Advances in radiation oncology in the management of soft tissue sarcoma
放疗于治疗肉瘤的最新发展

Brian O'Sullivan
Bartley-Smith / Wharton Chair
Professor, Department of Radiation Oncology
The Princess Margaret / University of Toronto

Concurrent Session 1: Sarcoma
19 May 2017, 11:30 ~ 12:45

Principles and Axioms regarding RT

- Multidisciplinary Management
  - Proper attention to assessment and biopsy
- Local Management (surgery ± radiotherapy):
  - Sufficient clearance from gross disease:
    - Barriers: if intact and resected with the tumour may suffice
    - Distance: tumour in free tissue needs at least 2 cm (surgery alone, or for radiotherapy when indicated)
- Lymph node metastases are uncommon (appreciate which are at risk)
- Oligometastases can be salvaged selectively
  - surgery or SBRT
- Brachytherapy is effective but equivilance is doubtful compared to contemporary RT

Subsite considerations

- Extremity
  - Most common soft tissue sarcoma
    - ➢ *Provides most of the data on local management*
- Head and neck
  - Smaller than other subsites: less risk of metastases
  - Major functional, cosmetic, and local control challenges:
    - ➢ death is mostly from local disease
  - Some unique pathologies add complexicity
- Retroperitoneal
  - Unique behaviour for many (e.g. low grade liposarcoma)
    - ➢ Enormous size is possible due to location
  - Slow but inevitable time to recurrence (may be changing)

Limb Salvage Surgery in extremity (limb) STS

- Possible in 95% + of cases
- Surgery alone is possible if wide margins are achievable (2 cm) without sacrificing critical structures (bone, nerves, vessels)
  - Usually small superficial sarcomas; may require complex repair
- If wide resection is not possible in infiltrating lesions, combined treatment with radiation and surgery is recommended *

* Level 1 evidence (several RCTs)

VOLUME 25 · NUMBER 8 · MARCH 10 2007

JOURNAL OF CLINICAL ONCOLOGY

REVIEW ARTICLE

Evidence-Based Recommendations for Local Therapy for Soft Tissue Sarcomas

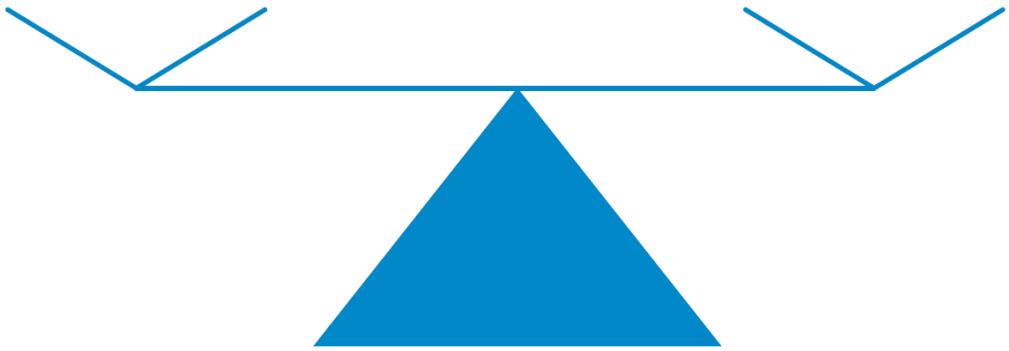
Peter W.T. Pisters, Brian O'Sullivan, and Robert G. Maki

Pisters P
O'Sullivan B
Maki R

Treatment Sequencing of External beam RT (most usual approach to adjuvant RT)

Treatment Sequencing Trade-Off Issues

Preop RT	**Postop RT**
Lower dose (50 Gy)	Higher dose (60-66 Gy)
Smaller field size	Larger field size
Reduced fibrosis	Increased fibrosis
Reduced edema	Increased edema
Increased wound complications (35%)	Wound complication risk as high as 17%



ARTICLES

Preoperative versus postoperative radiotherapy in soft-tissue sarcoma of the limbs: a randomised trial

Brian O'Sullivan, Aileen M Davis, Robert Turcotte, Robert Bell, Charles Catton, Pierre Chabot, Jay Wunder, Rita Kandel, Karen Goddard, Anna Sadura, Joseph Pater, Benny Zee

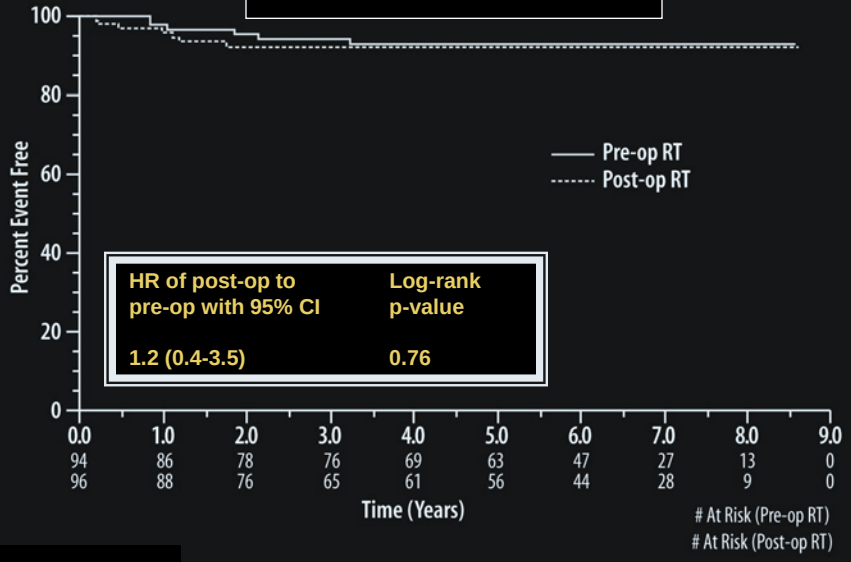
Lancet 2002, **359:** 2235–41. Published online June 11, 2002

O'Sullivan et al
Lancet 2002, 359: 2235-41

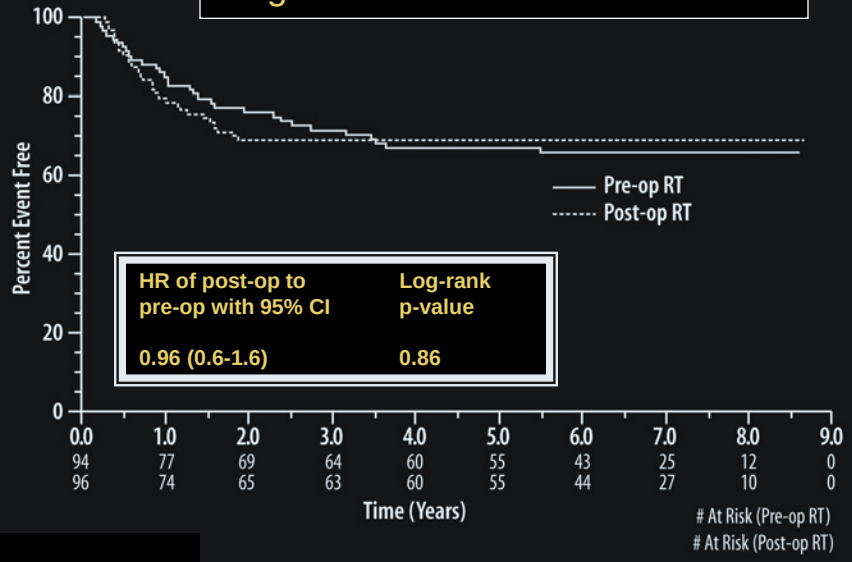
Major Wound-healing Complications (SR2 randomized trial)

		Pre-op	(%)	Post-op	(%)
Upper extremity		1/18	(5)	0/19	(0)
	proximal	1/10	(10)	0/11	(0)
	distal	0/8	(0)	0/8	(0)
Lower extremity		30/70	(43)	16/75	(20)
	proximal	20/38	(53)	15/54	(27)
	distal	10/32	(31)	1/21	(5)
Total	p = 0.01	31/88	(35)	16/94	(17)

