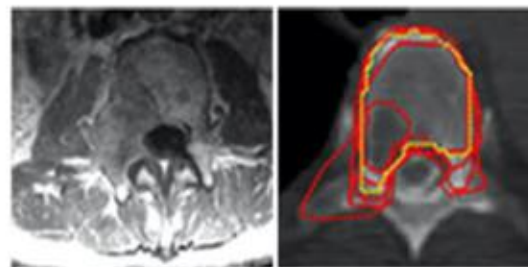
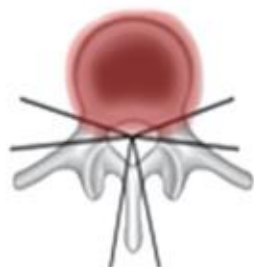
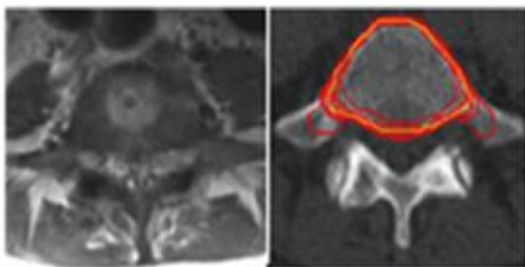
International Spine Radiosurgery Consortium Consensus Guidelines for Target Volume Definition in Spinal Stereotactic Radiosurgery

Brett W. Cox, MD,^{*,1} Daniel E. Spratt, MD,^{*,1} Michael Lovelock, PhD,[†]
Mark H. Bilsky, MD,[‡] Eric Lis, MD,[§] Samuel Ryu, MD,^{||} Jason Sheehan, MD,[¶]
Peter C. Gerszten, MD, MPH,^{**} Eric Chang, MD,^{††} Iris Gibbs, MD,^{‡‡} Scott Soltys, MD,^{‡‡}
Arjun Sahgal, MD,^{§§} Joe Deasy, PhD,[†] John Flickinger, MD,^{|||} Mubina Quader, PhD,^{|||}
Stefan Mindea, MD,^{¶¶} and Yoshiya Yamada, MD^{‡‡}

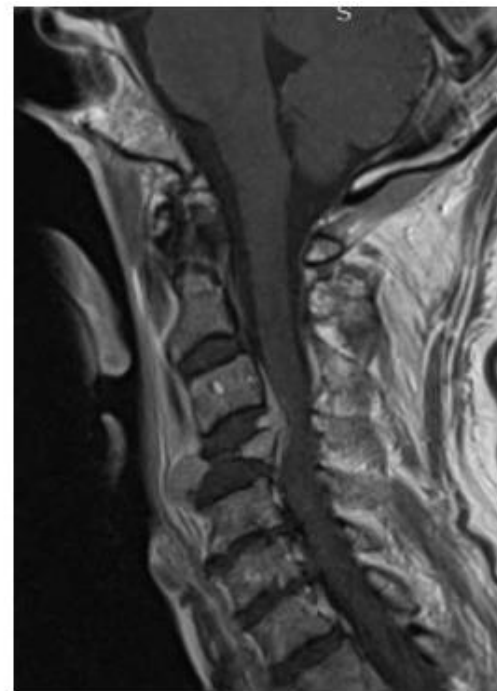
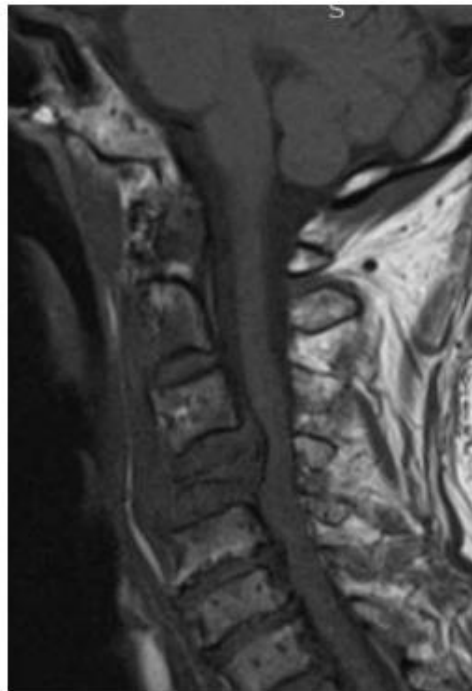
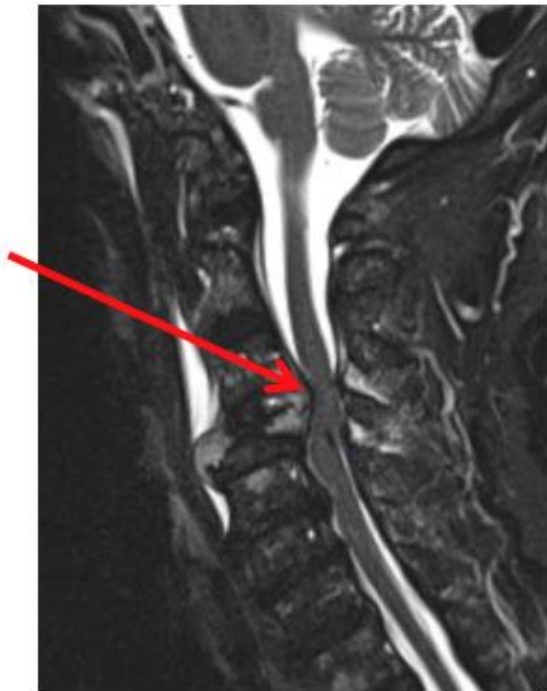


Consenso CTV

GTV involvement	CTV description
Any portion of the vertebral body	Include the entire vertebral body
Lateralized within the vertebral body	Include the entire vertebral body and the ipsilateral pedicle/transverse process
Diffusely involves the vertebral body	Include the entire vertebral body and the bilateral pedicles/transverse processes
GTV involves vertebral body and unilateral pedicle	Include entire vertebral body, pedicle, ipsilateral transverse process, and ipsilateral lamina
GTV involves vertebral body and bilateral pedicles/transverse processes	Include entire vertebral body, bilateral pedicles/transverse processes, and bilateral laminae
GTV involves unilateral pedicle	Include pedicle, ipsilateral transverse process, and ipsilateral lamina, $\pm$ vertebral body
GTV involves unilateral lamina	Include lamina, ipsilateral pedicle/transverse process, and spinous process
GTV involves spinous process	Include entire spinous process and bilateral laminae

