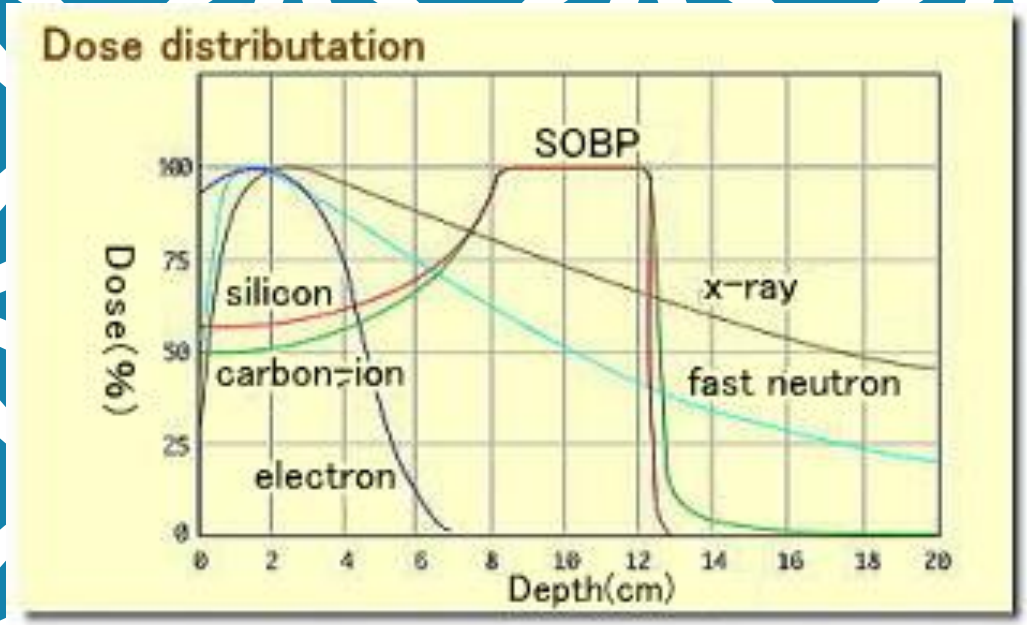
@DRRUXINWONG



PARTICLE THERAPY FOR SPINAL/BONE SARCOMAS

Singapore Orthopaedic Association 45th Annual Scientific Meeting
25th Nov 2023

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www.ro-se.org

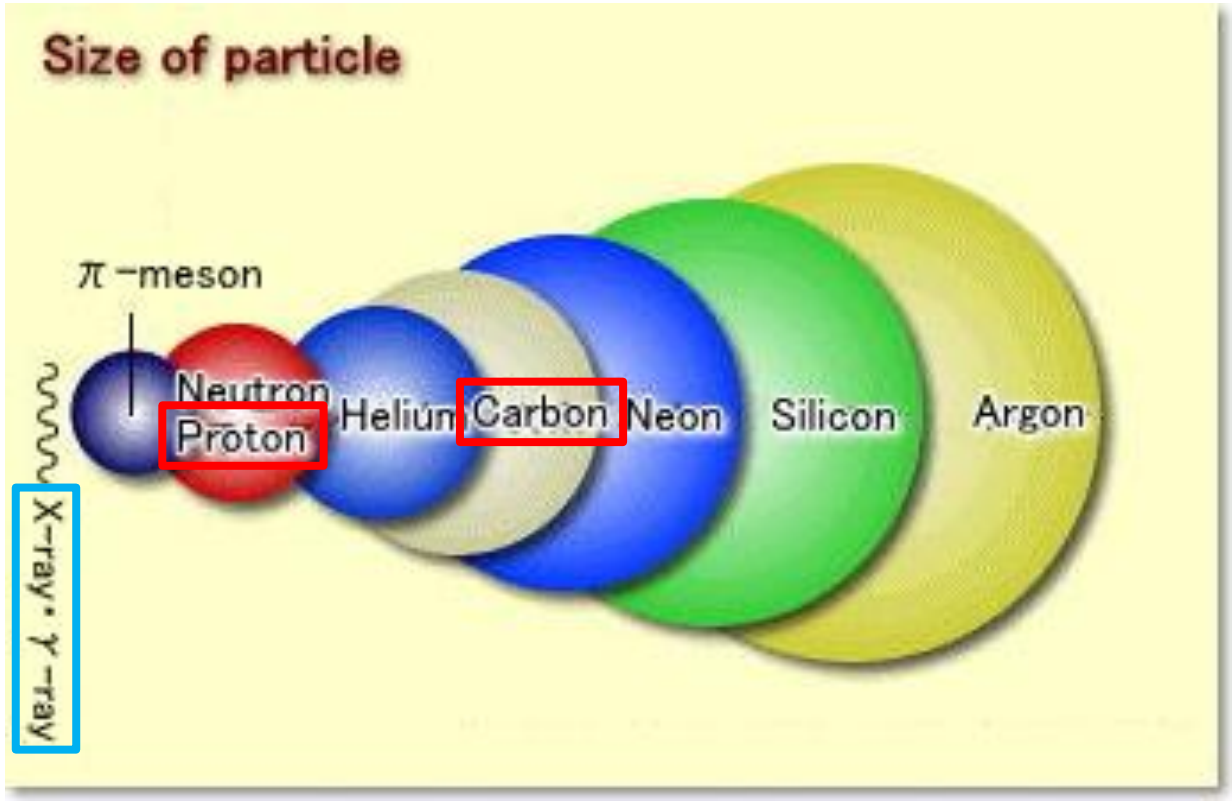
WHAT IS PARTICLE THERAPY?

Conventional radiotherapy

- X-rays, γ-rays
  - Waves of light
    - Electric charge (-)
    - Mass (-)

Particle therapy

- Protons, carbon ions
  - Particles of ion
    - Electric charge (+)
    - Mass (+)

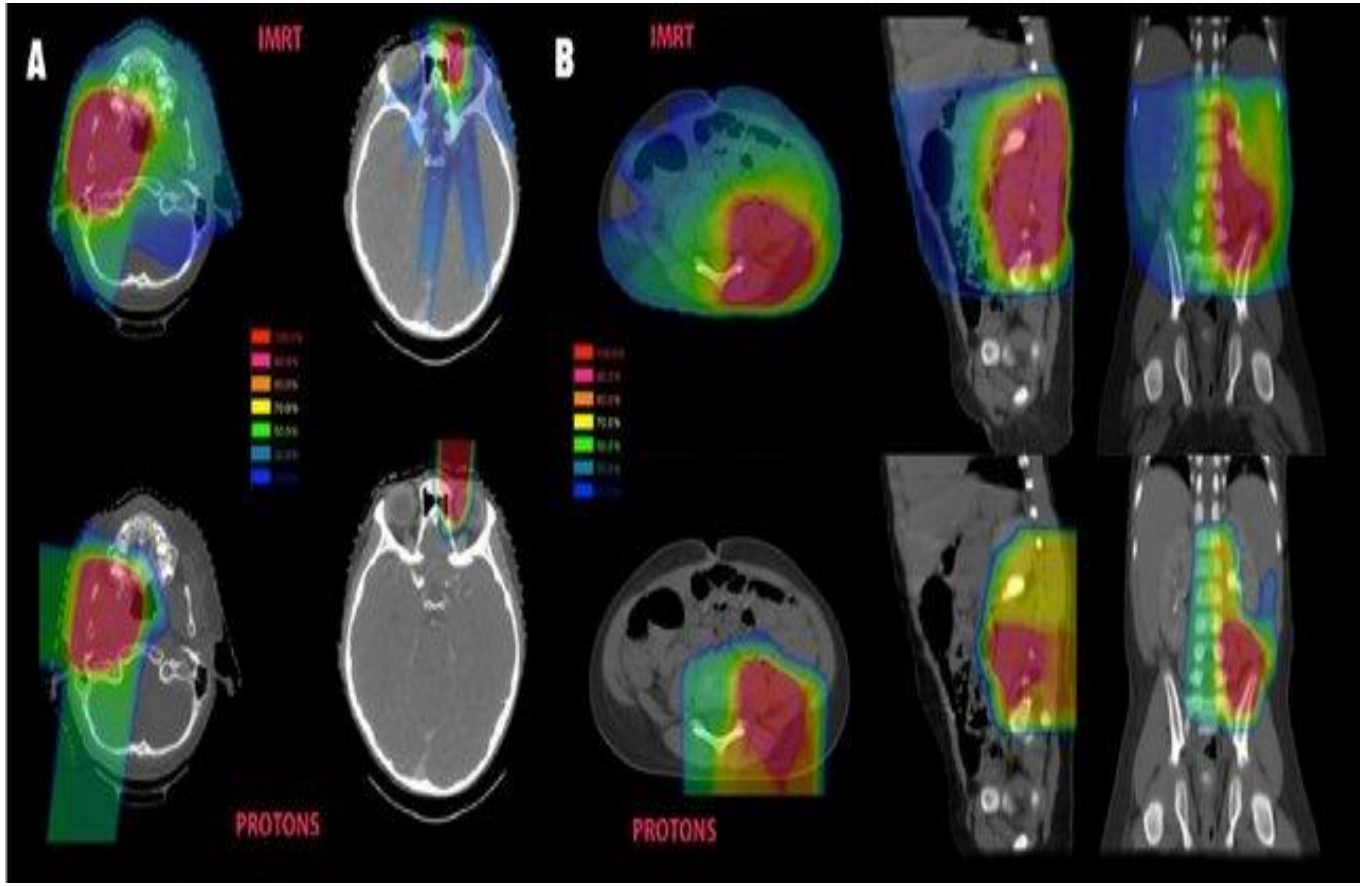


Credit: Dr Yusuke Demizu

ESSENCE

Distal sparing

Allowing for dose escalation



Credit: Torunn Yock
Cancer 2014

A: Pediatric rhabdo

B: pediatric pelvic sarcoma

MOH indications for adults

MINISTRY OF HEALTH
SINGAPORE

For Public | For Healthcare Professionals | e-Services | Who We Are

MediShield Life Claim and MediSave Withdrawal Limits for Approved Proton Beam Therapy (PBT) Indications

S/N	Indication	PBT Category	MediShield Life Claim Limit	MediSave Withdrawal Limit
Cancer subtypes for patients of all ages				
Musculoskeletal system				
1	Base of Skull Chordoma	3	$1,800 per treatment	$2,800 per treatment
2	Base of Skull Chondrosarcoma			
3	Spinal and Paraspinal Bone and Soft Tissue Sarcoma	1	$300 per treatment	$80 per treatment
4	Non-metastatic retroperitoneal sarcomas			

Pediatric and young adults

Musculoskeletal				
28	Ewing sarcoma			
29	Spinal/ paraspinal bone and soft tissue sarcoma			
30	Rhabdomyosarcoma: orbit, parameningeal, head and neck, pelvis	1	$300 per treatment	$80 per treatment
31	Pelvic Sarcoma			
32	Osteosarcoma			

BONE AND SOFT TISSUE SARCOMAS (BSTSS)

Indications for particle therapy

- Malignant histology >> definitive or adjuvant
- Unresectable: skull base (SB), spine, pelvis, face etc.
- No metastasis (but allowed if oligomets in ewing/RMS)

One of the best indications for particle therapy

- treated with particle therapy since its early history.