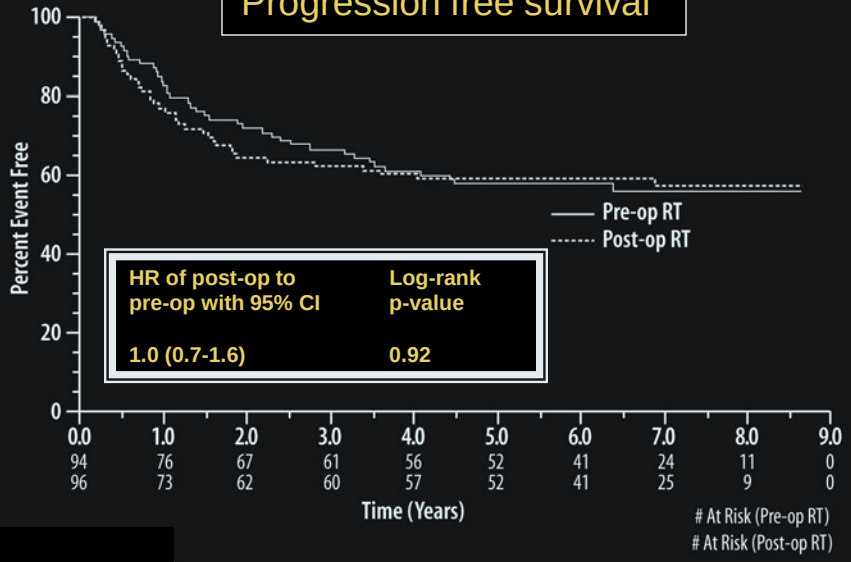
Local recurrence free



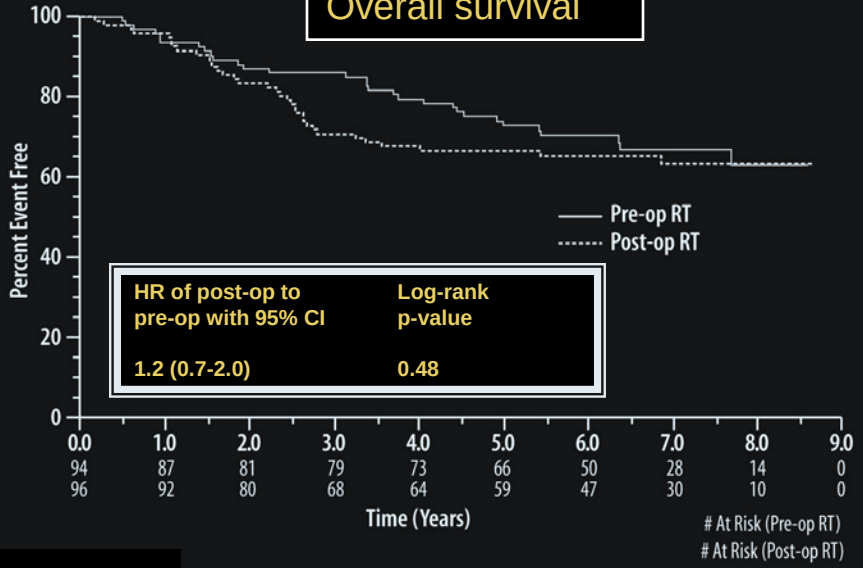
Regional / distant recurrence free



Progression free survival



Overall survival



National Cancer Institute of Canada
Institut national du cancer du Canada
Clinical Trials Group
Groupe des essais cliniques

SR2 Canadian Trial (n = 90 vs 90): 5 year Results

UHN Princess Margaret Cancer Centre

NCIC CTG SR2 – late effects

Table 4
Function by grade of radiation morbidity and treatment arm

		Musculoskeletal Tumor Society Rating Scale			Toronto Extremity Salvage Score		
		n	mean (sd)	*P*[a]	*n*	mean (sd)	*P*
Subcutaneous fibrosis	<2	61	30.5 (7.7)	0.002	54	87.0 (18.2)	0.001
	>2	47	27.7 (7.5)		45	77.1 (19.4)	
Joint stiffness	<2	85	30.8 (7.1)	0.001	76	86.4 (17.0)	0.001
	>2	23	24.2 (7.9)		23	69.4 (21.0)	
Edema	<2	87	30.4 (7.2)	<0.001	80	85.0 (18.3)	0.01
	>2	21	21.9 (8.6)		19	71.9 (20.3)	
Treatment arm	Pre-op	60	29.9 (7.8)	0.08	64	85.1 (19.3)	0.17
	Post-op	63	28.0 (8.6)		66	81.3 (17.2)	

[a] *P*-values were calculated by Wilcoxon rank sum test.

Table 3
Late radiation toxicity by treatment arm

		Preoperative radiotherapy, *n*=73 (%)	Postoperative radiotherapy, *n*=56 (%)
Subcutaneous fibrosis	<2	50 (68.5)[a]	29 (51.8)
	>2	23 (31.5)	27 (48.2)
Joint	<2	60 (82.2)	43 (76.8)
	>2	13 (17.8)	13 (23.2)
Edema	<2	62 (84.9)	43 (76.8)
	>2	11 (15.1)	13 (23.2)

[a] *P*=0.07 calculated by Fisher's exact test.

- NCIC SR2 study
- 129 pts
  - Trend towards more late complications with post-op RT patients
  - Worse function with increasing grade of RT morbidity
  - Association of field size (i.e. volume treated) with worse fibrosis and limb function

Davis, O'Sullivan, Turcotte et al Radiother Oncol 2005

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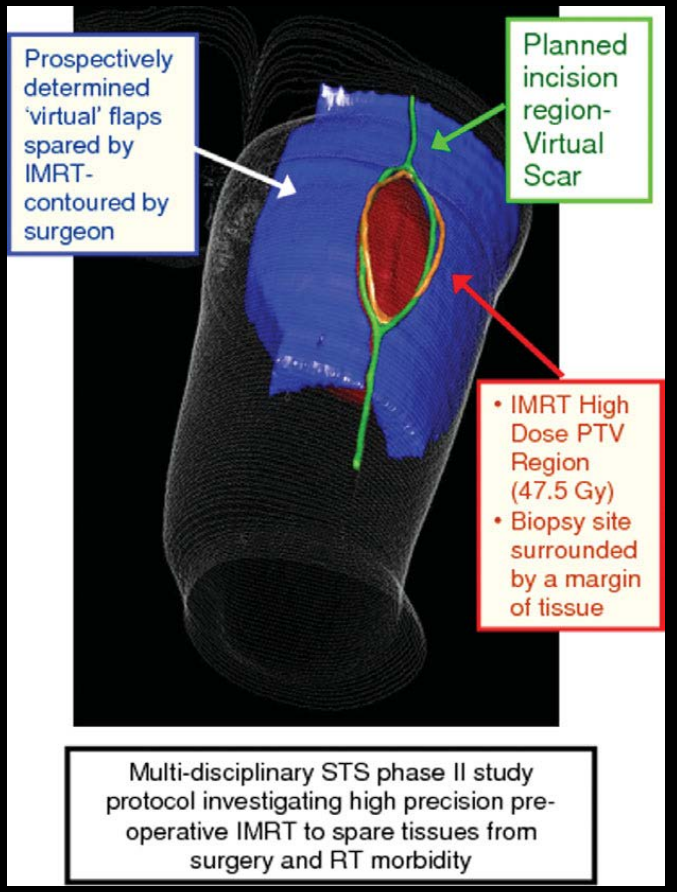
Current RT techniques (3DCRT or IMRT based)

- 2 phase II studies investigating 3DCRT/IMRT to spare normal tissue
  - PMH (IMRT only)
    - 59 pts lower extremity pts only
    - WCs 30.5%
    - 5-yr local RFS 88.2%
    - Surgical aspects compared to SR2
      - Vacuum assisted wound closure
      - >90% primary wound closure (70% SR2)
  - RTOG (3DCRT/IMRT)
  - 71 pts upper and lower extremity
    - WCs 36.6%
    - 2-yr local control 88.6%



Doses to bone reduced in both studies

PMH: O'Sullivan et al Cancer 2013
RTOG: Wang et al JCO 2015

Difference between RTOGs and PMH IMRT trial

Table 1 Summary of the details of RTOG 0630 and PMH-IMRT trial[9,10]

Item	RTOG 0630 (Wang et al 2015)	PMH-IMRT-LE-STS (O'Sullivan et al 2013)
Technique	3D or IMRT	IMRT alone
Anatomic site	Upper or lower extremity	Lower extremity
Chemotherapy	Cohort A: (closed Jan 2010)-induction chemotherapy (50 Gy)-concurrent chemotherapy (44 Gy)	No chemotherapy
Image guidance	2D or 3D daily image guidance	3D daily online cone-beam CT
Post-op boost (+margins)	External beam radiotherapy or brachytherapy (LDR, HDR, or IORT)	No postoperative boost
Primary end-point	Reduction of late morbidity at 2 years by RTOG/EORTC criteria (> grade 2 lymphedema, subcutaneous fibrosis, joint stiffness)	Reduction of wound complications by the SR2 criteria at 120 days
Secondary end-points	Similar between both studies	Similar between both studies
Target definitions	CTV high grade: 3 cm longitudinally; 1.5 cm axially	CTV 4 cm longitudinally: 1.5 cm axially. "Flap" is contoured as a region of interest.