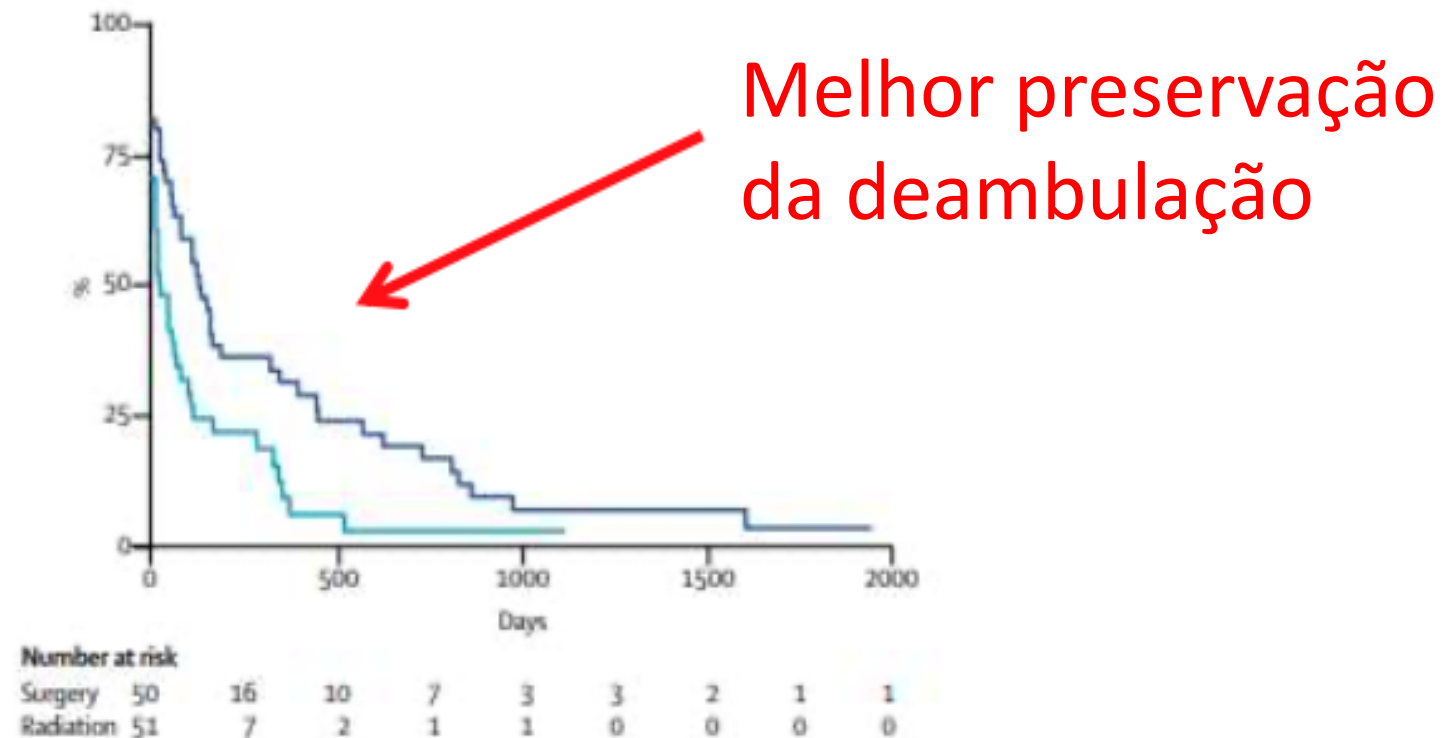


Pós operatória

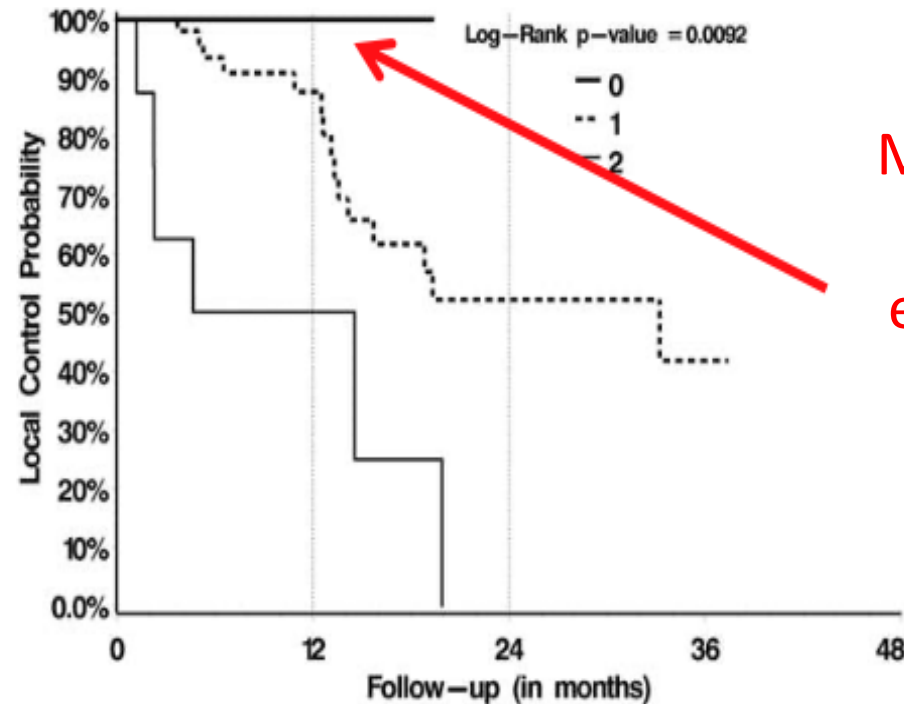


Cirurgia para compressão medular

- Randomized surgery followed by RT vs. RT alone



Extensão epidural pós OP impacta em controle local



Melhor Controle local
com menos dc
epidural residual pós
cirurgia

Doença Epidural / Compressão

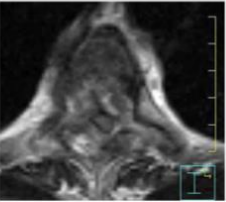
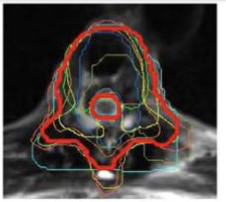
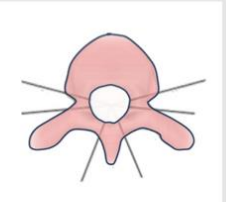
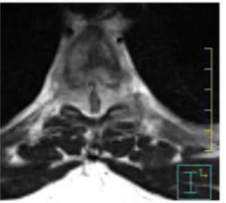
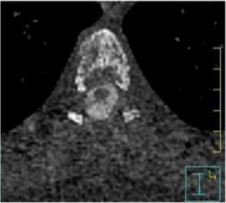
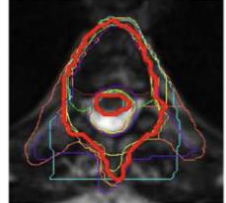
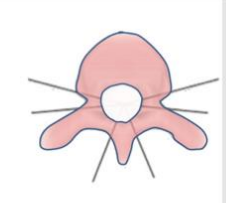
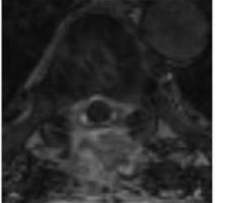
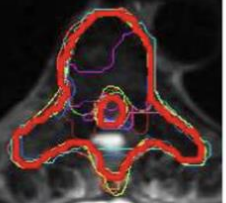
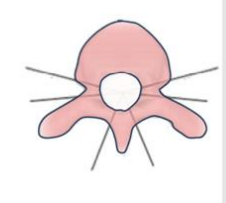
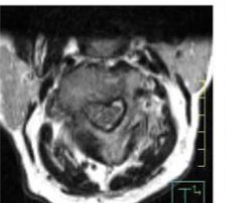
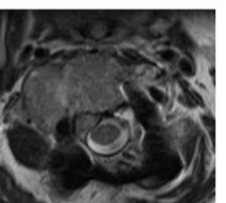
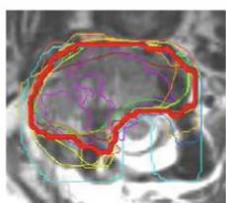
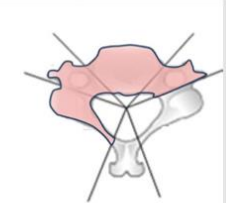
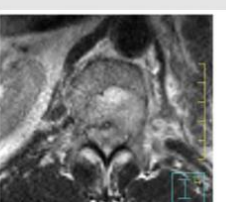
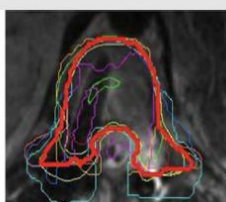
- Doença epidural é frequentemente sub-dosada pelo limite da medula
- Maiores taxas de recorrência
- Dose mínima de 14/15Gy (1fx) é preditor de recorrência
- **Cirurgia de separação + SBAR**
 - Remover o máximo de doença epidural para melhorar dosimetria e reconstruir o canal medular
 - Cirurgia rápida (<3hrs) pouco mórbida