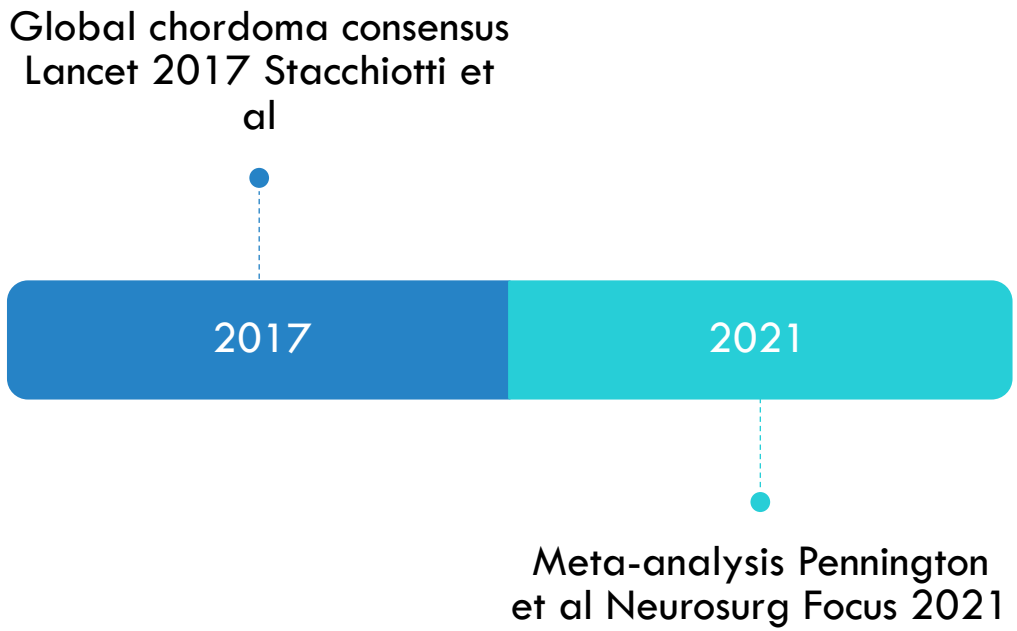
OUTLINE

- spinal chordoma/CS
- unresectable truncal/soft tissue sarcomas
- pediatric sarcomas

EVIDENCE

Chordoma/CS

SPINE AND SACRAL CHORDOMA CHONDROSARCOMA



Japanese experience: past to present

Building a global consensus approach to chordoma: a position paper from the medical and patient community

*Silvia Stacchiotti, Josh Sommer, on behalf of a Chordoma global consensus group**

Chordomas are very rare bone malignant tumours that have had a shortage of effective treatments for a long time. New treatments are now available for both the local and the metastatic phase of the disease, but the degree of uncertainty in selecting the most appropriate treatment remains high and their adoption remains inconsistent across the world, resulting in suboptimum outcomes for many patients. In December, 2013, the European Society for Medical Oncology (ESMO) convened a consensus meeting to update its clinical practice guidelines on sarcomas. ESMO also hosted a parallel consensus meeting on chordoma that included more than 40 chordoma experts from several disciplines and from both sides of the Atlantic, with the contribution and sponsorship of the Chordoma Foundation, a global patient advocacy group. The consensus reached at that meeting is shown in this position paper.

Lancet Oncol 2015; 16: e71–83

*Members of this group are listed in the appendix

Adult Mesenchymal Tumour Medical Therapy Unit, Cancer Medicine Department, Fondazione IRCCS Istituto Nazionale dei Tumori, Milan, Italy (S Stacchiotti MD); **and Chordoma Foundation, Durham, USA** (J Sommer)

Correspondence to:
Dr Silvia Stacchiotti, Adult Mesenchymal Tumour Medical

Introduction

Chordomas are rare cancers, which have long been in need of more effective treatments. Innovative treatment

one every 100 000.[3] Chordoma is a tumour showing notochordal differentiation. The notochord disappears in human beings at about 8 weeks in the fetal

SACRAL SPINE

Chordoma global consensus

complete en-bloc resection (level of evidence IV, recommendation A).

Intralesional surgery followed by RT not an equivalent (level of evidence V, recommendation A).

Tumour rupture must be avoided : seeding (level of evidence IV, recommendation E).

SACRAL SPINE

Chordoma global consensus

- adequate margins are only achieved in roughly 50% of cases
- anterior resection plane should not fall just beyond the sacral fascia (level of evidence V, recommendation B
- Resection should include the mesosigmoid or mesorectum
- colostomy to avoid bone infection from colorectal fistula (level of evidence V, recommendation C

SACRAL SPINE

Chordoma global consensus

Extension to gluteal muscles or along the sacro-tuberous ligaments

Soft tissue cover includes

- Omentoplasty
- rectus muscle myocutaneous

SACRAL SPINE

Chordoma global consensus

For tumours arising from S4 and below, surgery should definitely be offered (level of evidence IV, recommendation A).

from S3, surgery is the standard treatment, if preservation of S2 roots is possible

above S3, surgery always results in neurological sequelae

risks and benefits of surgery versus radiation alone should be discussed with the patient (level of evidence IV, recommendation B)

S1, surgery has substantial morbidity. Definitive radiotherapy should be regarded as a valid alternative (level of evidence V, recommendation C)

SACRAL SPINE

Chordoma global consensus

Carbon ion or proton-beam radiotherapy should be used for definitive treatment after biopsy only in patients who do not want surgery (level of evidence V*, recommendation A)

THORACOLUMBAR

Surgical principles similar to sacral tumours

Thoracic most suitable to resection with acceptable morbidities. (level of evidence IV, recommendation B).

Lumbar vertebral bodies is inevitably followed by major functional sequelae. If feasible, R0 resection remains the primary approach (level of evidence IV, recommendation B), but alternatives should be discussed

When tumour extension into the neck, the thorax or mediastinum, or the retroperitoneum, a combination of radiotherapy and surgery can be considered (level of evidence V, recommendation B).

Definitive radiotherapy has to be considered when the disease is not resectable or neurological impairment is not acceptable (level of evidence V, recommendation A).

THORACOLUMBAR

Chordoma global consensus

The potential effect of spine-stabilising metal implants should be discussed by the surgeon and the radiation oncologist before surgery

→Streak artefacts

→Implants can interact with particle therapy

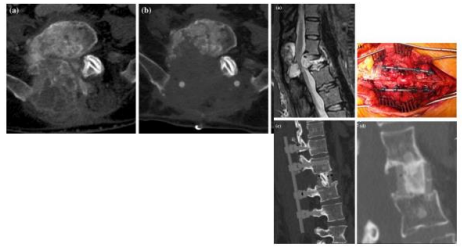
How to deal with metallic artefacts ?

Eur Spine J
DOI 10.1007/s00586-017-5258-5

ORIGINAL ARTICLE

Carbon-fiber-reinforced PEEK fixation system in the treatment of spine tumors: a preliminary report

Stefano Boriani[1] · Giuseppe Tedesco[2] · Lu Ming[3] · Riccardo Ghermandi[2] · Maurizio Amichetti[4] · Piero Fossati[5] · Marco Krengli[6] · Loredana Mavilla[7] · Alessandro Gasbarrini[2]

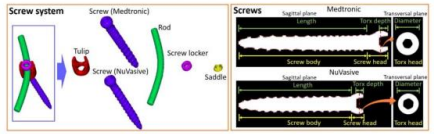


ESTRO School

J Appl Clin Med Phys. 2023;24:e13800.

A component method to delineate surgical spine implants for proton Monte Carlo dose calculation

Chih-Wei Chang[1] | Serdar Charyyev[1] | Joseph Harms[2] | Roelf Slopsema[3] | Jonathan Wolf[1] | Daniel Refai[3] | Tim Yoon[4] | Mark W. McDonald[1] | Jeffrey D. Bradley[1] | Shuai Leng[5] | Jun Zhou[1] | Xiaofeng Yang[1,6] | Liyong Lin[1]



By combining prior implant knowledge, extended HU, and a fine resolution reconstruction, a novel component method for surgical implant delineation, was developed for the recently introduced MC in commercial treatment planning systems. It was applied on the screw systems from two major vendors in a spine surgeon phantom and a patient, respectively. The method shows accurate implant characterization, potentially improving proton MC dose calculation for patients with metallic implants.