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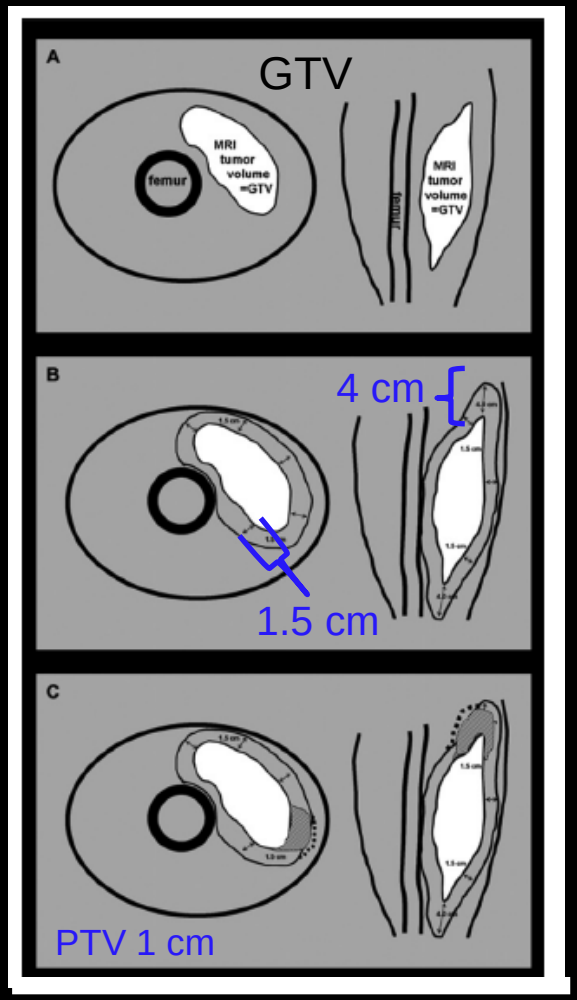
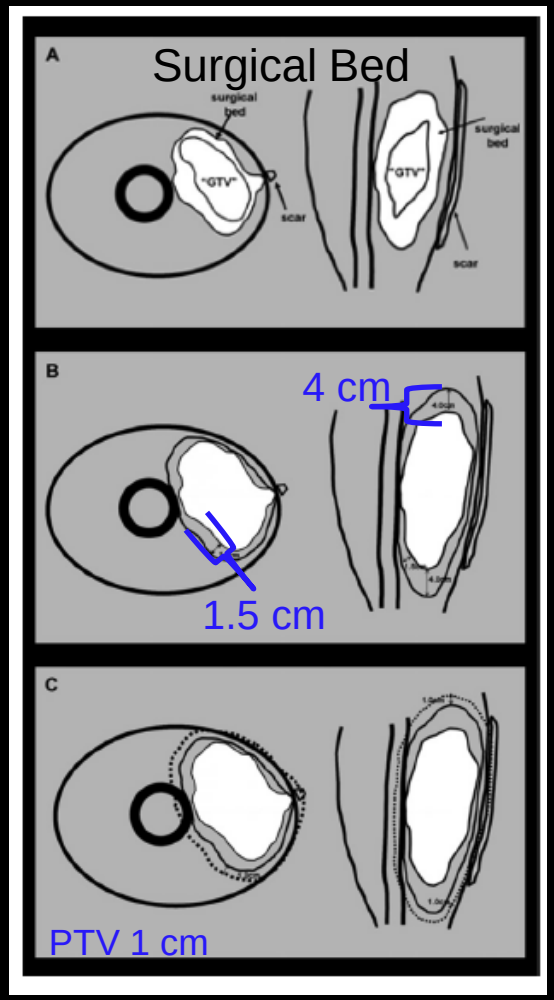
The role of radiotherapy in the management of localized soft tissue sarcomas

Siaw Sze Tiong[1], Colleen Dickie[1], Rick L. Haas[2], Brian O'Sullivan[1]

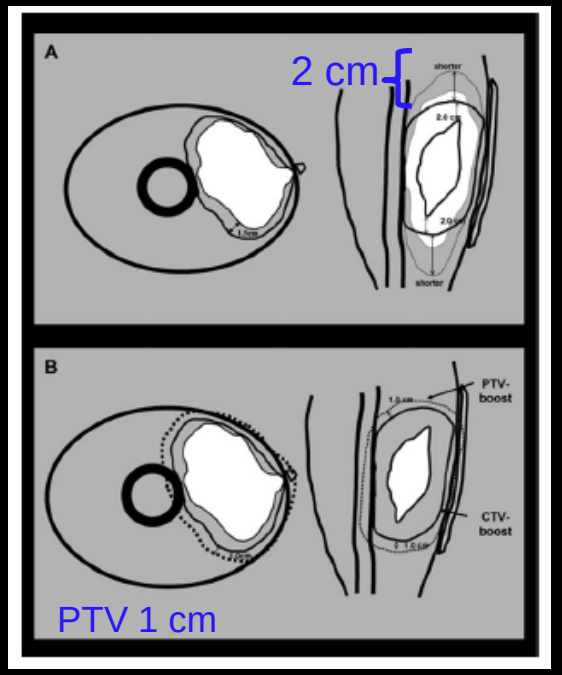
RT Dose and Volume Definition



Preoperative RT
50 Gy in 25 fx



Postoperative RT
60-66 Gy in 30-33 fx



Boost
10-16 Gy in 5-8 fx


CME ASTRO *Int J Radiat Oncol Biol Phys.* 2012;84:572-580 International Journal of Radiation Oncology biology • physics www.redjournal.org

Critical Review

Radiotherapy for Management of Extremity Soft Tissue Sarcomas: Why, When, and Where?

Rick L.M. Haas, MD, PhD,* Thomas F. DeLaney, MD, PhD,† Brian O'Sullivan, MD, PhD,‡ Ronald B. Keus, MD,§ Cécile Le Pechoux, MD, PhD,|| Patricia Olmi, MD, PhD,¶ Jan-Peter Poulsen, MD, PhD,# Beatrice Seddon, MD, PhD,** and Dian Wang, MD, PhD††

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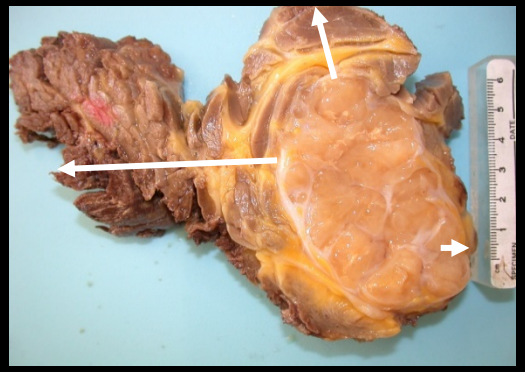
MRI-Histological Correlation of "Edema"
Resolution of a Radiation Oncology Question by Pathologists, Radiologists and Surgeons

- Tissue sampled from tumor to margin of resection in all six planes



- Presence of tumor cells (<1 cm or >1cm) from nearest tumor edge by light microscopy
  - Tumor cells present outside of tumor in 10/15 cases (67%)
    - <1 cm from tumor = 6/15
    - >1 cm from tumor = 4/15 up to 4 cm
  - Our CTVs have continued to be 4 cm, as used in SR2

"Histological Assessment of Peritumoral Edema in Soft Tissue Sarcoma"
White et al Int J Radiat Oncol Biol Phys 2005

http://clinicaltrials.gov/show/NCT00423618

"Randomised trial of Volume of post-operative Radiotherapy given to adult patients with Extremity soft tissue sarcoma (VORTEX)"

NCRI UK: PI M.H. Robinson

Post-op (66 Gy)

R

- 2 cm margin throughout
- 5 cm longitudinal margin to 25 f + 2 cm boost 16 Gy

End-points: Local control and function Toronto Extremity Salvage Score (TESS)

Enrollment (March 2006 – July 2011):

- Anticipated 400 patients (required to detect non-inferiority in 2 yr local recurrence free rates of <=10% (80% power).
- Accrual completed after 216 patient, with power to detect difference in TESS of 10 points at 2 years

