Proton Therapy for Pediatric Cancers

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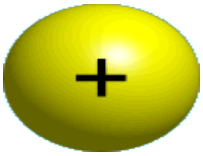
Pediatric Cancers: What is Proton therapy?

- Three main types of treatment for tumors
  - **Surgery** – to remove the tumor
  - **Chemotherapy** – to travel through the entire body and kill cancer cells
  - **Radiation therapy**
    - Use of high energy particles or waves to kill cancer cells
    - Directed at the area where the tumor is or was
      - Only works where its aimed
      - Only causes side effects where it's aimed
      - The goal of every radiation oncologist is to deliver the radiation where it is needed, and not anywhere else

Pediatric Cancers: What is Proton therapy?

- "Standard" or "regular" radiation uses X-rays
  - X-rays do not have mass or charge and travel through the patient
- Protons are heavy and positively charged – thus they **STOP** within tissues
  - With careful planning, we can determine the stopping point
    - Protons allow sparing of more healthy, normal tissue



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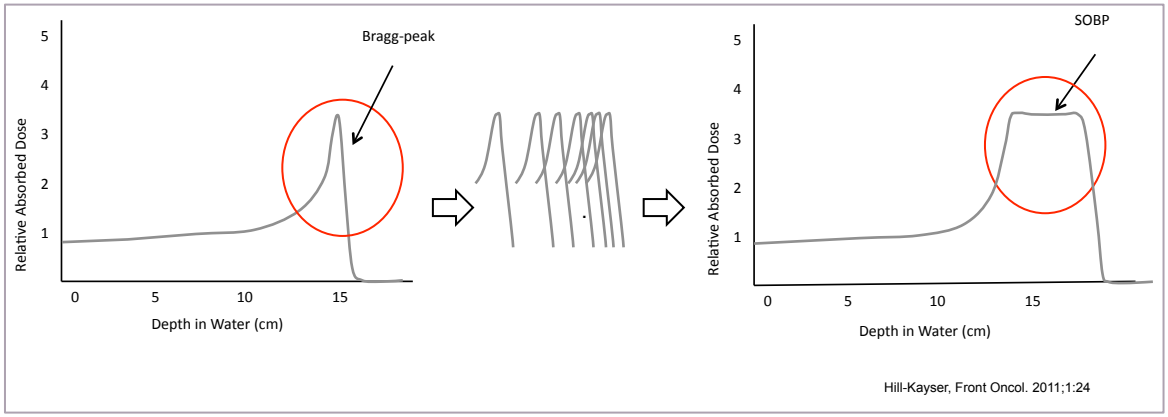
Pediatric Cancers: What is Proton therapy?



Hill-Kayser, Front Oncol. 2011;1:24

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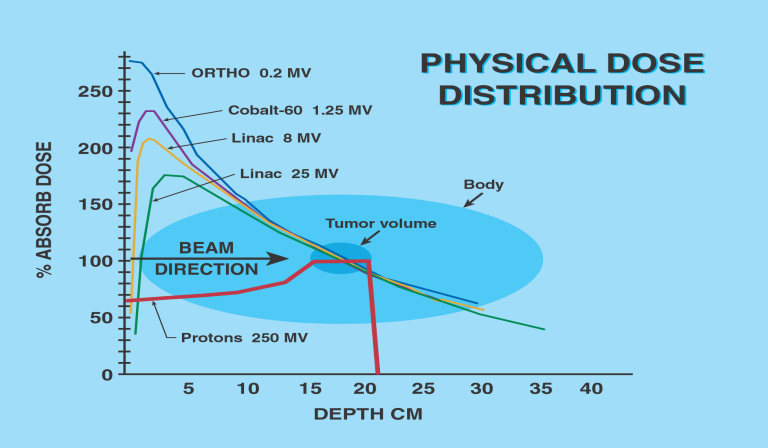
Pediatric Cancers: What is Proton therapy?