Spinal Chordoma treated by protons at PSI

ESTRO School

100 patients included in the study,
median follow-up >5 years (65 months; range, 13-175 months)

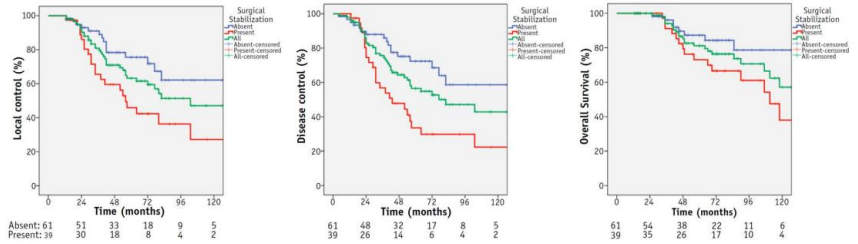


Fig. 2. Local control, disease control, and overall survival stratified by presence or absence of surgical stabilization.

(Snider JW et al, IJROBP, 2018)

IMPLANTS

IS GTR NECESSARY? WHAT ABOUT STABILISING INSTRUMENTS?

Local Control After Proton Therapy for Pediatric Chordoma

Red journal 2021, Indelicato et al

5-yr LC 85%, no diff btw GTR/STR/no sx

Implants a/w complications

IMPLANTS

Confounders
- larger tumours
- complex locations

Possible reasons
- scattering of protons, streak artefacts

META-ANALYSIS

NEUROSURGICAL FOCUS

Neurosurg Focus 50 (5):E17, 2021

Systematic review of charged-particle therapy for chordomas and sarcomas of the mobile spine and sacrum

Zach Pennington, BS,[1] Jeff Ehresman, BS,[1] Aladine A. Elsamadicy, MD,[2] John H. Shin, MD,[3] C. Rory Goodwin, MD, PhD,[4] Joseph H. Schwab, MD,[5] and Daniel M. Sciubba, MD[1]

[1]Department of Neurosurgery, Johns Hopkins University School of Medicine, Baltimore, Maryland; [2]Department of Neurosurgery, Yale University School of Medicine, New Haven, Connecticut; [3]Department of Neurosurgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts; [4]Department of Neurosurgery, Duke University Medical Center, Durham, North Carolina; and [5]Department of Orthopaedic Surgery, Massachusetts General Hospital, Harvard Medical School, Boston, Massachusetts

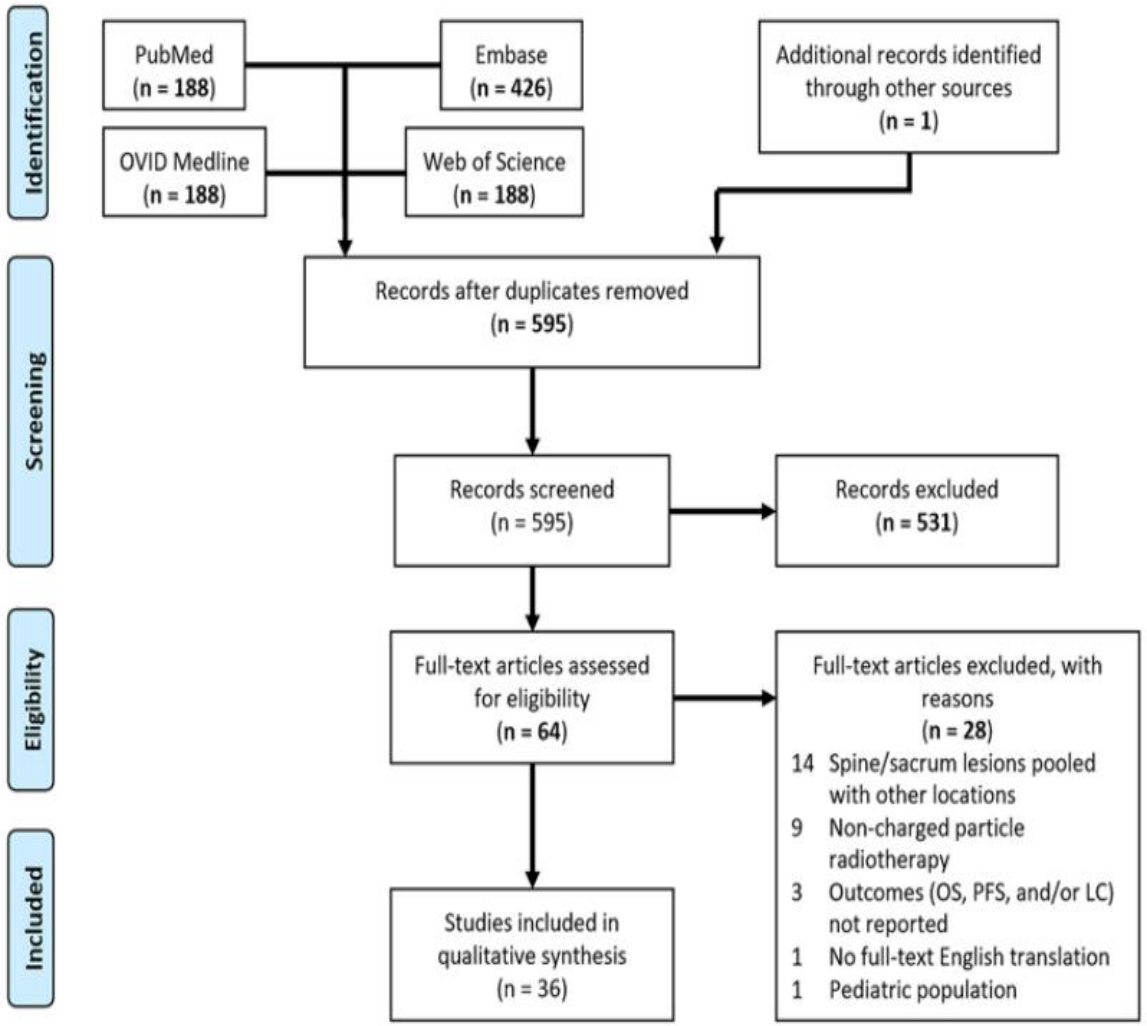


FIG. 1. PRISMA flow diagram for study queries.

TABLE 1. Series describing outcomes for patients treated with proton-only regimens

Authors & Year (LOE)	Neuropathology	Pt Demogr: Sex; Med Age; Med FU; Med CTV	RT Regimen	Op Outcome	LC & Mets	OS	PFS, DFS, DSS, &/or RFS	Vol Resp	Toxicity	
									Acute	Late
Aibe et al. 2018[11]* (IV)	33 chrd, 11 w/ pre-RT surgical spacer placement; 100% S	55% M; 71 yrs; 37 mos; 284.4 cm^3	TD 70.4 RBE, frx 2.2 RBE, 5 days/wk × 6 wks	NA	3-yr LC: 81.8%; mets 11.8%; med time to mets 28 mos	3-yr 92.7%	3-yr PFS 89.6% & DFS 81.9%	NG	Overall: ≥64%, ≥3% grd ≥3; skin: 32% grd 2, 2% grd 3; GI: 2% grd 3; GU: 5% grd 2; pain: 47% grd 2; other: 9% grd 2	Overall: ≥58%, ≥6% grd ≥3; pain: 43% grd 2; sacral frac: 9% grd 2, 5% grd 3; GI: 5% grd 2, 2% grd 3; GU: 5% grd 2; neurop: 5% grd 2
Cote et al., 2018[22]† (IV)	22 high-risk chrd; LOC: 1 T, 8 L, 13 S	59% M; 65 yrs; 44.8 mos; NG	TD med 73.8 RBE, preop 50.4 RBE, frx 1.8; 5 days/wk × 6 wks; concurrent nilotinib 200 mg 2/day × 56 days	45% op, 55% no op	LC: NG; mets: NG	2-yr 95%, LFU 77%, med 61.5 mos	2-yr med PFS 58.2 mos, ~90% of pts	NG	RT toxicity not separated from nilotinib toxicity	RT toxicity not separated from nilotinib toxicity
Demizu et al., 2017[33]*‡ (IV)	28 spine chrd sarcoma; LOC: 8 C, 5 L, 2 L/S, 13 S	NG; NG; NG; NG	TD med 70.0 Gy; frx NG; time NG	61% op, 39% no op	5-yr 55.6%; mets: NG	5-yr 70.7%	5-yr PFS 30.7%	NG	Not separated from skull base outcomes	Not separated from skull base outcomes
Indelicato et al., 2016[40] (IV)	34 chrd; 17 cndr; LOC: 20 C, 10 T/L, 21 S	66% M; 58 yrs; 3.7 yrs; NG	TD med 70.2 RBE (chrd 70.2, cndr 72 RBE); frx NG; time NG; 28 prRT; 23 prRT + phRT	NG; instrumentation in 47%	LC: 4-yr 58%, mets: 14%; LR: 35% med 1.7 yrs	4-yr 72%	PFS med 1.7 yrs; DFS: 57%; DSS 4-yr 72%	NG	NG	Overall: 16% grd ≥3; 2 secondary cancer
Murray et al., 2020[41]§ (IV)	116 chrd; LOC: 50 C, 8 T, 13 L, 45 S	60% M; 57 yrs; 64.7 mos; 809 cm^3	TD med 74 RBE; frx NG; time NG; 90% prRT only; 10% prRT + phRT	57% R0/R1; 43% R2/biopsy only; instrumentation in 43%	LC: 67.9% 5 yrs; mets: 17.2% LFU; LR: 32.8% LFU	81.6% 5 yrs	DFS 5-yr 62.1%	NG	NG	Chrd + cndr pooled; overall: 33.5%; 7.7% grd ≥3
Murray et al., 2020[41]§ (IV)	39 cndr; LOC: 11 C, 21 T, 0 L, 1 S; 6 pelvis	64% M; 50 yrs; 64.7 mos; 386 cm^3	TD med 70 RBE; frx NG; time NG; 85% prRT only; 15% prRT + phRT	64% R0/R1; 36% R2/biopsy only; instrumentation in 41%	LC: 55.9% 5 yrs; mets: 17.9% LFU; LR: 38.5% LFU	67.3% 5 yrs	DFS 5-yr 51.7%	NG	NG	Chrd + cndr pooled; overall: 33.5%; 7.7% grd ≥3
Snider et al., 2018[42]§ (IV)	100 spinal chrd; LOC: 46 C, 4 T, 12 L, 38 S	57% M; 56 yrs; 65 mos; NG	TD med 74 RBE; frx 1.8–2 RBE; time NG; 88% prRT; 12% phRT-prRT combo	40% R0/R1 rsxn; 60% R2 rsxn; 39% w/ instrumentation	LC: 5-yr 63% med 103 mos; 63% LFU; mets: NG	81% 5 yrs; med 157 mos	PFS 5-yr 57%, med 82 mos	NG	Overall: 8% grd ≥3; skin: 6% grd 3; mucositis: 2% grd 3	Overall: 5% grd ≥3; sacral frx: 3% grd 3; GI: 2% grd 3
Staab et al., 2011[43]§ (IV)	40 chrd; LOC: 16 C, 3 T, 1 T/L, 10 L, 11 S	63% M; 58 yrs; 43 mos; NG	TD med 74 RBE; frx 1.8–2.0 RBE; 4 days/wk × 8–10 wks; 78% prRT; 22% prRT + phRT	53% R0/R1; 47% R2; 53% prior instrumentation	LC: 62% 5 yrs; mets: NG	80% 5 yrs	DFS 5-yr 57%	NG	Overall: 2.5%; 0% grd ≥3; post-RT neurop 2.5%	Overall: 5% grd ≥3; 1 secondary malignancy, 1 vertebral frac requiring op
Tran et al., 2020[44]§ (IV)	5 unresec chrd; LOC: 100% S	100% M; 67 yrs; 18 mos; NG	TD 70 RBE; frx 2.5 RBE; 41 days w/ 39°–42°C hyperthermia	NA	LC: 100%; mets: 0%	Med >18 mos	PFS med >18 mos; DSS >18 mos	Initial ↑ in 4/5; 9–72% ↓ (med 48%) LFU	Overall: 100%; 20% grd ≥3; pain: 100% grd 2–3; skin: 60% grd 2; GI: 20% grd 3	Overall: 60%; 0% grd ≥3, 20% grd 3, iliac frac; skin: 20% grd 2; GI: 20% grd 1