Pós OP delineamento

Consensus Contouring Guidelines for Postoperative Stereotactic Body Radiation Therapy for Metastatic Solid Tumor Malignancies to the Spine

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Simon S. Lo, MD, FACR,[†] Scott G. Soltys, MD,[‡] Samuel Ryu, MD,[§]
Todd McNutt, PhD,^{*} Samuel T. Chao, MD,^{||} Yoshiya Yamada, MD,[¶]
Amol Ghia, MD,[#] Eric L. Chang, MD,^{**} Jason Sheehan, MD, PhD,^{††}
and Arjun Sahgal, MD, FRCPC^{‡‡}**

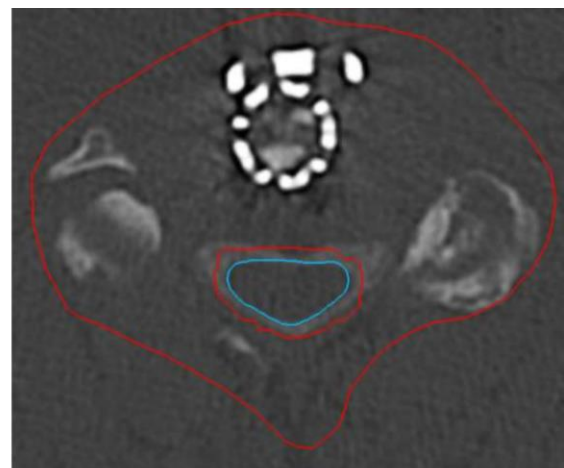
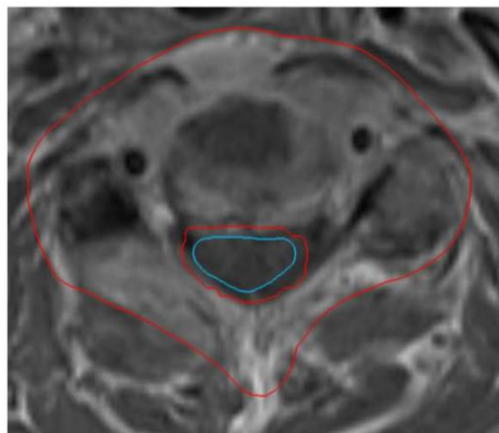
Table 3 Consensus clinical target volume contours for postoperative stereotactic body radiation therapy for spine metastases

Patient no.	Preoperative axial MRI	Postoperative axial CT myelogram or T2 MRI	Simulation MRI with individual and consensus CTV contour	Schematic diagram
1				
2				
3				
4				
5				

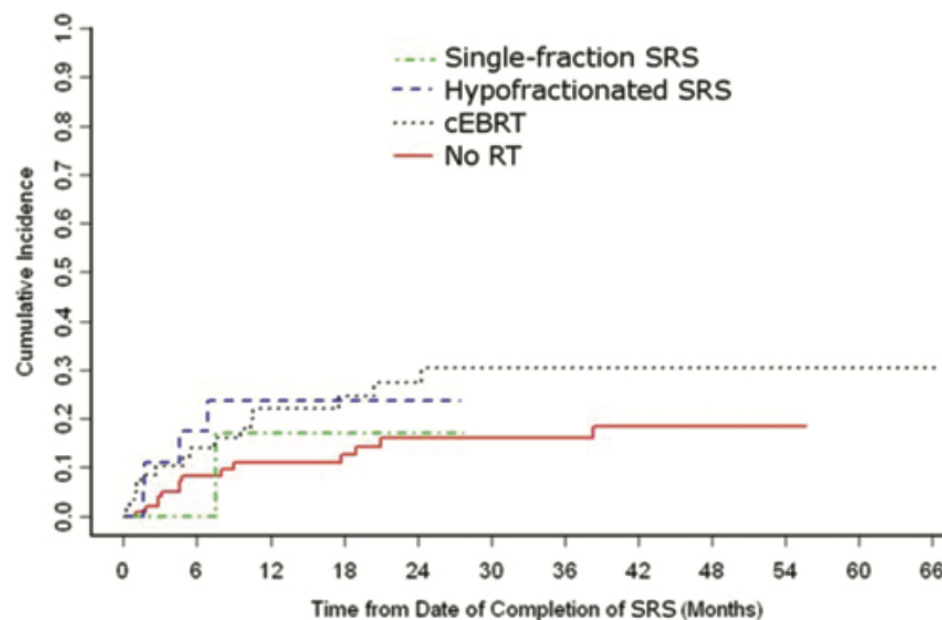
Parece fácil, só que....