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Pediatric Cancers: Clinical Use of Proton Therapy

- Many pediatric solid tumors require radiation
  - Brain tumors
    - Medulloblastoma
    - Ependymoma
    - Rhabdoid tumors
    - Astrocytomas
  - Solid and liquid tumors of childhood
    - Rhabdomyosarcoma
    - Ewings sarcoma
    - Neuroblastoma
    - Hodgkin Disease
    - Wilms Tumor

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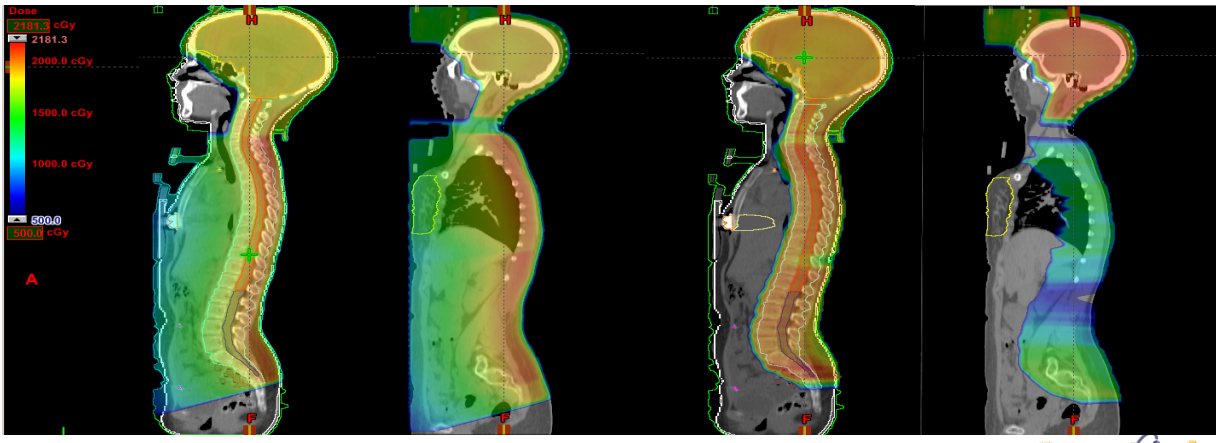
Proton Therapy and Pediatrics: Brain Tumors



Kumar, JPHO, 2013

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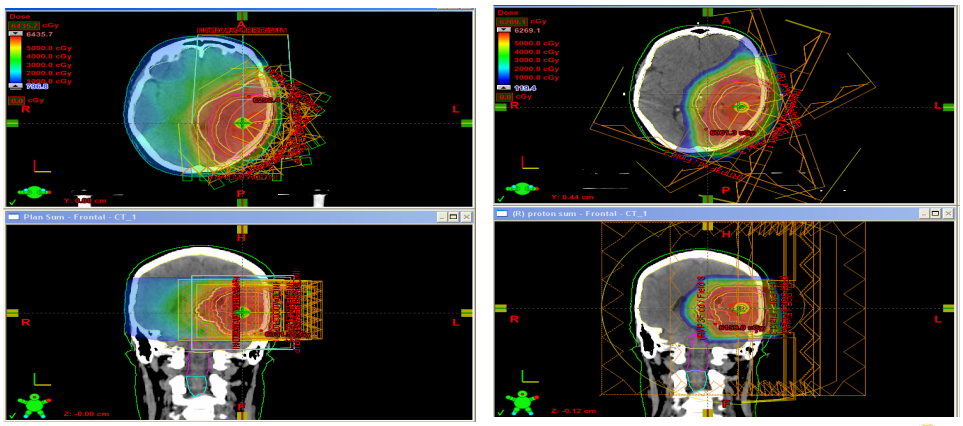
Proton Therapy and Pediatrics: Brain Tumors



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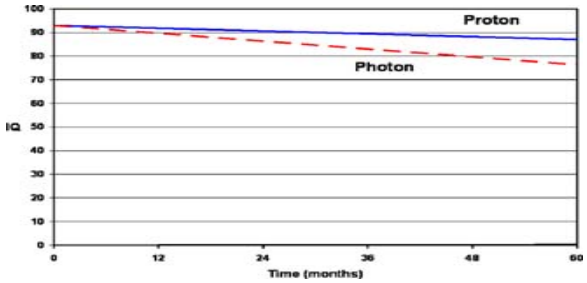
Proton Therapy and Pediatrics: Brain Tumors



- Mathematical models suggest decreased neurocognitive impact of RT based on less interval dose
- Requires clinical verification