CONCLUSIONS FROM META-A:

Of those studies including only nonsurgical patients, LC is similar for patients treated with protons (82% at 3 years) and CIRT (72%– 100% at 5 years)

LC and OS appear similar between patients treated with definitive charged-particle (proton or hadron-based) radiotherapy and historical multicenter surgical cohorts of chordoma (LC approximately 75%–80% and OS approximately 70%–85% at 5 years following R0 resection)

BSTSS TREATED WITH PARTICLE THERAPY IN JAPAN

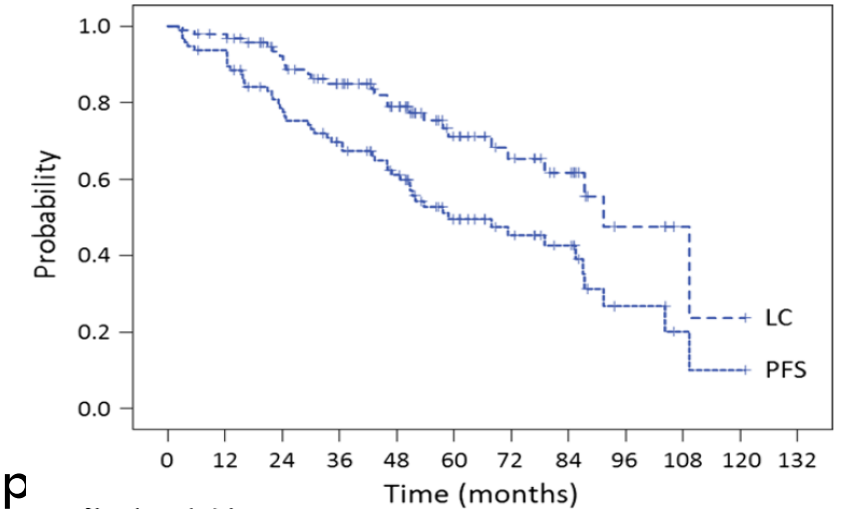
Histology	n = 877
Chordoma	374
Chondrosarcoma	123
Osteosarcoma	96
MFH/UPS	54
Liposarcoma	26
Ewing sarcoma	21
MPNST	21
Others	162

Tumor location	n = 877
Pelvis	466
Skull base	140
Spine/paraspine	115
Head and neck	57
Retroperitoneum	30
Thorax	21
Others	162

(2004–2012)
Reported by JASTRO Particle Therapy Committee, 2015

MFH, malignant fibrous histiocytoma;
UPS, undifferentiated pleomorphic sarcoma;
MPNST, malignant peripheral nerve sheath tumor

BONE SARCOMAS OF SB AND SPINE: PBT



96 pts (Japanese multi-institution)

Chordoma: 72 pts, chondrosarcoma: 20 pts, osteosarcoma: 4 p

Skull base: 68 pts, sacrum: 13 pts, cervical spine: 8 pts, etc.

Median total dose: 70 Gy (RBE)…median BED_{10}: 86 Gy (RBE)

Median FU: 53 mo

5-yr OS: 75%, PFS: 50%, LC: 71%

Acute toxicities of G3: 9 pts (9%)

Late toxicities of ≥G3: 9 pts (9%)

- G4: tissue necrosis, brainstem infarction

Japanese experience Demizu et al

PELVIC SARCOMAS: PBT OR CIRT

91 pts (single institution)

Chordoma: 53 pts, chondrosarcoma: 14 pts,
osteosarcoma: 10 pts, UPS: 5 pts, etc.