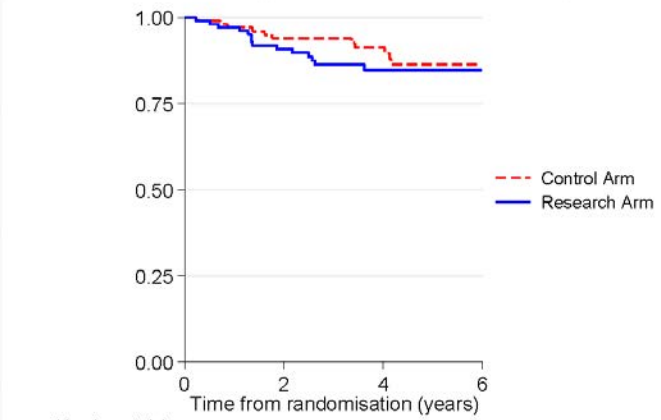
VorteX trial

ASTRO 2016

RTTQA Radiotherapy Trials Quality Assurance

@CRCTU Cancer Research UK Clinical Trials Unit

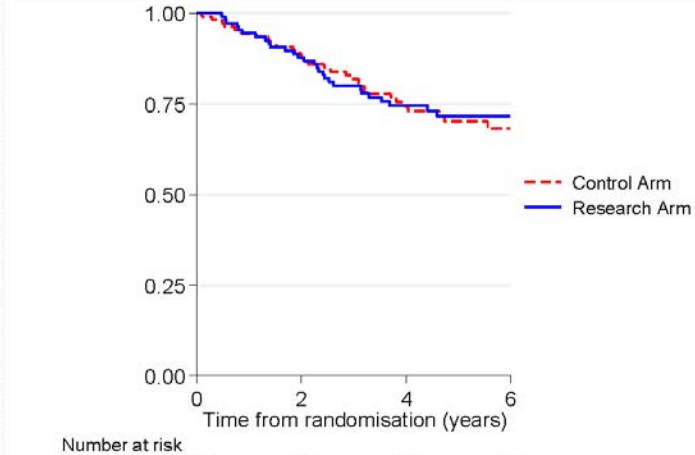
Time to Local Recurrence



Number at risk

Control Arm	108	88	57	19
Research Arm	108	84	50	23

Overall Survival



Number at risk

Control Arm	108	93	61	21
Research Arm	108	92	56	25

Late Radiation Morbidity – 2 years

RTOG/EORTC Late Radiation Morbidity Score (Graded 0-5)

Numbers are %	Control (N=80)	Research (N=69)	Chi² p
Skin >=2	29	28	0.870
Sub-cutaneous >=2	43	32	0.182
Bone >=2	1	1	0.915
Joint >=2	9	4	0.276

No difference in late toxicities at follow up time points up to 2 years.

Conclusions

- There is no evidence that the use of smaller margins between the GTV & CTV when delivering post-operative radiotherapy to adults with extremity STS improves limb function.
- Patient numbers limit our ability to confirm that the research arm is non-inferior to the control arm in terms of local recurrence.

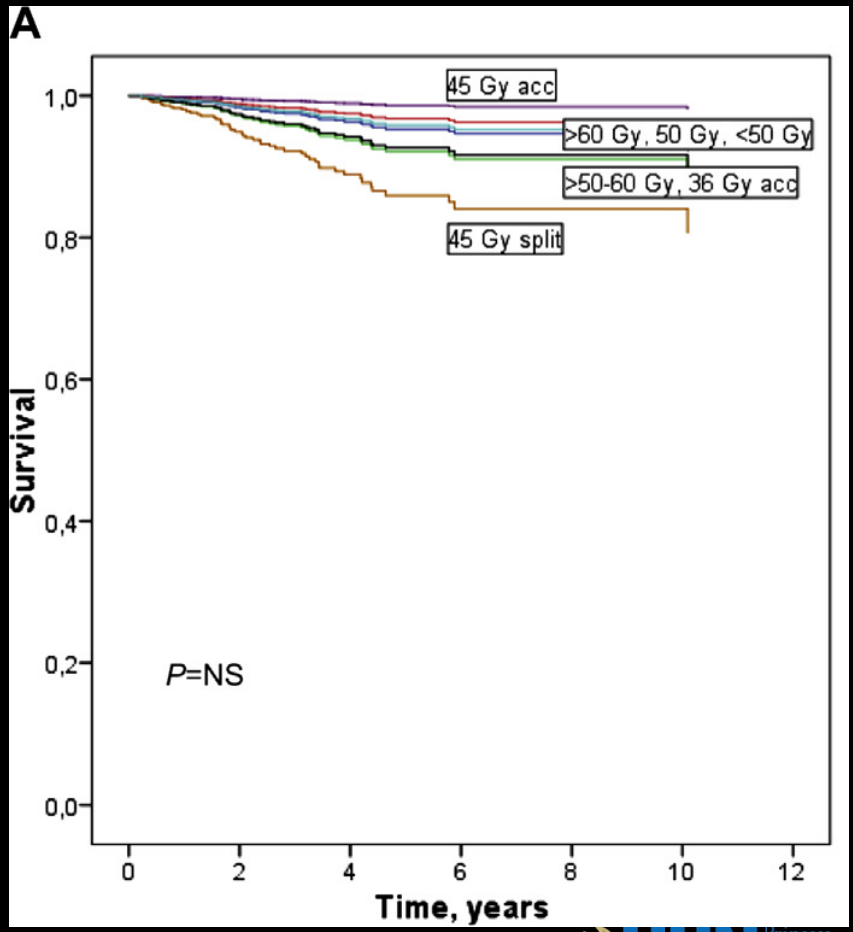
Robinson MH et al

UHN Princess Margaret Cancer Centre

Post-op RT dose and local control (R0 disease)

- **Retrospective multicentre study (SSG)**
- **Overall 462 pts extremity and truncal STS**

- Subset of 245 pts given 50 Gy postop RT
  - Local control: 84.5%
  - Surgical margins wide or marginal: ~90% LC
  - No apparent difference in local control between doses: 88.1% LC



Jebsen et al IJROBP 2013

Post-op RT dose and local control (R0 disease)

Retrospective study from Bordeaux, France

- Overall 205 pts extremity and truncal STS
- Subset of 163 pts: postop RT, median dose 50.3 Gy
- Negative (R0) margins in 147
- Local control (93%) in R0

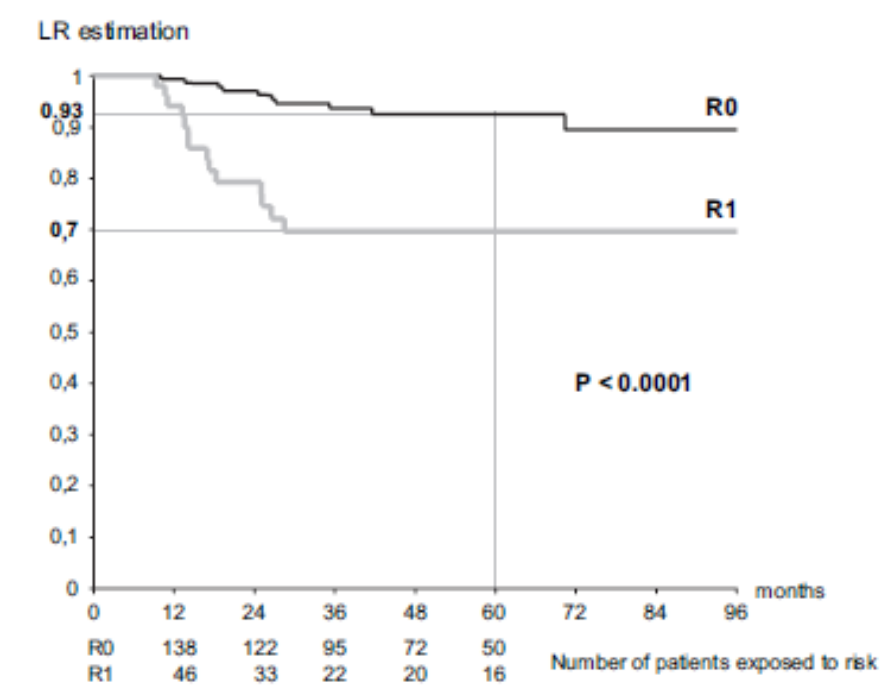


Figure 1. Local recurrence-free probability according to resection type.

Stoeckle et al Eur J Surg Oncol 2006

ClinicalTrials.gov Identifier:
NCT02565498

Phase III Study of preoperative vs. postoperative IMRT for truncal/extremity soft tissue sarcoma (SR50/50)

Peter Chung MBChB, MRCP, FRCR, FRCPC
Mt Sinai Toronto / Princess Margaret Sarcoma Group

Extremity or Trunk

R

50 Gy pre-op

Optional post-op boost for positive margins

50 Gy post-op

+

boost 16 Gy for post-op margins

Replica of SR2 except post-op dose
Open to other centres
(potentially Harvard and McGill)