Como Resolver - Mielografia



Resultados SBRT pós separação



24Gy x 1fx

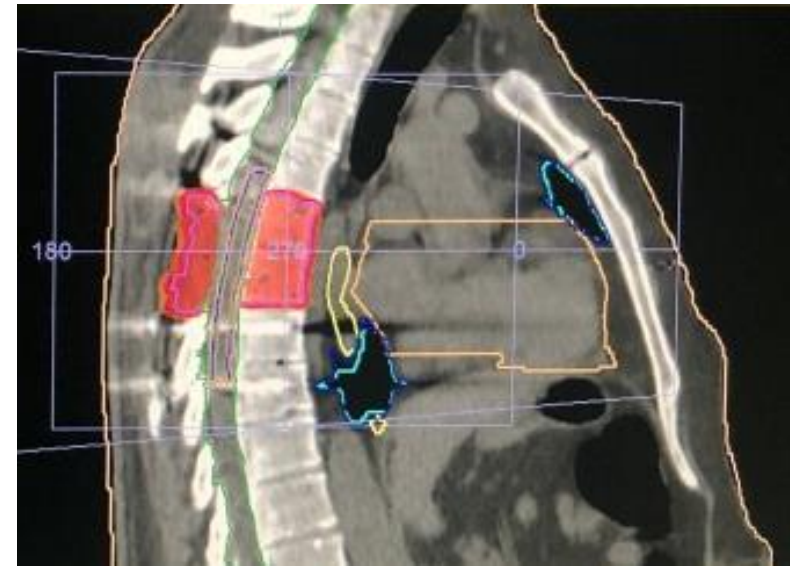
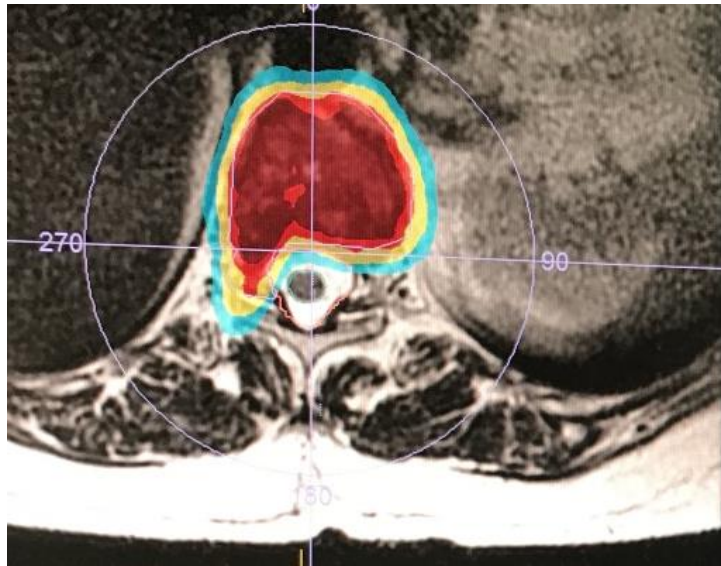
24-30Gy x 3fx

18-26Gy – 5-6Fx

FIG. 3. The cumulative incidence of local progression by preoperative RT fractionation regimen.

Hipofracionamento com doses baixas pior controle local
Progressão (22.6% vs 4.1%)

Planejamento?



Prescrições de Dose Razoáveis

- 18-24Gy x 1 fração
- 12Gy x 2 frações
- 8-10Gy x 3 frações
- 6-8Gy x 5 frações

Prescrições de Dose Razoáveis

– RTOG 0631	16 or 18 Gy
– Cleveland Clinic	18 Gy
– MSKCC	24 Gy
– Stanford	20 Gy (usually the D95% to PTV)
– MDACC	24 Gy to GTV, 16 Gy to CTV
– Sunnybrook	24 Gy in 2 fractions
– Johns Hopkins	24 Gy in 2 fractions

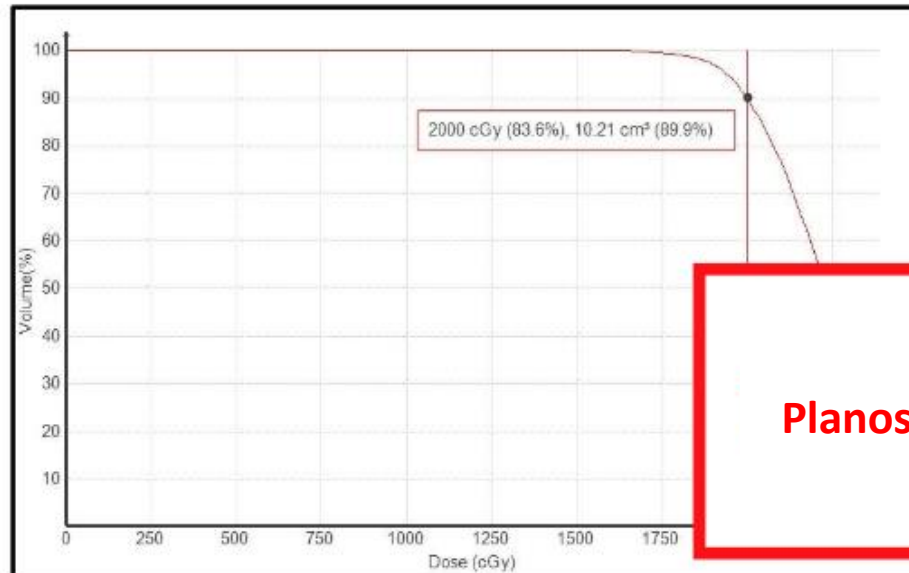
Diferença dosimétricas na Prescrição de dose

- Prescrição de dose de alguma forma se correlaciona com controle local
- Mas a evidência é controversa por que os estudos iniciais não reportavam detalhes dosimétricos

Sem convenção de nomenclatura para Dose prescrita

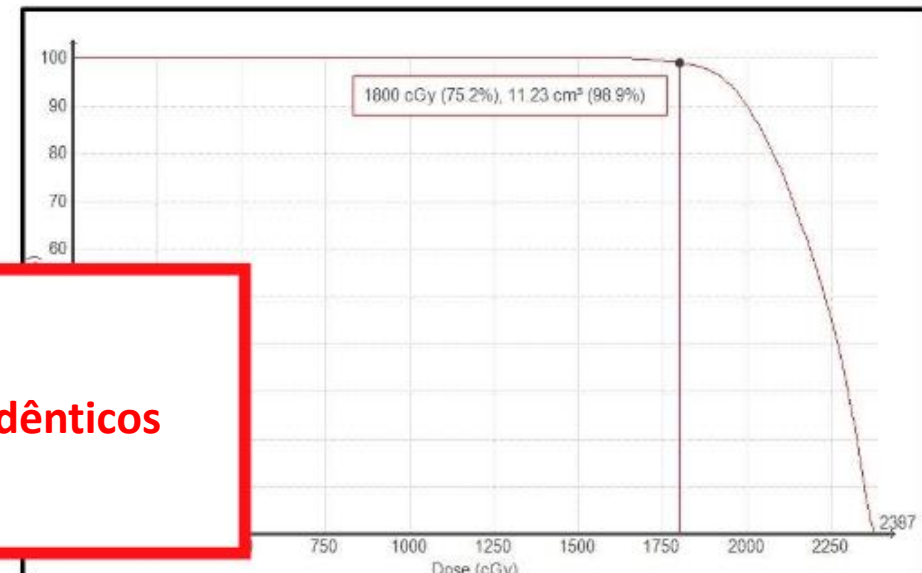
'20 Gy'

84% IDL, 90% coverage



'18 Gy'