PBT: 52 pts, CIRT: 39 pts

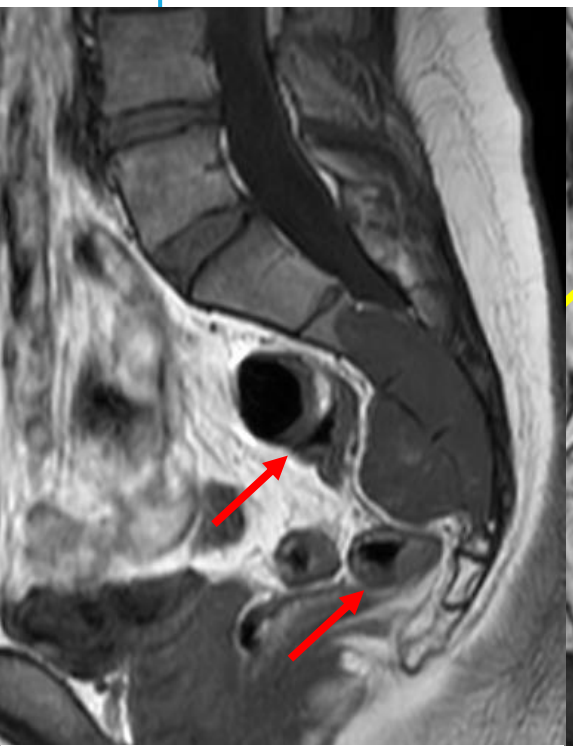
3-yr OS: 83%, PFS: 72%, LC: 92%

No significant difference between PBT and CIRT

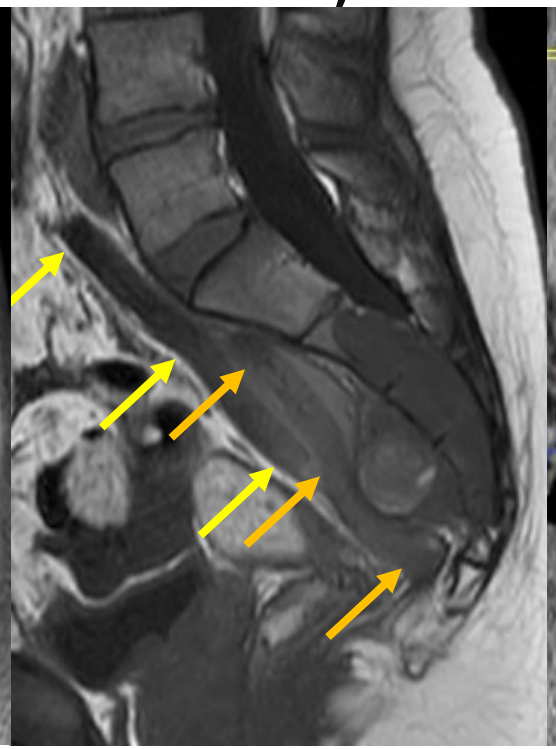
16# worse toxicities than 32#

Demizu et al, Kobe Proton Center

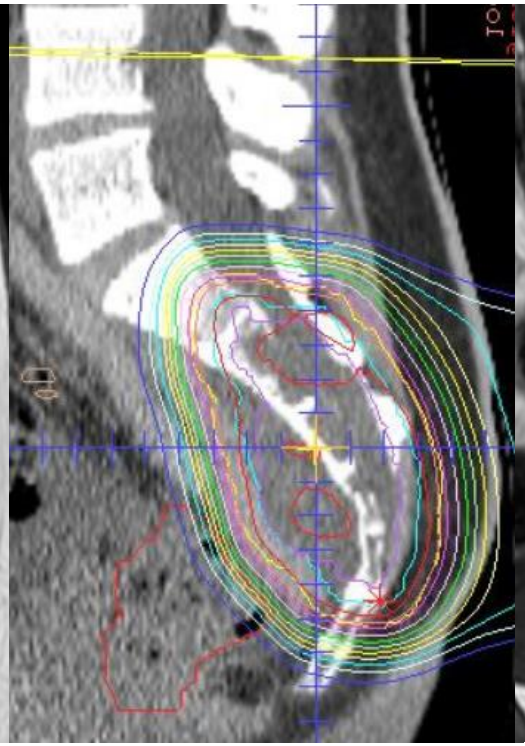
CASE: 20S MALE, SACRAL CHORDOMA



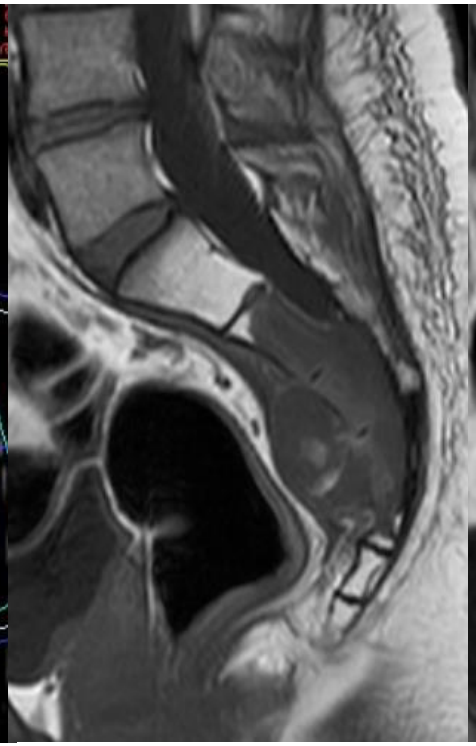
Before surgical spacer placement (SSP)



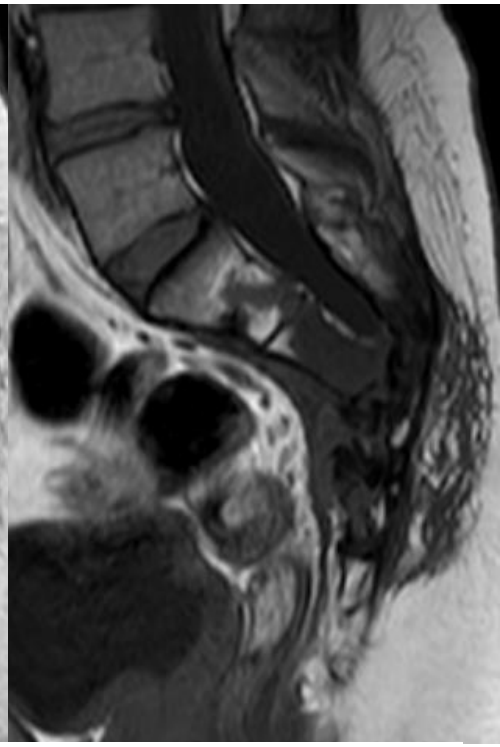
After SSP



PBT
70.4 Gy (RBE)
/16 fr



7M later
Tumor shrank
Spacer disappeared



6Y 8M later
No relapse
No severe toxicity

Credits Dr Demizu

UNRESECTABLE BONE SARCOMAS

Axial skeleton: Pelvic, Facial bones,

Unresectable truncal soft tissue sarcomas

- Solitary fibrous tumour
- Desmoid (progressive)
- UPS
- MPNST

Original Article

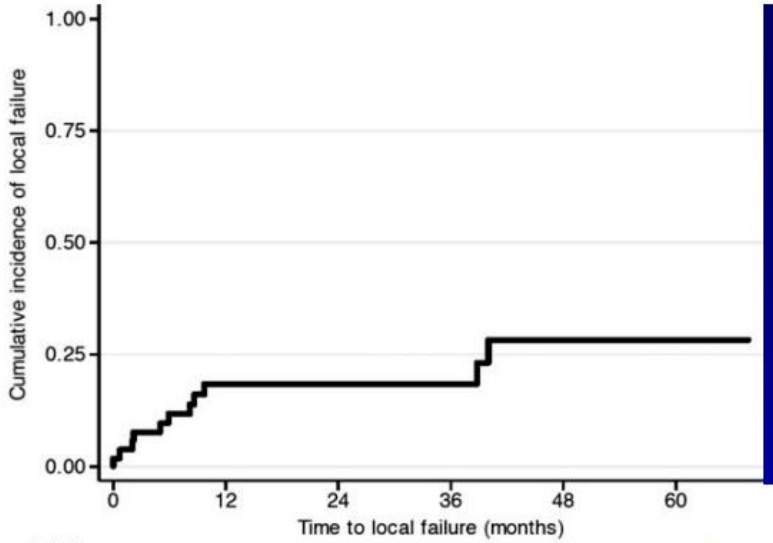
Proton-Based Radiotherapy for Unresectable or Incompletely Resected Osteosarcoma

I. Frank Ciernik, MD[1,2]; Andrzej Niemierko, PhD[1,3,4]; David C. Harmon, MD[3,5]; Wendy Kobayashi, BA[1]; Yen-Lin Chen, MD[1,3,4]; Torunn I. Yock, MD[1,3,4]; David H. Ebb, MD[3,6]; Edwin Choy, MD, PhD[3,5]; Kevin A. Raskin, MD[3,7]; Norbert Liebsch, MD, PhD[1,3,4]; Francis J. Hornicek, MD, PhD[3,7]; and Thomas F. DeLaney, MD[1,3,4]

BACKGROUND: A study was undertaken to assess clinical outcome and the role of proton therapy for local control of osteosarcoma (OSA). **METHODS:** All patients who received proton therapy or mixed photon-proton radiotherapy from 1983 to 2009 at the Massachusetts General Hospital were reviewed. Criteria for proton therapy were the need for high dose in the context of highly conformal radiotherapy of unresected or partially resected OSA, positive postoperative margins, postoperative imaging studies with macroscopic disease, or incomplete resection as defined by the surgeon. The primary endpoint was local control of the site treated; secondary endpoints were disease-free survival (DFS), overall survival (OS), long-term toxicity, and prognostic factors associated with clinical outcome. **RESULTS:** Fifty-five patients with a median age of 29 years (range, 2-76 years) were offered proton therapy. The mean dose was 68.4 gray (Gy; standard deviation, 5.4 Gy). Of the total dose, 58.2% (range, 11%-100%) was delivered with protons. Local control after 3 and 5 years was 82% and 72%, respectively. The distant failure rate was 26% after 3 and 5 years. The 5-year DFS was 65%, and the 5-year OS was 67%. The extent of surgical resection did not correlate with outcome. Risk factors for local failure were $\geq$2 grade disease ($P < .0001$) and total treatment length ($P = .008$). Grade 3 to 4 late toxicity was seen in 30.1 % of patients. One patient died from treatment-associated acute lymphocytic leukemia, and 1 from secondary carcinoma of the maxilla. **CONCLUSIONS:** Proton therapy to deliver high radiotherapy doses allows locally curative treatment for some patients with unresectable or incompletely resected OSA. *Cancer* **2011;117:4522–30.** © *2011 American Cancer Society.*

KEYWORDS: osteosarcoma, sarcoma, radiotherapy, proton therapy, particle therapy, combined modality.

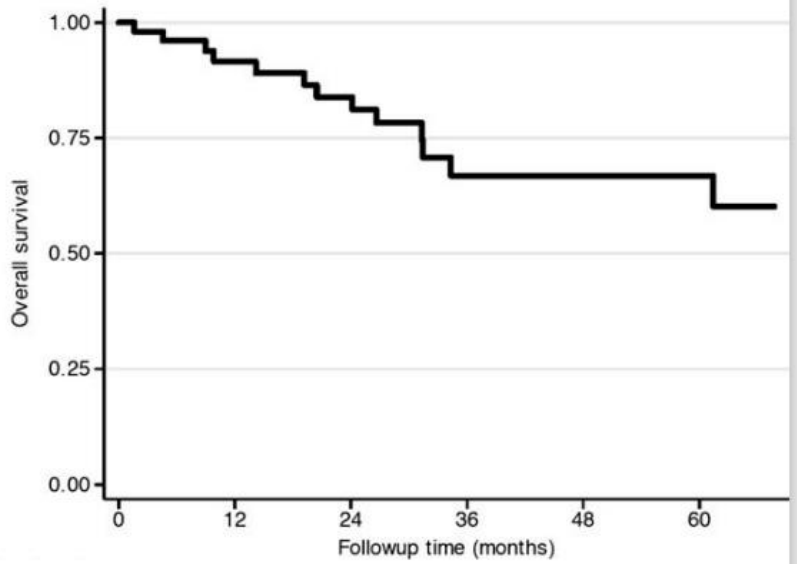
MGH data
All osteosarcoma
Protons +/- photons
3 yr 82%