UHN Princess Margaret Cancer Centre

Oral Oncology 46 (2010) 786–790

Contents lists available at ScienceDirect

Oral Oncology

journal homepage: www.elsevier.com/locate/oraloncology

Review

Management of adult soft tissue sarcomas of the head and neck

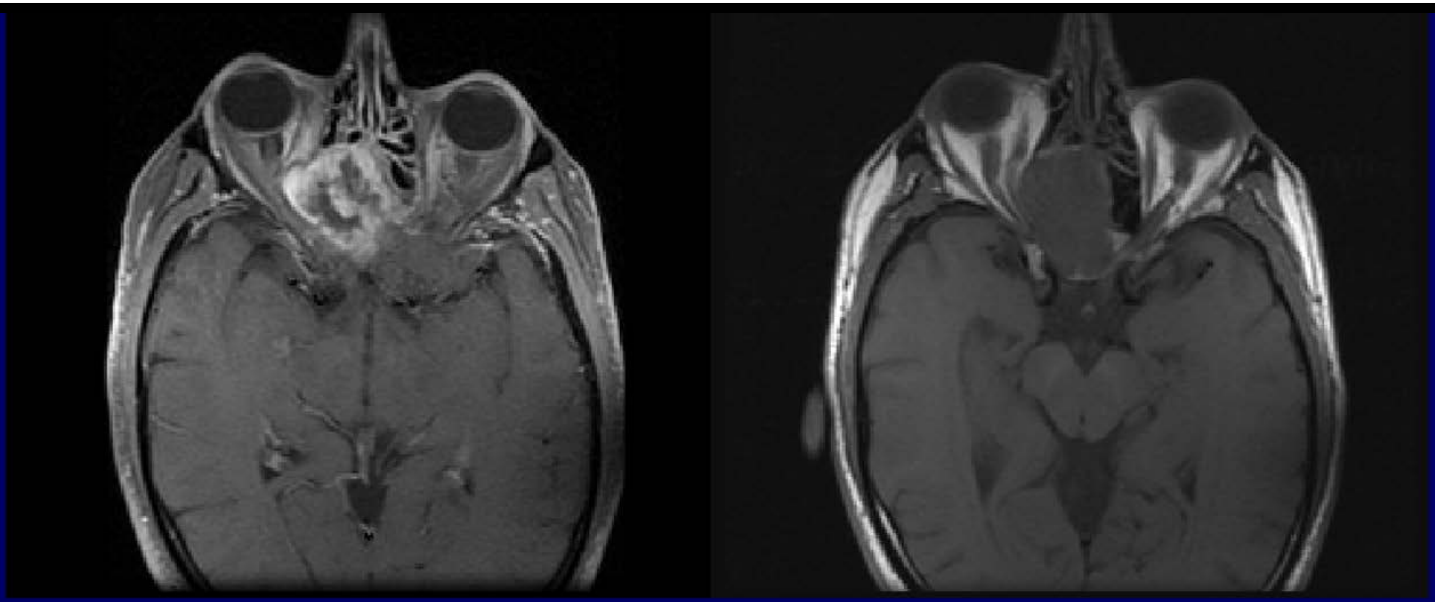
Remco de Bree [a,*], Isaäc van der Waal [b], Eelco de Bree [c], C. René Leemans [a]

[a] Department of Otolaryngology, Head and Neck Surgery, VU University Medical Center, De Boelelaan 1117, 1081 HV Amsterdam, The Netherlands
[b] Oral and Maxillofacial Surgery / Oral Pathology VU University Medical Center and Academic Centre for Dentistry, Amsterdam, The Netherlands
[c] Department of Surgical Oncology, Medical School of Crete University Hospital, P.O. Box 1352, 71110 Heraklion, Greece

- Survival varies from 50 to 80%
- Prognostic factors are tumour grade, margin status and tumour size
- Local control is disappointing (60-70 % range) and usually is the cause of death
- Anatomic constraints:
  - Difficulty obtaining wide surgical margins
  - Most patients undergo RT, which may also be difficult to deliver

Personalizing Pre-op RT in HN STS

45 year old male with leiomyosarcoma skull base with proptosis and optic nerve compression and tumor abutment of the chiasm



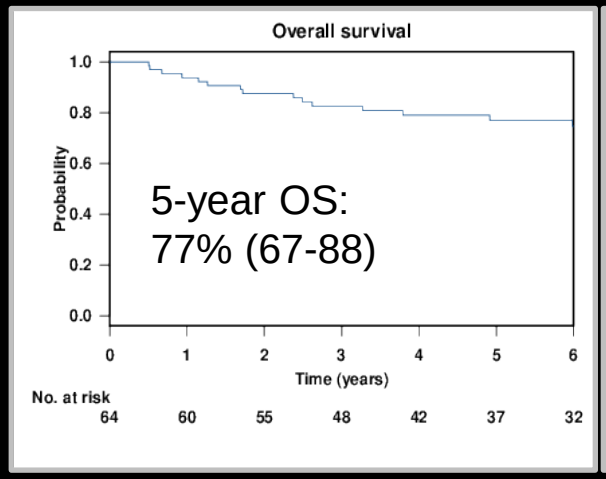
From: O'Sullivan, B., J. Wunder and P. W. Pisters. "Target description for radiotherapy of soft tissue sarcoma". In: V. Gregoire, P. Scalliet and K. K. Ang (editors) Clinical target volumes in conformal radiotherapy and intensity modulated radiotherapy. Heidelberg, Springer: 205-227, 2003.

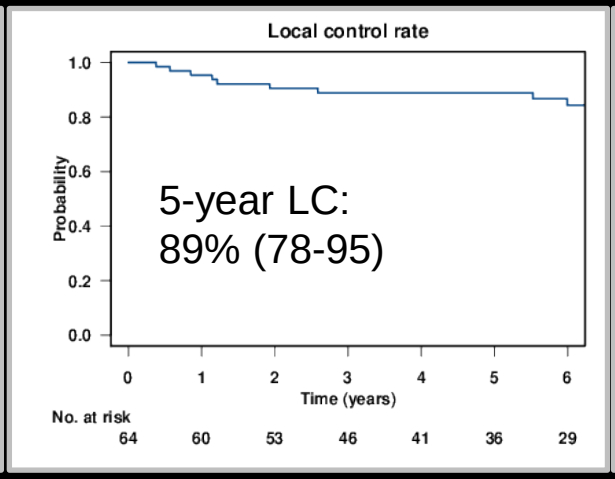
Our indications: pre-op RT in HN STS

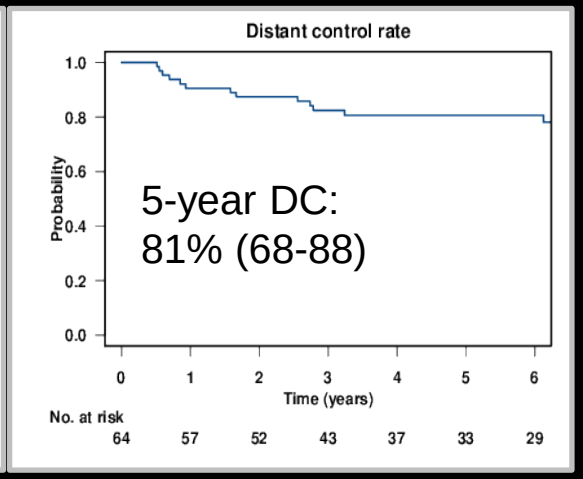
- The need to maximally restrict RT volumes in certain sites (eg. proximity to optic apparatus, spinal cord, brain stem etc.)
- Desire to also minimize RT dose in some anatomic sites (e.g. pharynx, parotid, mandible etc.)

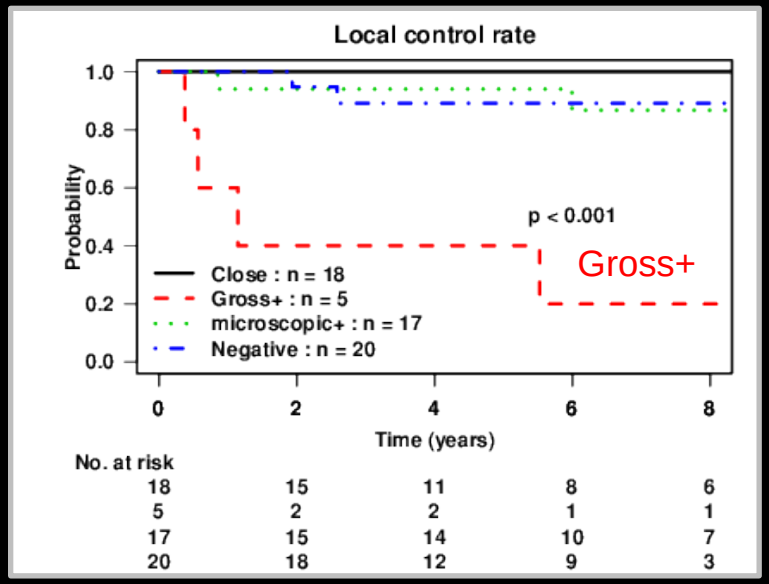
➢ *But be mindful of consequences of wound complications in this location*

Outcomes (Median FU: 6.6 years)









Local Control by Margin Status

Margin Status	HR(95%CI)	p-value
Close	Reference	
Microscopic+	2.3 (0.3,19.1)	0.43
Negative	2.2 (0.3,17.9)	0.45
Gross+	36.2 (6.6,197.8)	**<0.001**

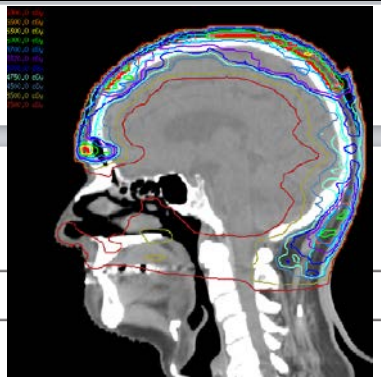
Prospective Cohort (n=60), Unpublished
Period: 1990 – 2014
Outcomes:
Control rates similar to extremity sarcoma