75% IDL, 99% coverage



Planos Idênticos

Dose Prescrita vs Dosimetria

- MSKCC
- 31 pctes com seguimento de 5 anos
- 24Gy x 1
- CL 92%

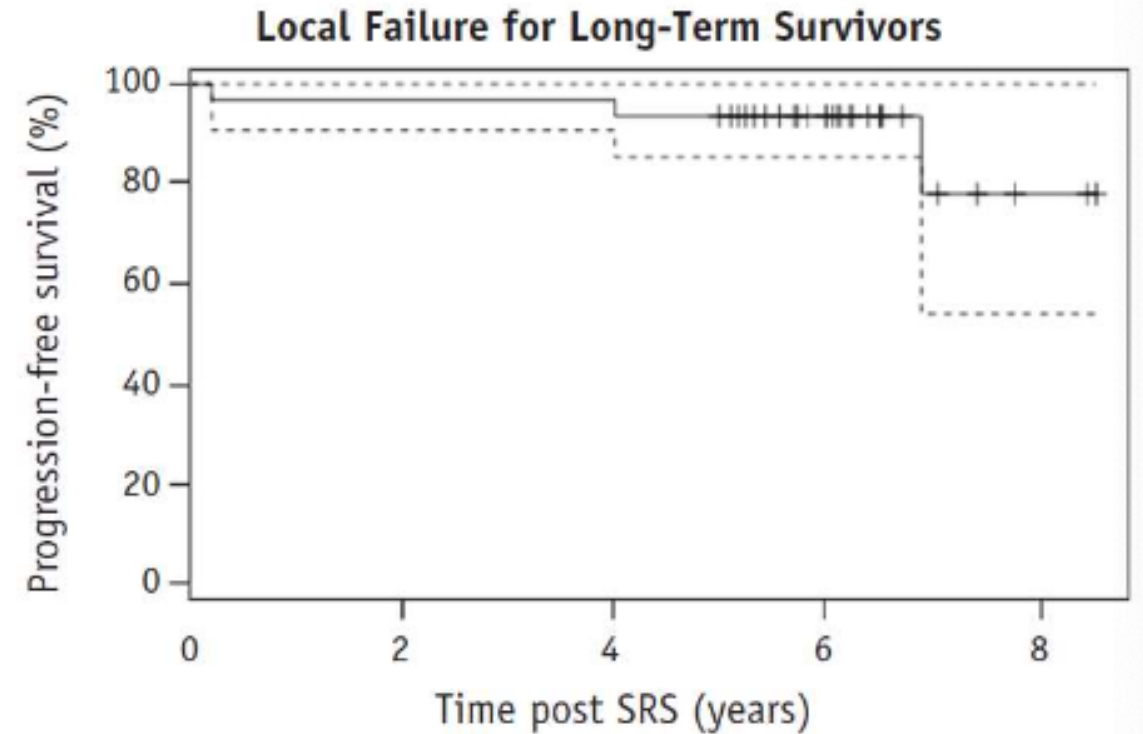


Fig. 1. Disease progression. Kaplan-Meier analysis for local tumor control in patients surviving >5 years after 24-Gy spinal stereotactic radiosurgery (SRS) delivered in a single fraction (patients at risk, n=31).

Dose Prescrita vs Dosimetria

PTV D95: 87.7% dos 24Gy → 21Gy

Table 2 Dosimetric characteristics

Parameter	Overall	LF	VCF	Neuropathy
Tumor (lesions*)	33	3	11	6
PTV (cm ³)	67.9 (9.39-204.4)	86.4 (52.6-123.1)	75.2 (15.2-145.3)	77.6 (20.0-195.2)
PTV V95 (%)	91.9 (74.6-100.0)	92.1 (88.2-95.2)	92.2 (82.2-99.8)	94.3 (89.4-98.2)
PTV D95 (%)	87.7 (52.3-101.4)	87.4 (76.7-95.5)	86.1 (52.3-101.0)	93.2 (83.2-99.9)
GTV (cm ³)	23.3 (0.99-109.4)	42.9 (11.8-83.6)	21.9 (1.8-57.7)	29.2 (7.1-73.5)
GTV Dmin (cGy)	1649 (838-2419)	1242 (908-1501)	1510 (908-2396)	1605 (1460-1858)
Spinal cord (lesions*)	25	3	4	4
Dmax (cGy)	1342 (994-1671)	1398 (1200-1594)	1355 (1200-1448)	1296 (1200-1399)
D05 (cGy)	1068 (498-1316)	1143 (873-1316)	1063 (873-1220)	1062 (924-1222)
Cauda equina (lesions*)	7	0	6	1
Dmax (cGy)	1500 (921-1612)	-	1597 (1585-1612)	1599
D05 (cGy)	1032 (509-1280)	-	1119 (587-1280)	1198

Abbreviations: D05 = minimum dose to hottest 5% of spinal cord/cauda equina; D95 (%) = dose received by 95% of PTV; Dmax = maximum dose; GTV = gross treatment volume; LF = local failure; PTV = planning treatment volume; V95 (%) = volume receiving 95% of prescribed dose; VCF = vertebral body compression fracture.

Data presented as mean (range).

* Number of lesions with available dosimetric parameters, not the total number of treated lesions in this cohort.

Dmin vs Cobertura

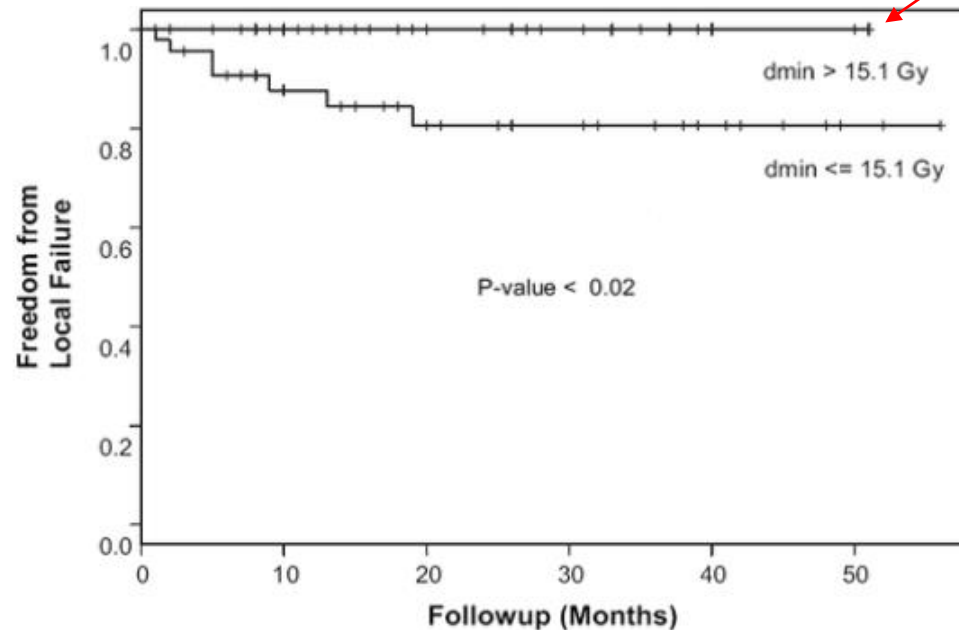


Fig. 3. Kaplan-Meier curves of freedom from local failure for (1) Patients with $D_{\min} \leq$ the median $D_{\min}$ (15.1 Gy), and (2) Patients with $D_{\min} > 15.1$ Gy. The median followup was 17.5 months for patients with $D_{\min} < 15.1$ Gy, and 19 months for patients with $D_{\min} > 15.1$ Gy.