Osteosarcoma Protons

Overall Survival 67%

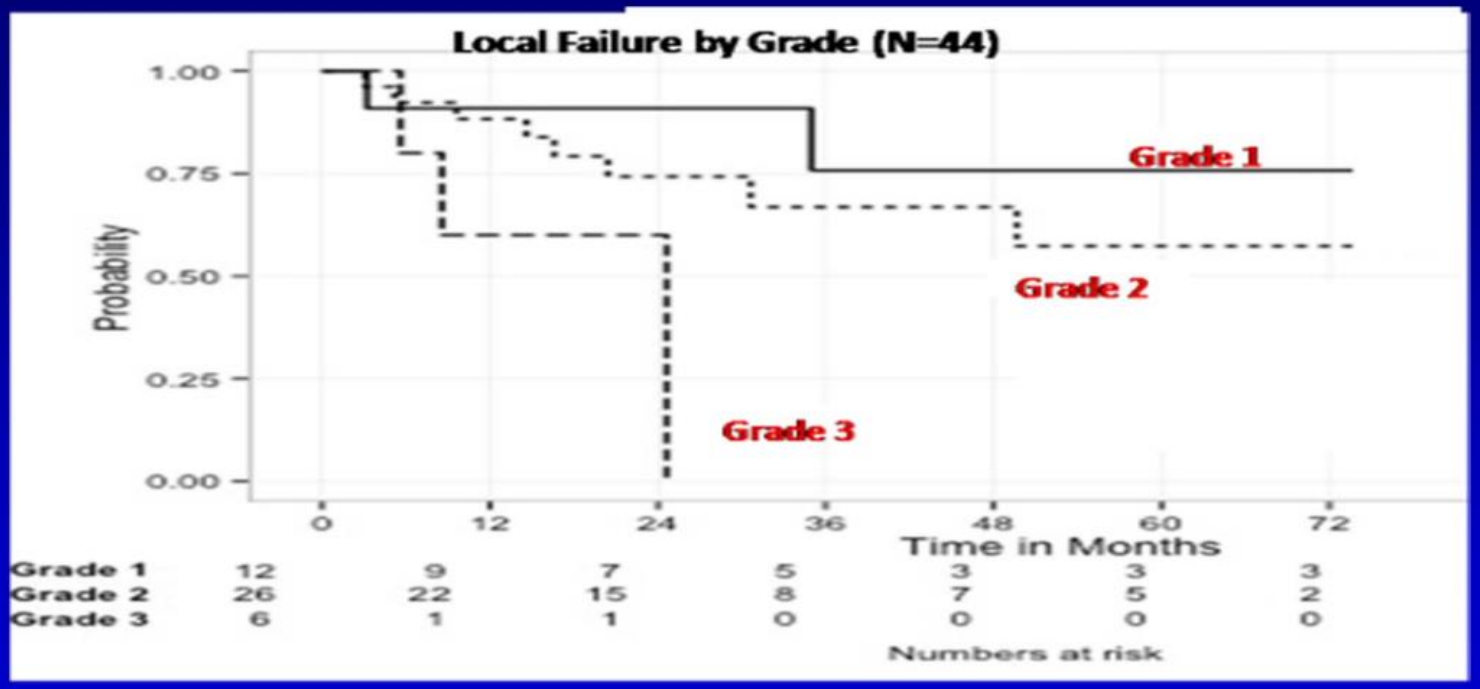
Local Failure 28%



MASSACHUSETTS GENERAL HOSPITAL

Harvard Medical School

Local Failure By Grade



MASSACHUSETTS GENERAL HOSPITAL

Harvard Medical School

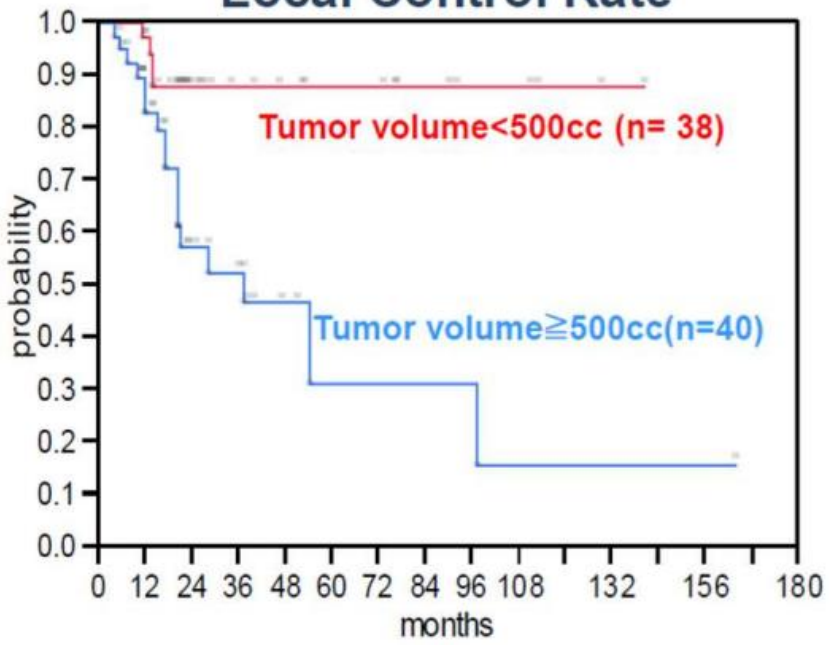
Chondrosarc proton series from MGH
- Protons only

Osteosarcoma of the Trunk
Result By Tumor Volume

ESTRO School

A smaller tumor volume provides a better result.

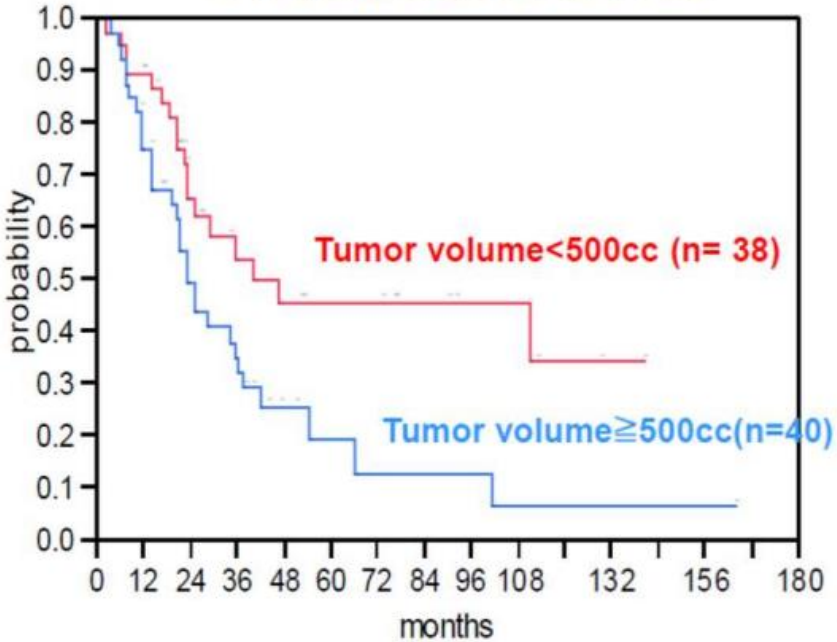
Local Control Rate



	2y	5y
＜500cc	87%	87%
≧ 500cc	57%	31%

Logrank p=0.0006

Overall Survival Rate



	2y	5y
＜ 500cc	65%	46%
≧ 500cc	50%	19%

Logrank p=0.015

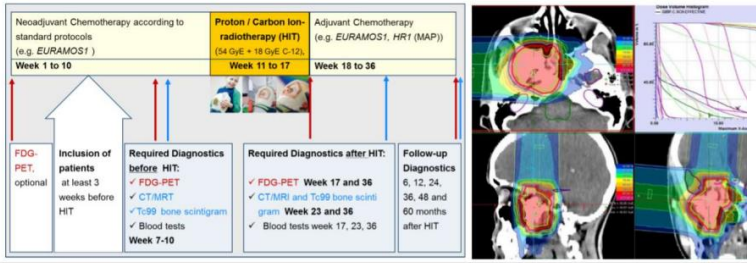
NIRS

QST Chiba

OSCAR- trial

OSteosarcoma – CArbon Ion Radiotherapy: Phase I/II therapy trial to determine the safety and efficacy of heavy ion radiotherapy in patients with inoperable high-grade osteosarcoma

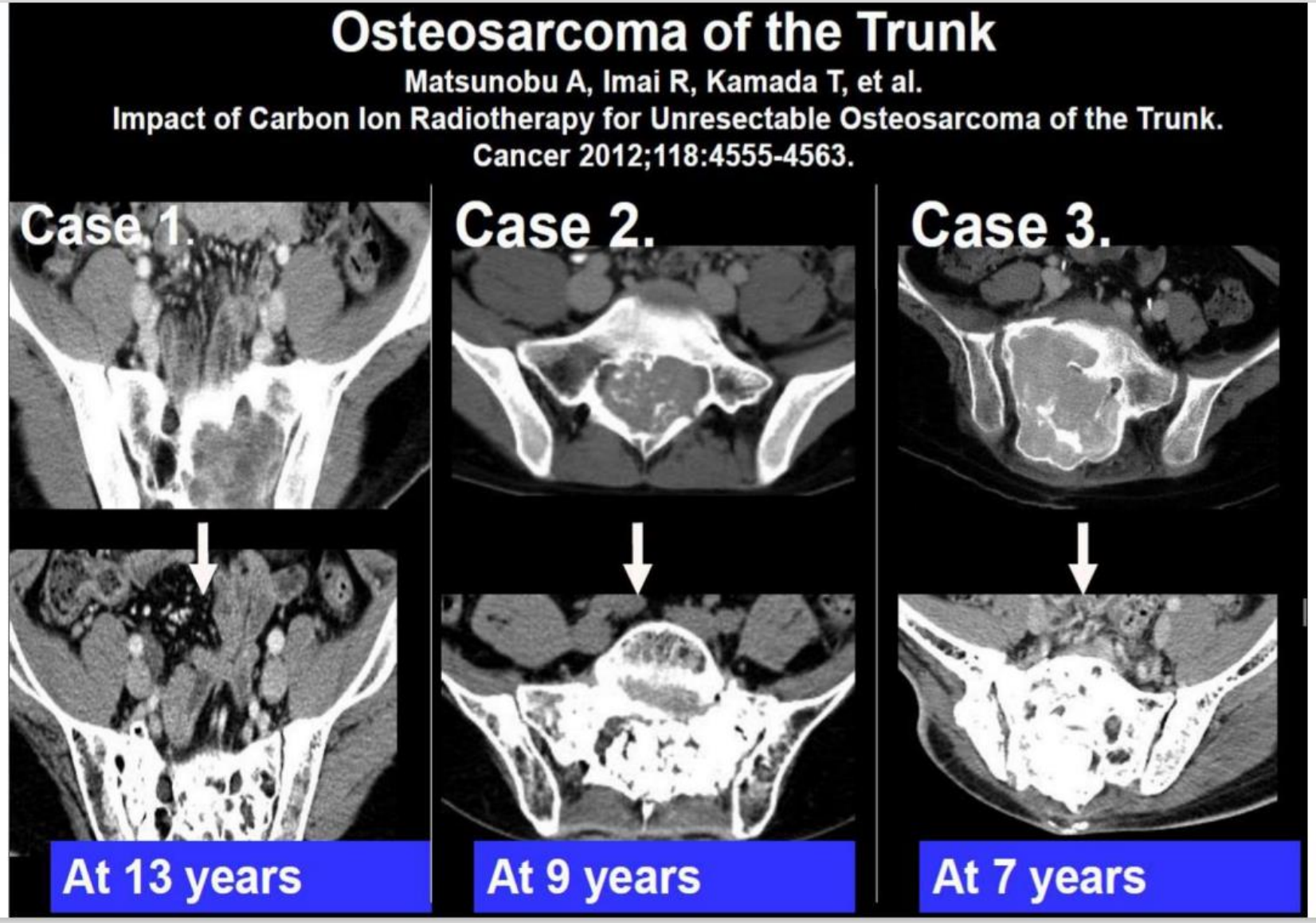
Secondary endpoints: local control disease-free and progression-free survival, Overall survival, role of FDG-PET in response monitoring