Angiosarcoma – local treatments

- Very capricious tumor in its typical scalp location, with “multifocality”
- Defeats surgical prediction of where the margin should be, and similarly for radiotherapy
  - Currently for scalp lesions we treat whole scalp electively (IMRT) and often parotid and upper neck on the dominant side
  - RT Responsive but recur unpredictably
  - Careful decisions about interdigitating surgery and radiotherapy, and must treat individually

HEAD & NECK

JOURNAL OF THE SCIENCES AND SPECIALTIES OF THE HEAD AND NECK



Published on Line 2017, cover edition

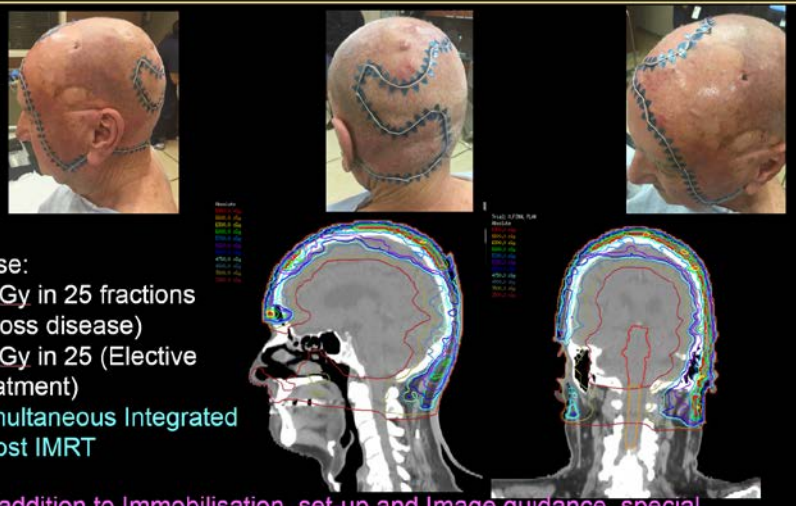
ORIGINAL ARTICLE

Survival outcomes for cutaneous angiosarcoma of the scalp versus face

Jonathan M. Bernstein, MD, FRCS,[1] Jonathan C. Irish, MD, FRCSC,[1]* Dale H. Brown, MD, FRCSC,[1] David Goldstein, MD, FRCSC,[1] Peter Chung, MBChB, FRCPC,[2] Albiruni R. Abdul Razak, MB, MRCPI,[3] Charles Catton, MD, FRCSC,[2] Ralph W. Gilbert, MD, FRCSC,[1] Patrick J. Gullane, MB, FRCSC,[1] Brian O'Sullivan, MD, FRCPC[2]

[1]Department of Otolaryngology – Head and Neck Surgery / Surgical Oncology, University of Toronto, Princess Margaret Cancer Centre, University Health Network, Toronto, Ontario, Canada, [2]Department of Radiation Oncology, University of Toronto, Princess Margaret Cancer Centre, University Health Network, Toronto, Ontario, Canada, [3]Department of Medical Oncology, University of Toronto, Princess Margaret Cancer Centre, University Health Network, Toronto, Ontario, Canada.

Complex radiotherapy techniques for Angiosarcoma



Dose:
60 Gy in 25 fractions (Gross disease)
50 Gy in 25 (Elective treatment)
Simultaneous Integrated Boost IMRT

In addition to Immobilisation, set-up and Image guidance, special attention to surface dose needed (real and painted bolus)

- Scalp angiosarocoma has worse survival than Facial primaries (multiple reasons)
- Radiotherapy alone can cure these lesions but generally small facial area
- Large fields can be effective (unpredictable)
- Surgery normally limited to localised plaque-like disease, not the "paint-splatter" version of disease
- We use also use Taxanes with good response: local treatment then follows

Retroperitoneal STS - Rationale for pre-op RT

Pre-operative

Post-operative

Tolerance:

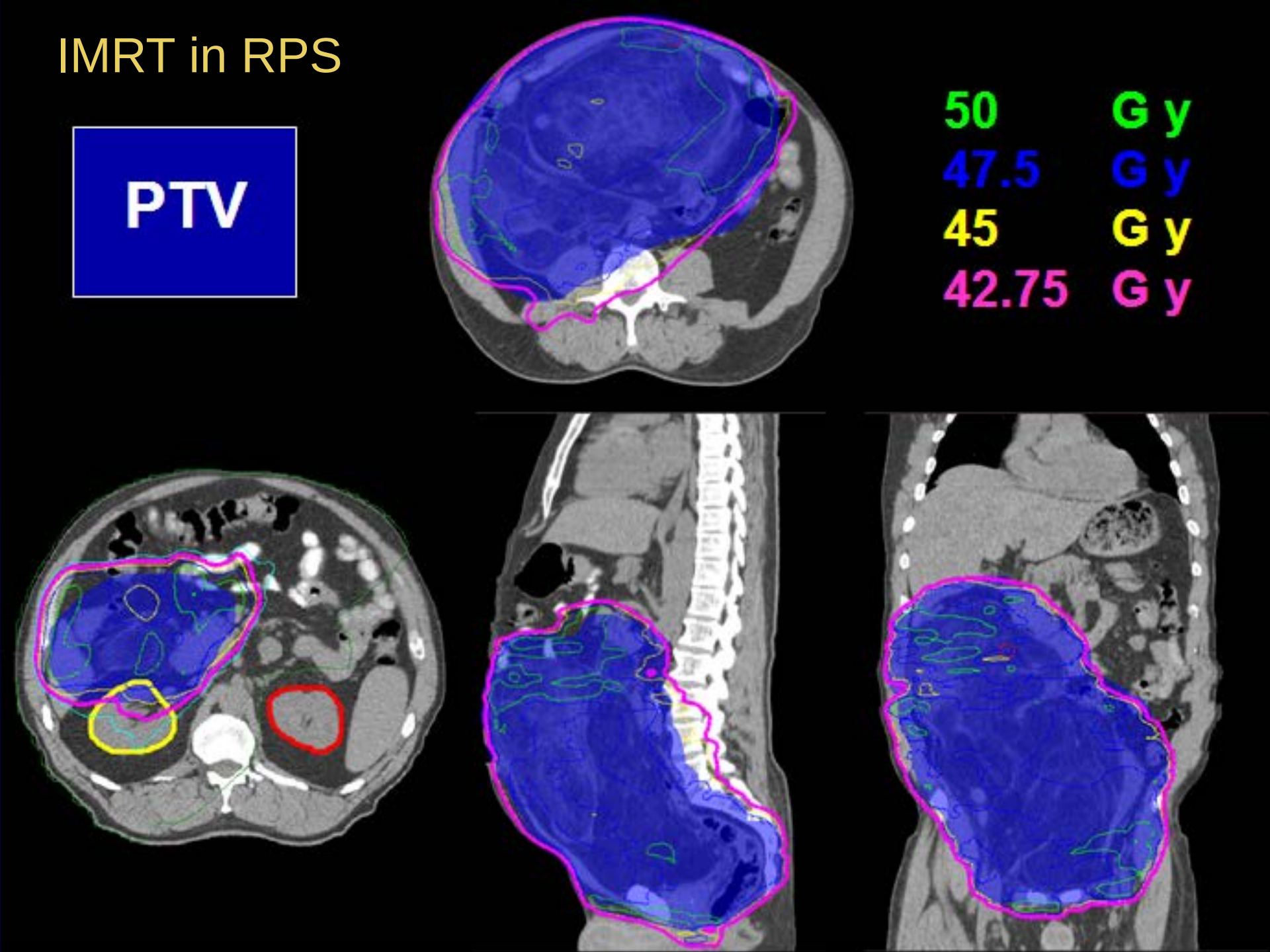
- Acute: bowel displaced
- Late: bowel not fixed as well as not displaced

Potential efficacy issues:

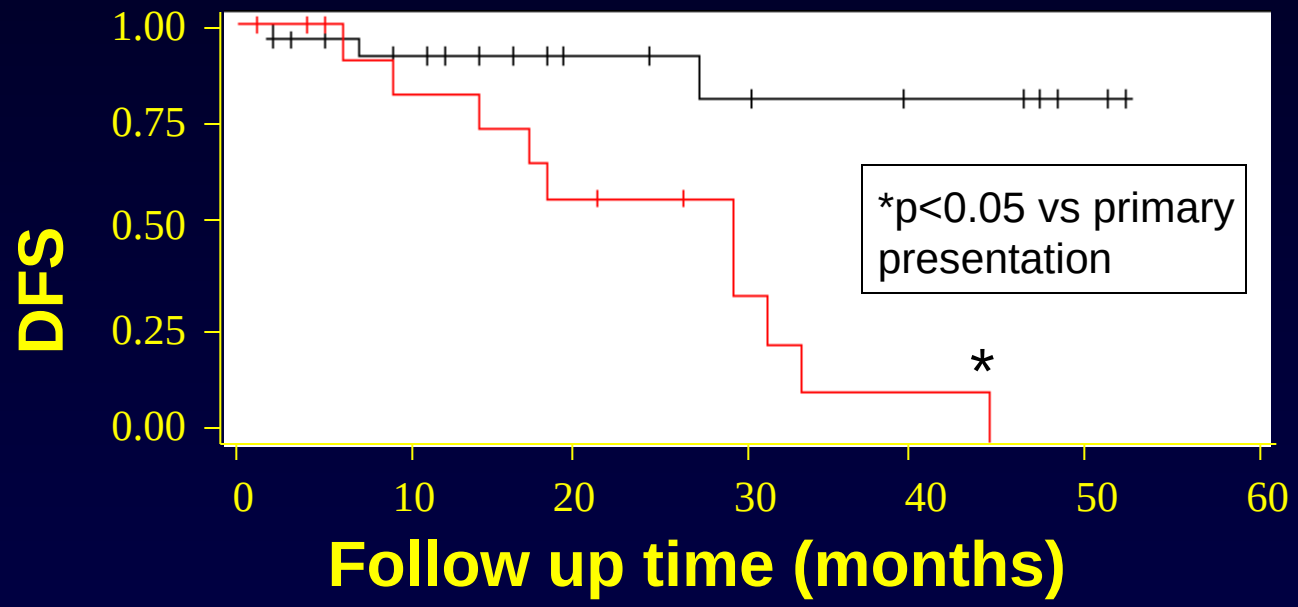
- Peritoneal barrier intact
- RT dose more effective
- Cavity not contaminated
- RT target better defined
- RT dose can be enhanced

Question: is radiotherapy of value, and if so what is the timing, dose and technique ?

IMRT in RPS



Initial results of a trial of pre-operative external-beam radiation therapy and postoperative brachytherapy for retroperitoneal sarcoma



Jones, et al Annals of Surgical oncology, 9(4): 346-354, 2002

Initial results of a trial of pre-operative external-beam radiation therapy and postoperative brachytherapy for retroperitoneal sarcoma

Jones, et al Annals of Surgical oncology, 9(4): 346-354, 2002

Contents lists available at ScienceDirect

Radiotherapy and Oncology

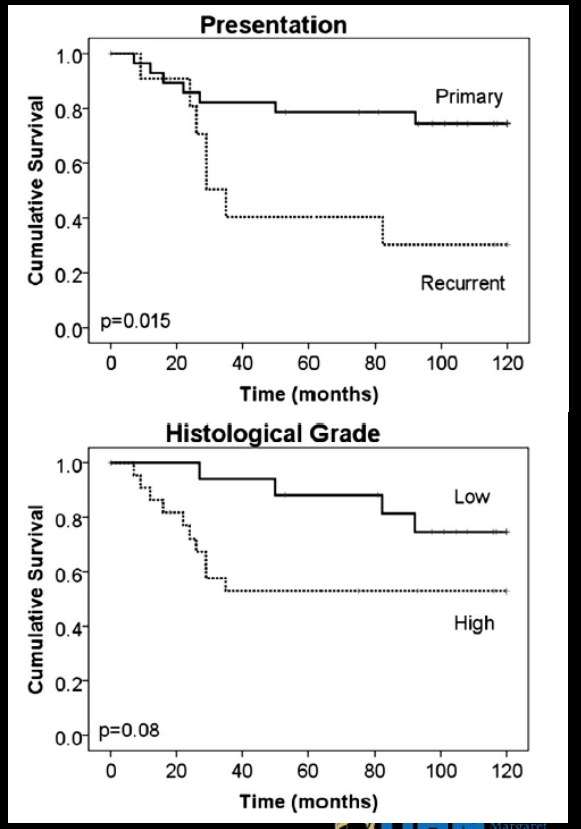
Radiotherapy and Oncology 110 (2014) 165–171

Phase II trial

Combined management of retroperitoneal sarcoma with dose intensification radiotherapy and resection: Long-term results of a prospective trial

Myles J.F. Smith [a,b], Paul F. Ridgway [c], Charles N. Catton [a,d], Amanda J. Cannell [a,b], Brian O'Sullivan [a,d], Lynn A. Mikula [e], Julia J. Jones [f], Carol J. Swallow [a,b,*]

- 40 patients had preoperative XRT and total gross resection in a prospective trial
- Median FU 106 mos
- RFS reduced in high vs low grade at 10 yrs
  - 53 % vs. 75 %
- 10 yrs RFS / OS reduced in recurrent vs primary disease presentation
  - RFS 30 % vs. 74 %
  - OS 36 % vs. 76 %



Preoperative or postoperative radiotherapy versus surgery alone for retroperitoneal sarcoma: a case-control, propensity score-matched analysis of a nationwide clinical oncology database

Lancet Oncol 2016; 17: 966–75

Daniel P Nussbaum, Christel N Rushing, Whitney O Lane, Diana M Cardona, David G Kirsch, Bercedis L Peterson, Dan G Blazer 3rd

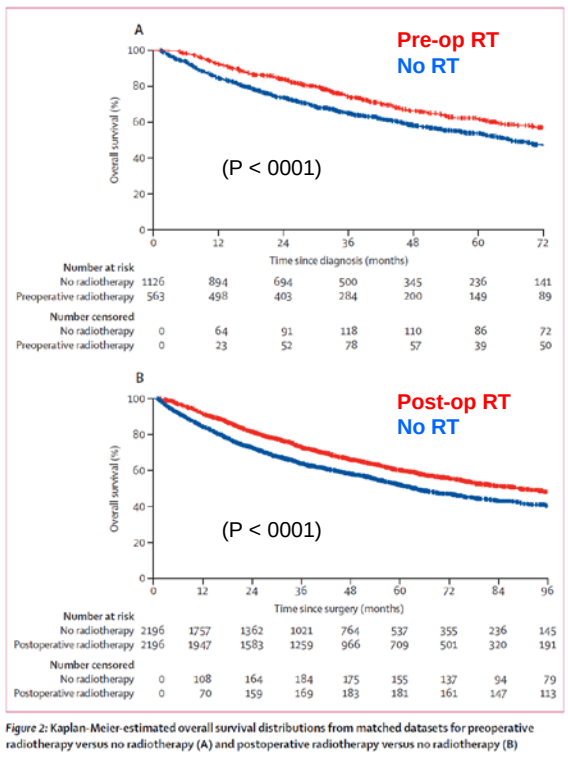


Figure 2: Kaplan-Meier-estimated overall survival distributions from matched datasets for preoperative radiotherapy versus no radiotherapy (A) and postoperative radiotherapy versus no radiotherapy (B)

National Cancer Data Base (NCDB)

Total cohort (localized primary RPS):	9068
Pre-op Radiotherapy (RT)	563
Post-op Radiotherapy (RT)	2215
No Radiotherapy (RT)	6290

Both approaches (pre- vs post-op RT) improve survival
Suggestion is that the current EORTC trial may be underpowered

EORTC Study (STRASS)

Patients with Primary untreated STS of RPS or pelvis

R
(1/1)

PIs:
Sylvie Bonvalot (Surgical Oncology)
Rick Haas (Radiation Oncology)

Arm 1

Curative intent surgery Alone

Arm 2

1) Preop RT within 8 wks
2) Repeat thoraco-abdo-pelvic CT 2 wks after end of RT
3) Curative intent surgery within 4-8 wks

Arm 1: 14, 24, 36, 48 weeks after randomization and Q6 mo thereafter until recurrence or death.

Arm 2: 24, 36, 48 weeks after randomization and Q6 mo thereafter until recurrence or death.