- 91 pctes 18-24Gy

- CL em 1 ano:

- **Dmin > 15Gy 100%**
- **Dmin ≤ 15Gy ~80%**

Dmin vs Cobertura

MDACC 332 ptes

- CL geral 88%
- Se GTV BED Dmin_____ CL 1 ano:
 - $> 33.4\text{Gy}_{10}$ - 94%
 - $< 33.4\text{Gy}_{10}$ - 80%
- 33.4Gy_{10} em 01 fração $\sim 14\text{Gy}_{10}$

Dmin vs Cobertura

Dmin no GTV correlaciona-se com Controle local

MSKCC	15	n=91
MDACC	14	n=332
Stanford	15	n=400+

15Gy dmin não é de forma isolado o que define controle local

15Gy EQD2 = 31Gy₁₀ (ex. < 10x3Gy)

mas Dmin adequado se correlaciona com um bom plano

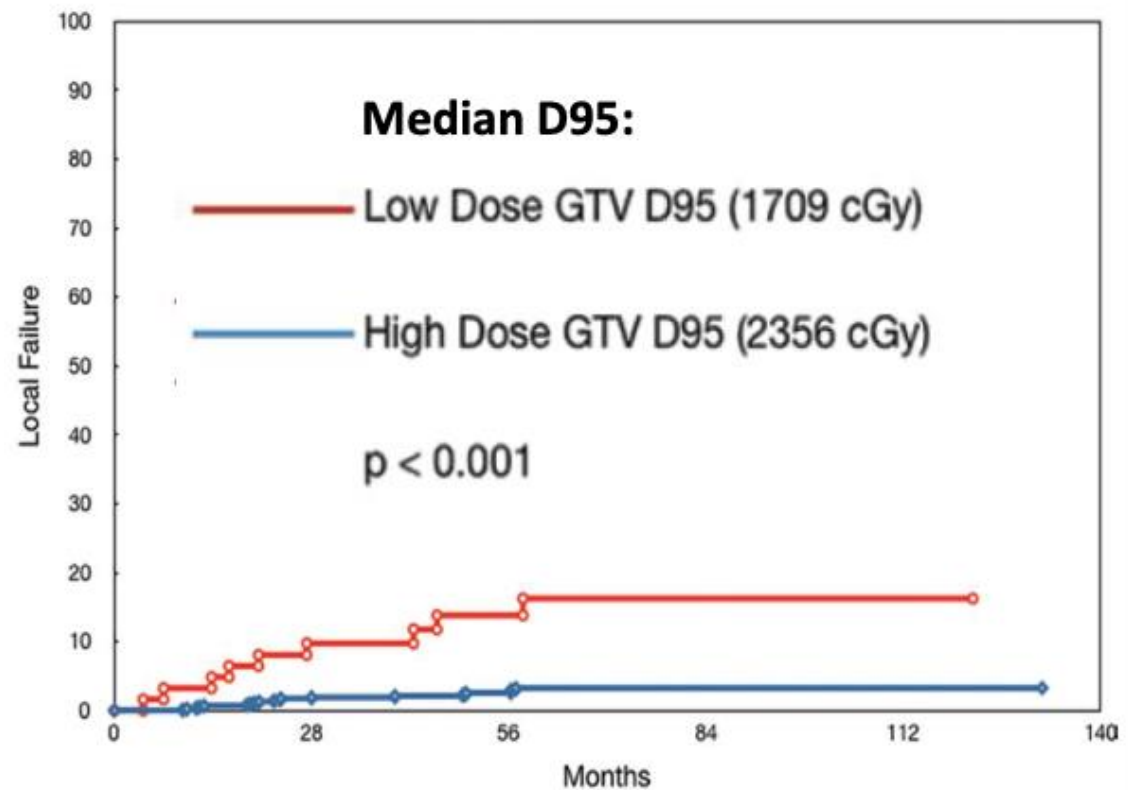
Cobertura GTV

MSKCC 811 ptes

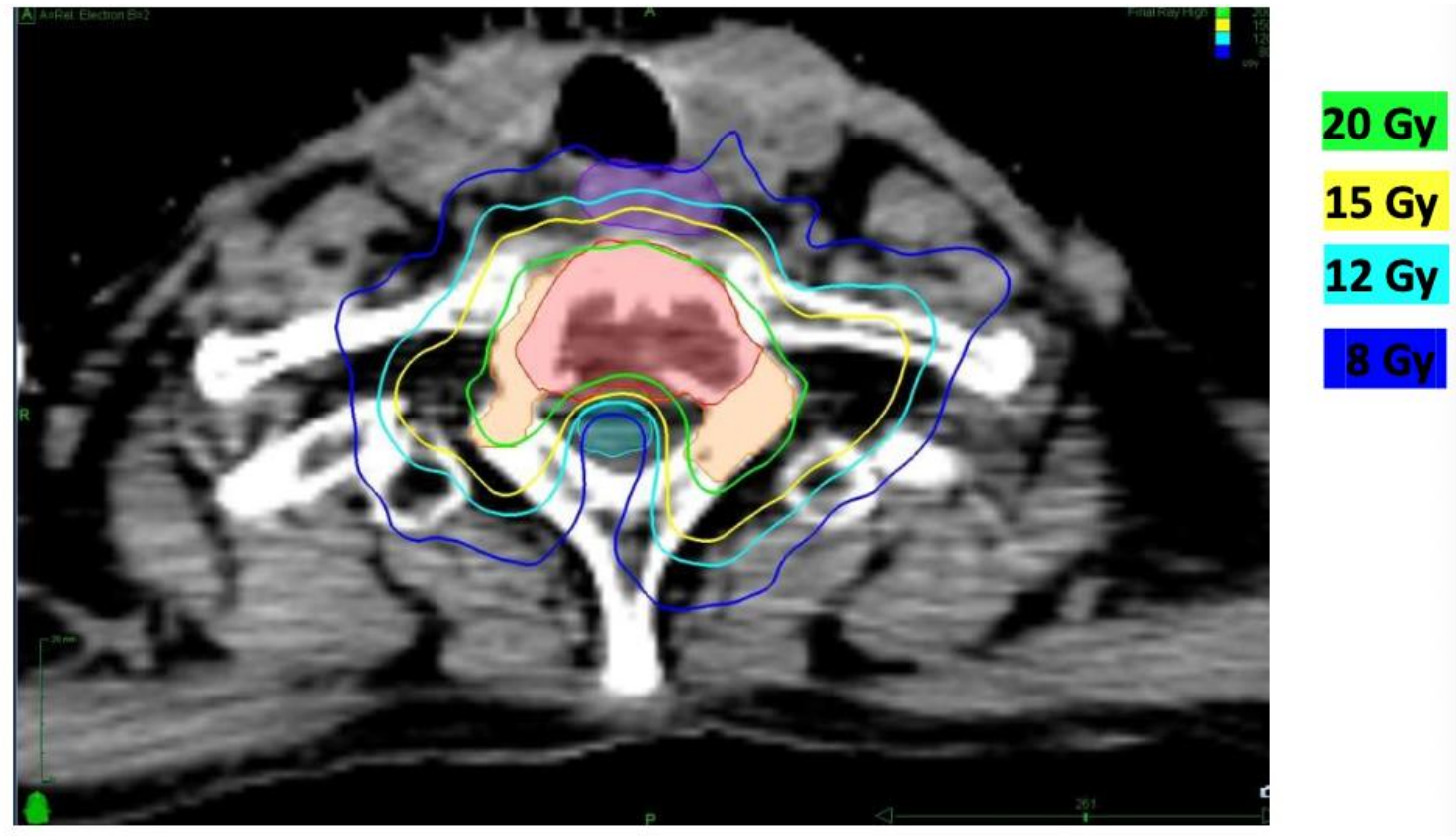
	<u>LF em 3 anos</u>
• Alta dose GTV	2%
• Baixa dose GTV	10%