German trial

research group	modality	overall Survival	PFS	comment
OSCAR	P + C	68 % (2 years)	45 % (2 years)	
COSS-Kollektiv	Heterogen	41 % (5 years)	26 % (5 years)	
DeLaney 2002	Ph / P	66 % (5 years)	40 % (5 years)	surgery, rarely pelvic
Ciernik 2011	P	67 % (5 years)	65 % (5 years)	surgery, high tox. (>30 %grade III-IV)
Matsunobu, 2012	C	58 % (2 years)	n/a, 2y-LC 73 %	surgery, short FU, 10 % grade III-IV
Kamada, 2002	C	46 % (3 years)	n/a, 3y-LC 73 %	surgery
Mohamad, 2018	C	50 % (3 years)	35 % (3 years)	Incl. pelcvic, 15 % grade III-IV

~ 35-73% 3-5year PFS



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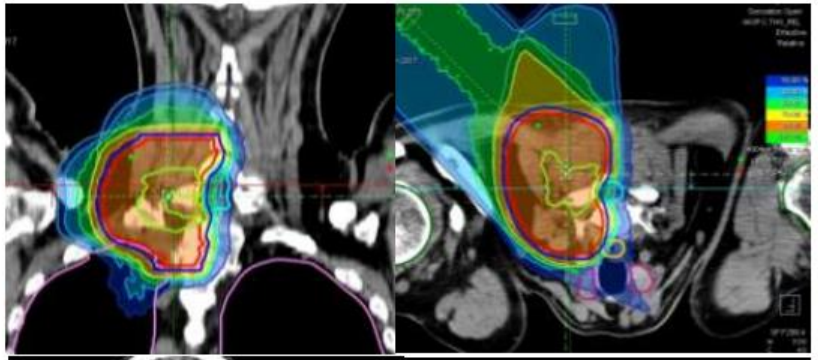
1 patient gave birth to healthy child years later

Testament to distal-sparing

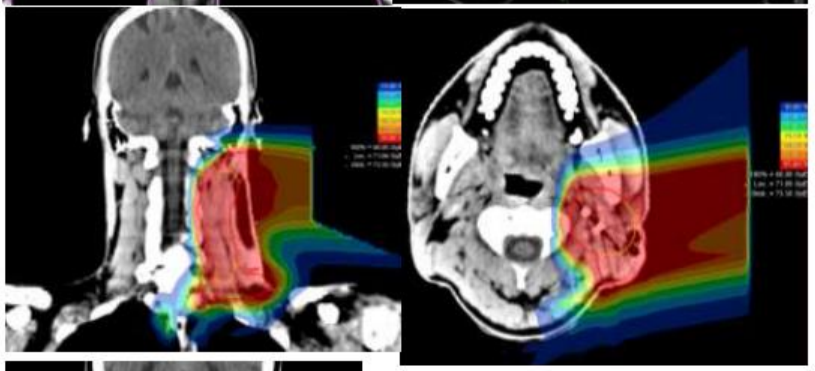
Soft tissue sarcoma

a) **definitive**

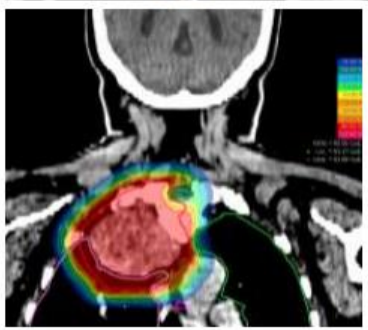
MPNST
Partial resection
Additive ^{12}C ion-RT