Temporary "on hold" for an unplanned interim analysis: if trend towards efficacy for RT, 80 additional patients to be added

EORTC European Organisation for Research and Treatment of Cancer

STRASS –EORTC 62092-22092

NEWSLETTER Issue January 2016

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Status of the trial 4 years after initiation

United Kingdom
Leeds – R. Turner
Newcastle - D. Lee
Sheffield - M. Robinson
Manchester - J. Wylie
London - D. Strauss
London ucl - B. Seddon
Birmingham - j. Sherriff
Bristol – M. Beasley
Glasgow - F. Cowie
Nottingham - C. Esler
Edinburgh - I. Fragkandrea

The Netherlands
Amsterdam – R. Haas
Nijmegen - J. Bonenkamp
Leiden – R.A.Nout
Groningen - R.J. Van Ginkel

Norway
Oslo – S. Stoldt

Sweden
Stockholm – J. Ahlen

Denmark
Herlev – A. Krarup-Hansen

Belgium
Brussels – D. Van Gestel
Leuven – D. Hompes

Poland
Warsaw - M. Szacht

France
Villejuif – C. LePéchoux
Lyon – P. Meeus
Bordeaux – E. Stoeckle
Paris – S. Bonvalot
Toulouse – M Delannes
Nice – J. Thariat
Montpellier – C. Llacer

Italy
Milano - A. Gronchi
Rozzano - V. Quagliuolo
Milano ieo – E. Pennachioli
Aviano – A. De Paoli
Padova – M. Rastrelli

Germany
Muenchen – J. Theisen
Koeln – S. Moenig
Muenchen – C. Belka
Mannheim - P. Hohenberger
Essen – Ch. Poettgen

Spain
Madrid – J.A. Corona
Barcelona – R. Verges

NON-EUROPEAN COUNTRY :
UNITED STATES Boston – Ch. Raut
CANADA Toronto - C. Swallow
Montreal – Ph. Wong

Green = recruiting
Red = not yet recruiting
Black = to be activated

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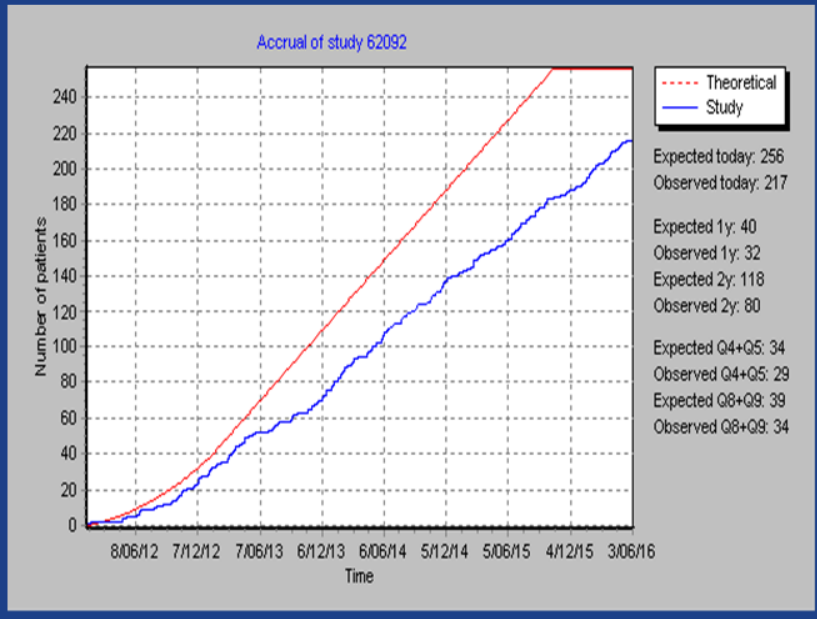
NEWSLETTER Issue January 2016

The STRASS study is activated in 11 European countries and 2 non-european Countries (United States and Canada). In total, 43 institutions are foreseen to participate to this trial.
Today 217 patients have been registered as showed on the curve below



Innovative radiotherapy of sarcoma: Proton beam radiation

Thomas F. DeLaney [a,b,c,d,1], Rick L.M. Haas [e,*]

European Journal of Cancer 62 (2016)

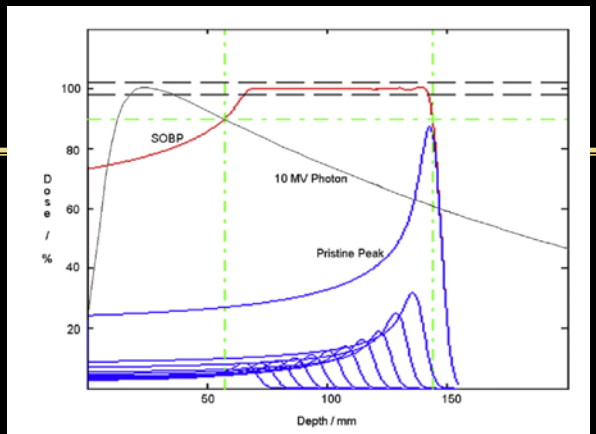


Fig. 1. Proton Bragg peaks of increasing energy and range (courtesy of Hanne Kooy, PhD, Massachusetts General Hospital, Boston, MA).

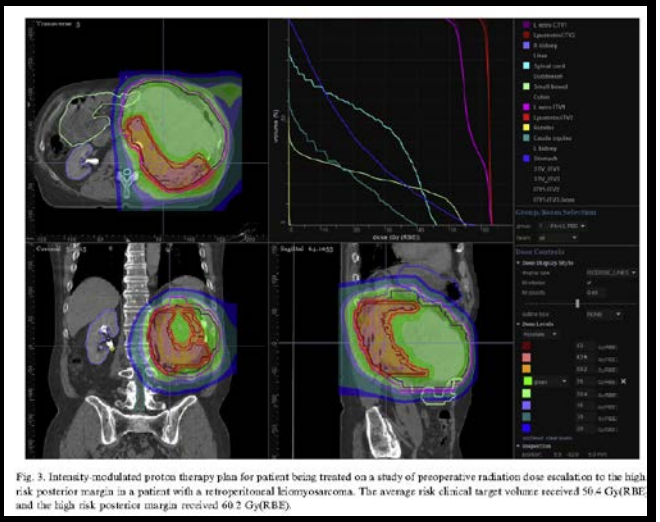


Fig. 3. Intensity-modulated proton therapy plan for patient being treated on a study of preoperative radiation dose escalation to the high risk posterior margin in a patient with a retroperitoneal leiomyosarcoma. The average risk clinical target volume received 50.4 Gy(RBE) and the high risk posterior margin received 60.2 Gy(RBE).

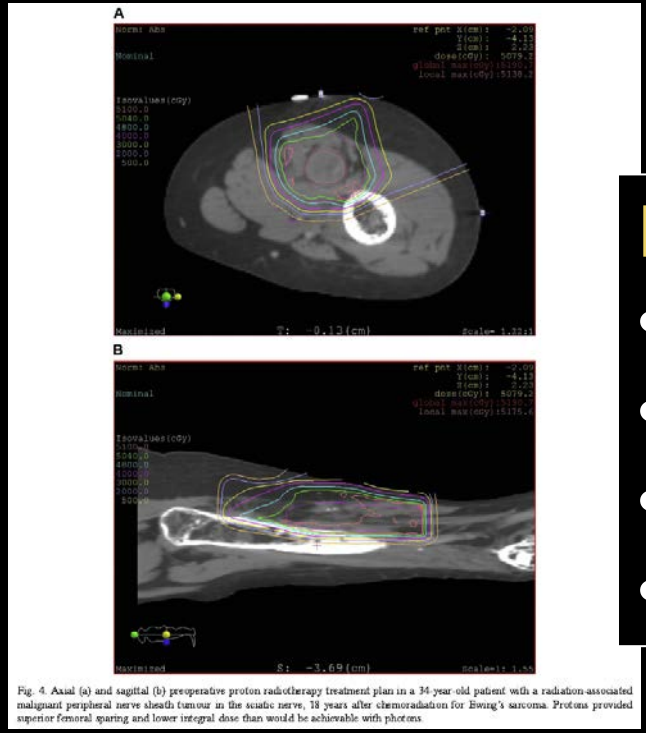


Fig. 4. Axial (a) and sagittal (b) preoperative proton radiotherapy treatment plan in a 34-year-old patient with a radiation-associated malignant peripheral nerve sheath tumour in the sciatic nerve, 18 years after chemoradiation for Ewing's sarcoma. Protons provided superior femoral sparing and lower integral dose than would be achievable with photons.

My thoughts:

- Skull base
- Spine
- Re-treatment
- Children

From Tom and Rick:

"In conclusion, PBT has gained its place among the armamentarium of modern radiotherapy techniques. PBT, if calculated on proper socio-economic grounds, is even quite cost-effective"

UHN Princess Margaret Cancer Centre

Take Home Points (1)

- Adjuvant RT for Extremity STS
  - Benefit in local disease control, >90%
  - High grade, deep seated, large tumors
- Still need to define who does not need RT
- Adjuvant RT for Retroperitoneal STS
  - Paucity of evidence
  - STRASS Trial has accrued, holding pending Interim analysis
  - Pre-op - favorable LC / OS, low toxicity

Take Home Points (2)

- Two Pre-op prospective phase 2 IGRT extremity trials
  - PMH and RTOG 0630
  - Significantly different irradiated volumes
    - Early reports of reduction in acute / late toxicities
      - Compared to the NCIC SR2 trial (O'Sullivan et al 2002)
- Post- op prospective multicenter trial (extremity)
  - VORTEX UK for Modest reduction in Field Size seems safe (Robinson M, ASTRO 2016)
- Pre-op vs Post-op 50 / 50 Trial accruing
- Role of new Technologies is evolving
- Need to develop approaches with other modalities