Linha de corte para Falha local

- GTV D95 18.3Gy
- PTV D95 17.4Gy



Dose vs Cobertura



- **Prescrição:** 18-24Gy 1 fração ou 24Gy x 2 ($\sim 18,5\text{Gy}_{10}$) ou 27Gy x 3 ($\sim 18,2\text{Gy}_{10}$)
- **Cobertura:** $\text{PTV} \geq 90\%$ (PTV 1 a 2mm sem margem para dentro do canal medular)
- **Dmin:** 15Gy (dose única) ou equivalente fracionado ex $\sim 21\text{Gy}$ em 03 frações
- **GTV** $\sim 100\%$ cobertura ou $\text{GTV D95} > 18\text{Gy}$ em fração única ou equivalente

Controvérsias – Delineamento Medula

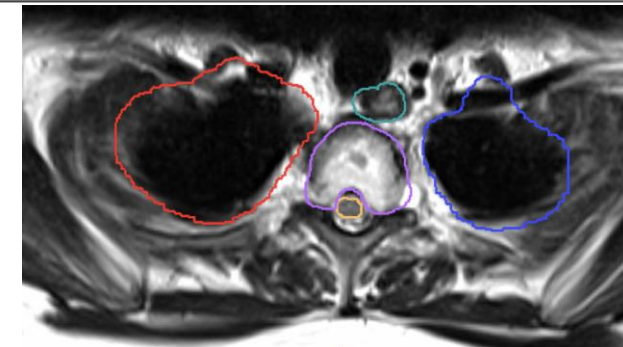
- Desenhar medula espinhal ou canal medular?
- Ressonância ou tomo-mielografia
- Adicionar PRV? Qual Margem?
- Dose permitida?

Controvérsias – Delineamento Medula

Imaging modality for definition of the spinal cord	Spinal cord in MRI	Spinal cord in MRI	Spinal cord in MRI	Spinal cord in MRI	Spinal canal in CT
Delineation of the spinal cord in cranio-caudal direction	At least 1 level above and below PTV	1 level above and below PTV	At least 1 level above and below PTV	1 level above and below PTV	1 level above and below PTV
Safety margins around the spinal cord in axial directions	1 mm	1 mm	1.5 mm	No	2 mm anterior and 1 mm lateral
Delineation of the cauda equina	Thecal sac	Thecal sac	Thecal sac	Thecal sac	Thecal sac
Delineation other OARs (e.g. kidney)	No application of safety margins	No application of safety margins	No application of safety margins	No application of safety margins	No application of safety margins

RTOG 0631: Medula na RM, 3mm acima e abaixo

Eu: Medula na Rm T2, 1 corpo vertebral acima e abaixo.
PRV 1.5mm



OAR - Medula

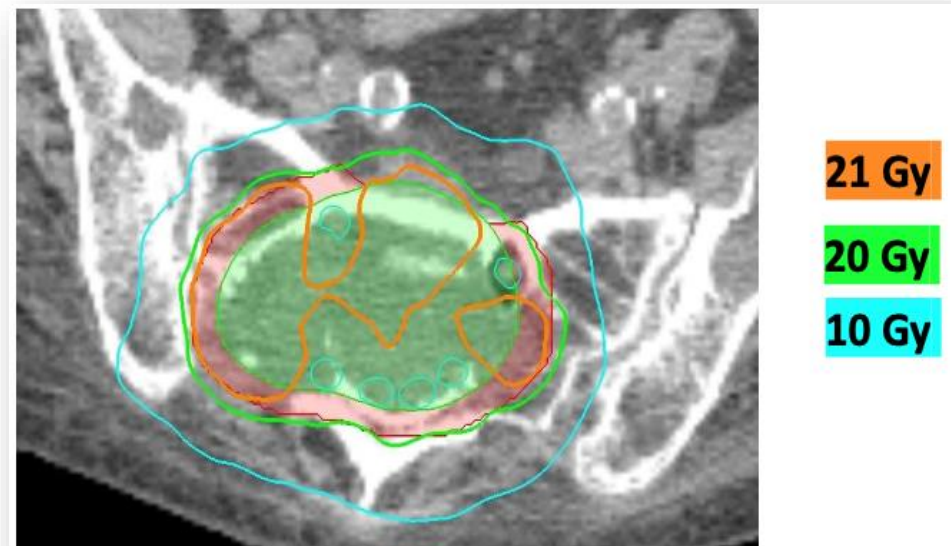
	1 fraction Pmax limit (Gy)	2 fractions Pmax limit (Gy)	3 fractions Pmax limit (Gy)	4 fraction Pmax limit (Gy)	5 fraction Pmax limit (Gy)
1% Probability	9.2	12.5	14.8	16.7	18.2
2% Probability	10.6	14.6	17.4	19.6	21.5
3% Probability	11.5	15.7	18.7	21.2	23.2
4% Probability	12.0	16.4	19.6	22.2	24.4
5% Probability	12.4	17.0	20.3	23.0	25.3