Undiff. Sarcoma
Partial resection
Additive ^{12}C ion-RT

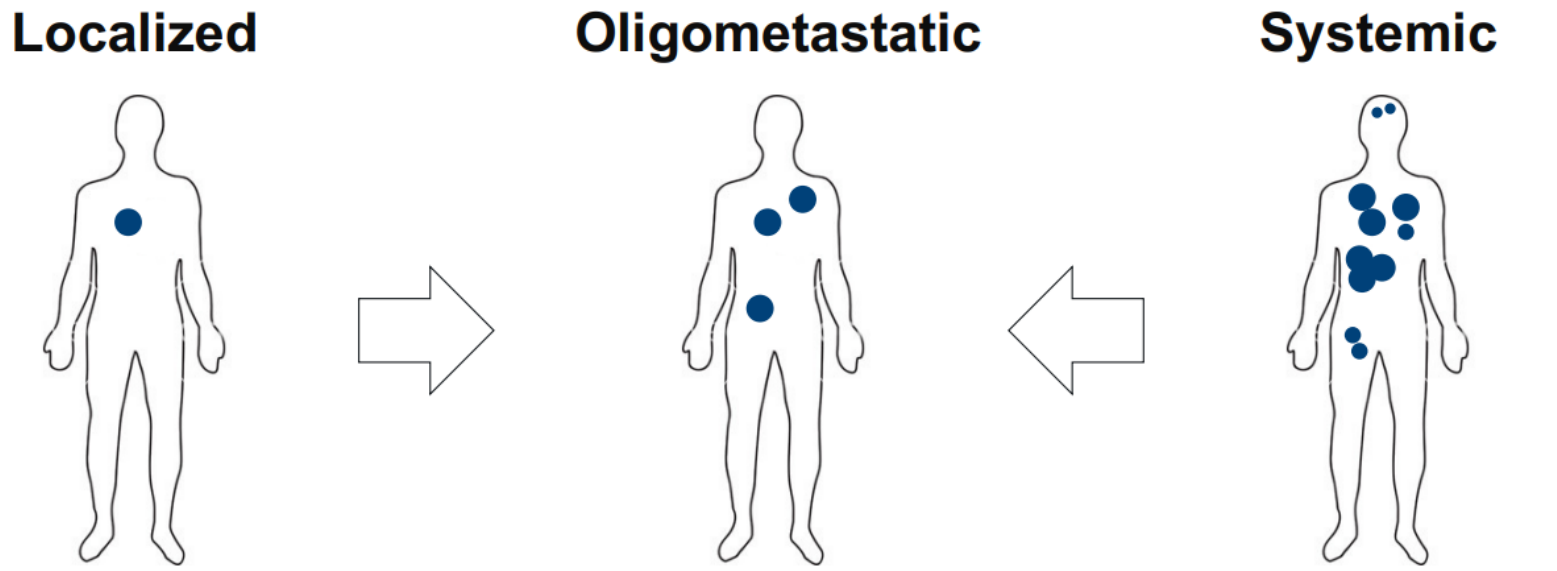


SFT
definitive ^{12}C ion-RT



ESTRO School

OLIGOMETS: NOT THE END OF THE ROAD



ESTRO

REFERENCES: *Hellman & Weichselbaum JCO 1995*

CREDITS TO MATTHIAS GUCKERBERGER TWITTER @MATTGUC

RADIOSURGERY

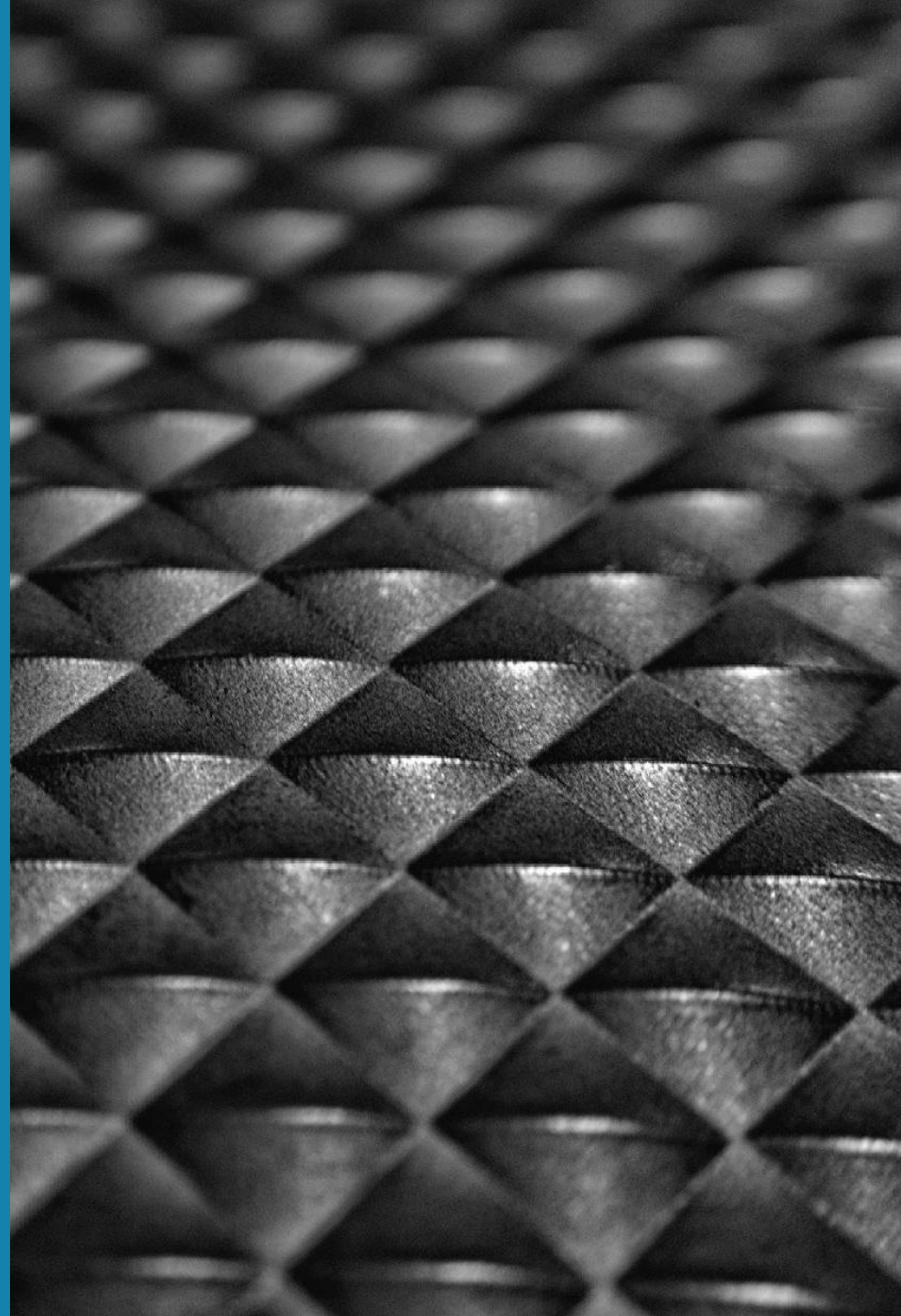
Ablative

>90% local control probability

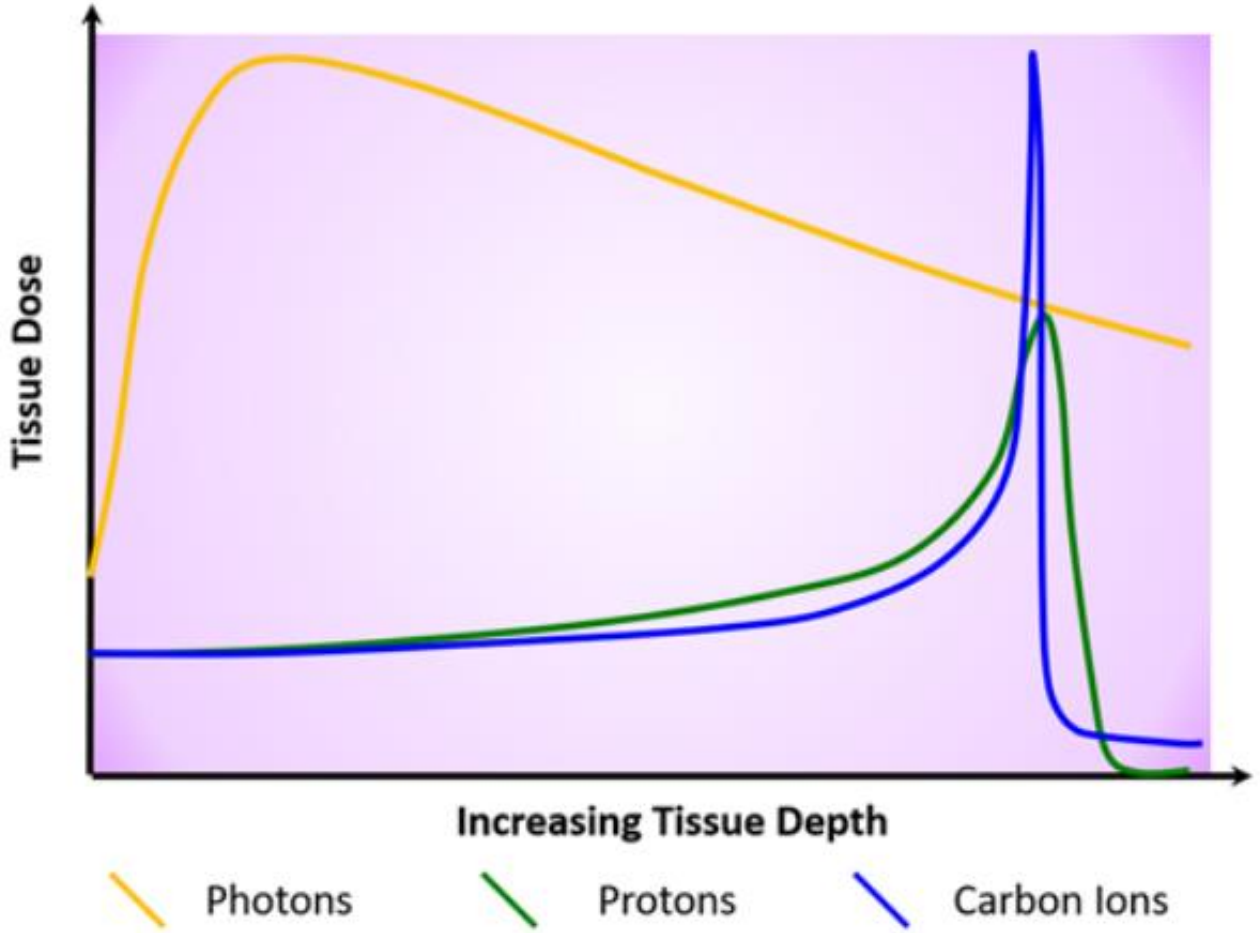
If done correctly, grade 3 toxicities <5%

CARBON

- heavier particle than protons
- efficacy theoretical, hard to have h2h comparisons
- limited to a few centers



CARBON VS PROTONS



Compensate for lack of carbon by dose escalation with protons?

Pennington et al 2021

PEDIATRIC BONE SOFT TISSUE SARCOMA

Indication for particle therapy

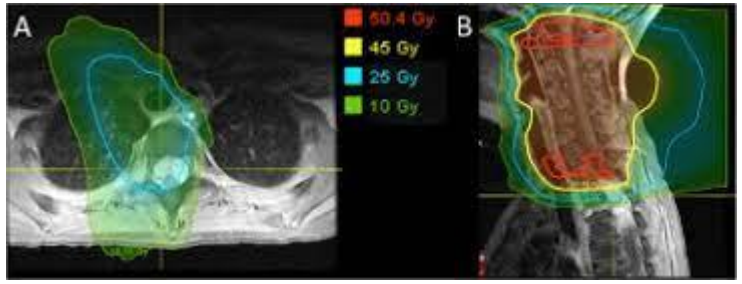
- Ewing sarcoma family of tumors, rhabdomyosarcoma, etc.
- Definitive RT if surgery is too morbid,
- adjuvant RT is almost always needed unless small and good response to chemo
- One of the best indications for PBT

SPINAL EWING MODERN SERIES

Indelicato et al 2022

32 patients, 14 definitive, 18 after biopsy/STR decompression

5 year LC 92%



PELVIC RHABDOMYOSARCOMA

Outcomes Following Proton Therapy for Group III Pelvic Rhabdomyosarcoma

Indelicato et al, red journal 2020

- n=31 (14 had resection)

- 5 year LC 83%

- no diff btw sx/definitive proton

LOCALLY RECURRENT BONE SARCOMAS

ROJ Radiation Oncology Journal

Case Report

pISSN 2234-1900 · eISSN 2234-3156
Radiat Oncol J [Epub ahead of print]
https://doi.org/10.3857/roj.2023.00815

Pulsed low-dose rate radiotherapy for recurrent bone sarcomas: case reports and brief review

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Purpose: Re-irradiation for bulky recurrent sarcoma carries significant risks. Pulsed low-dose rate radiotherapy (PLDR) is an attractive option for re-irradiation due to inherent radiobiological advantages.
Materials: We present two patients who underwent reirradiation using PLDR technique, followed by a literature review.
Results: The first case is that of a 76-year-old male who developed an in-field recurrence of a bulky pelvic bone high-grade chondrosarcoma after he was treated with definitive radiotherapy using helical TomoTherapy with a total dose of 66 Gy. The patient was re-irradiated using PLDR with a shrinking field technique; 50 Gy in 2 Gy fractions followed by a boost of 20 Gy in 2 Gy fractions. The patient remains disease-free without significant toxicity 60 months post-irradiation. The second case is that of an 82-year-old female who was treated with a definitive irradiation of 66 Gy in 33 fractions for a right shoulder grade II chondrosarcoma. She developed an in-field recurrence 28 months later and presented with bulky disease causing brachial plexopathy and lymphedema. The patient was re-irradiated with a palliative intent to a total dose of 50 Gy in 2 Gy fractions over 5 weeks using PLDR. Brachial plexopathy resolved shortly after re-irradiation, but local progression near the surface was evident 8 months later. She passed away from unrelated causes 11 months later.
Conclusion: We present two cases highlighting our early experience with PLDR, which was effective in the reirradiation of recurrent bony sarcoma. Our study highlights PLDR as an option for reirradiation in recurrent unresectable tumors.

Keywords: Recurrent cancer, Pulsed reduced dose-rate radiotherapy, Re-irradiation, Sarcoma, Bone

Re-irradiation is possible
- X-ray using special techniques
- Particles to spare normal tissue

TAKE HOME

- surgery is important for bone and soft tissue sarcoma
- particle therapy also has an important role
- issues to consider
  - Implants
  - Morbidities
  - Age
  - Histology

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