OAR - Esôfago

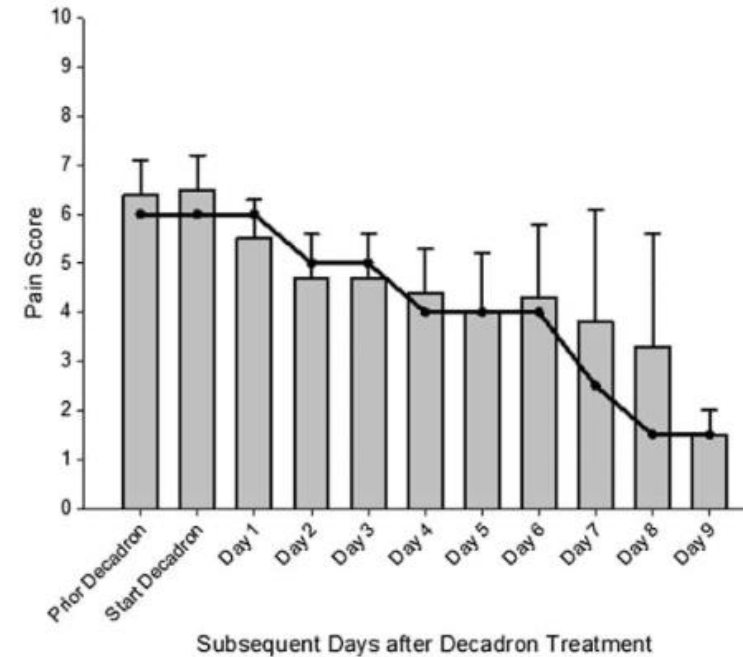
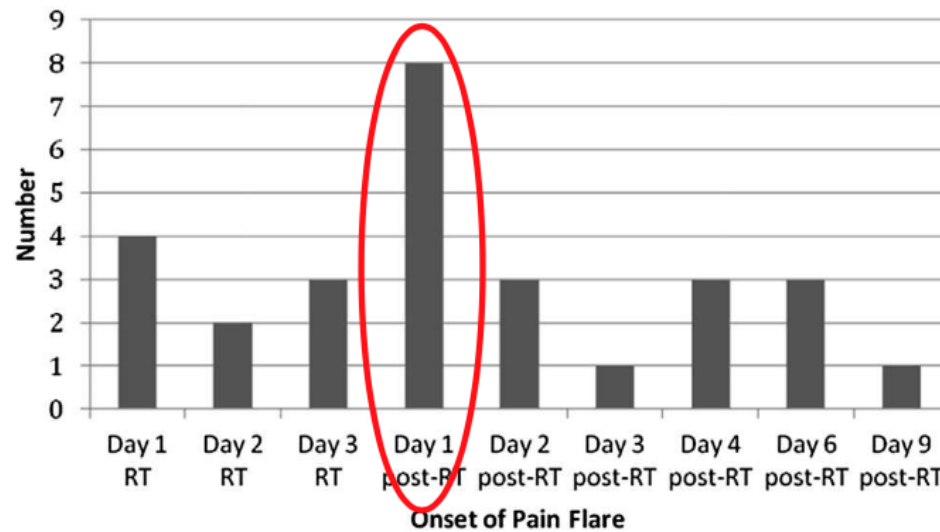
- Abelson et al. Dis Esophagus 2012 (Stanford)
 - Dmax 15.4Gy e D5cc 11.9Gy
 - Evitar irradiar circunferencialmente
- Cox et al. 2012 IJROBP (MSKCC)
 - $\leq 2.5\text{cc}$ receber 14Gy
 - Dmax <22Gy
 - **Doxirubicina ou gencitabina e manipulação iatrogênica foram responsáveis por toxicidade G4**
- RTOG 0631
 - Dmax 16 (< 0,03cc)

OAR- Nervos periféricos

- Poucos dados publicados
- Nervos distais mais “sensíveis” que proximais
- Eu: Tentar manter $< 105\%$ da dose, não descobrir

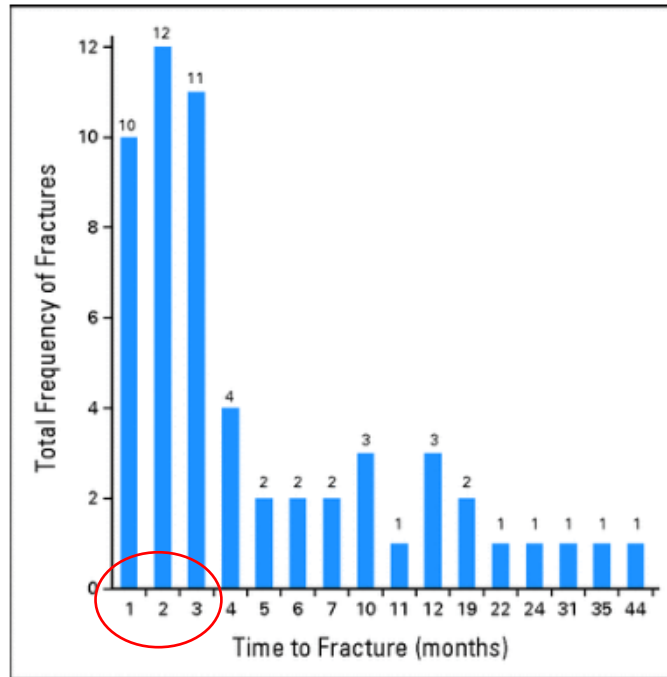


Toxicidade - Pain Flare

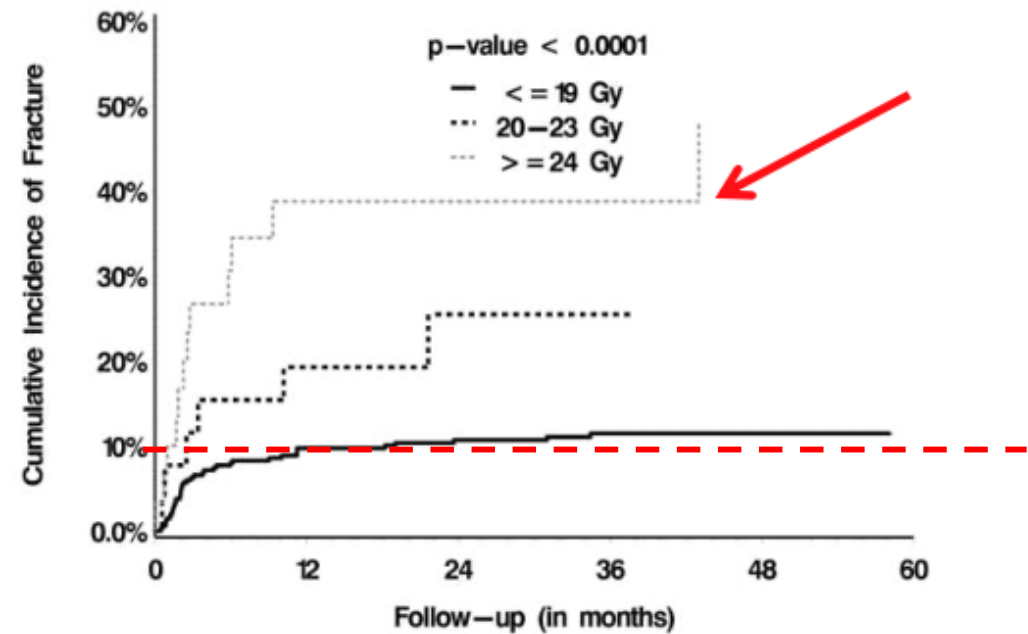


Dexametasona
Eu: 8mg 5 a 7 dias

Toxicidade - Fratura de corpo Vertebral



Saghal JCO 2013



MSKCC yamada

The background of the slide is a faded, light-colored image of a coastal landscape. It features prominent hills and mountains, including the Christ the Redeemer statue on a peak to the right and the Sugarloaf Mountain (Pão de Açúcar) on the left. The sky is a pale blue gradient. The entire image is framed by dark teal curved borders at the top and bottom.

OBRIGADO!