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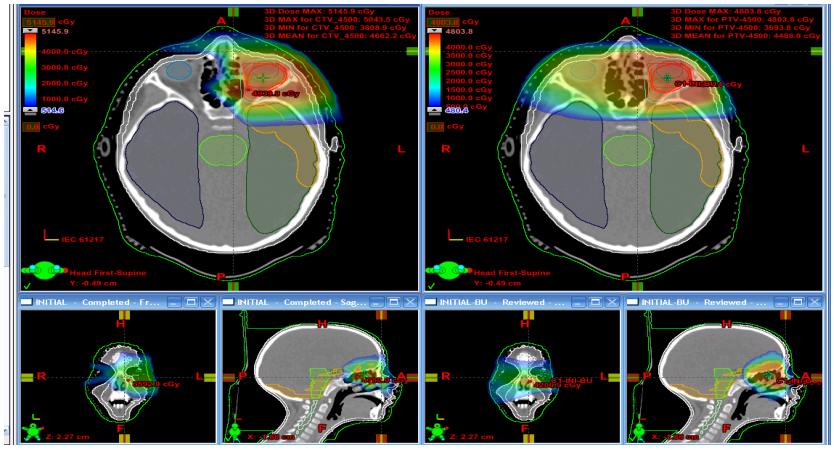
Proton Therapy and Pediatrics: Rhabdomyosarcoma



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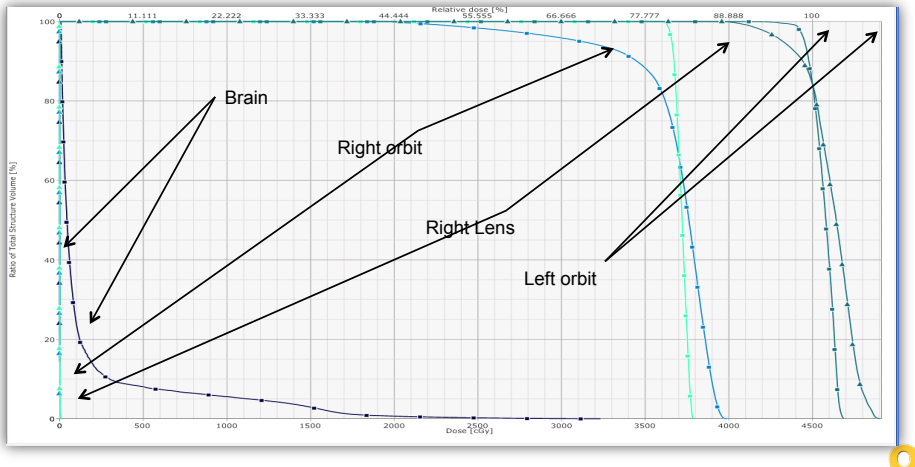
Proton Therapy and Pediatrics: Clinical Practice



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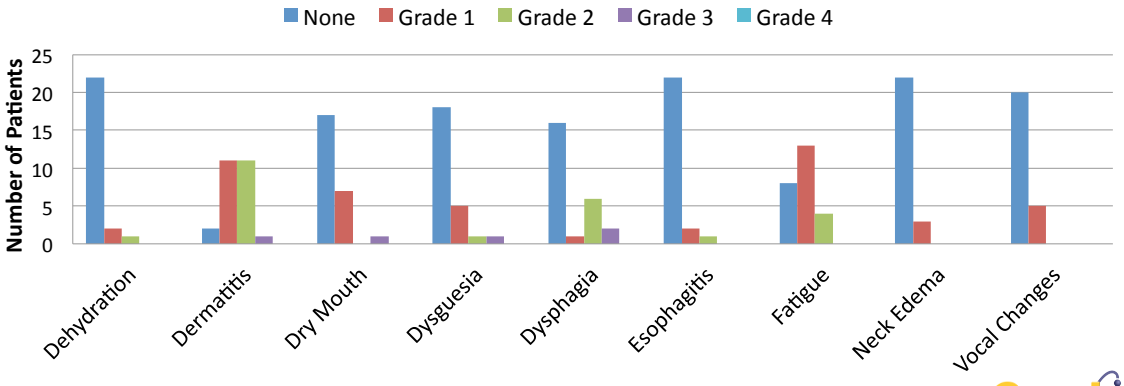
Proton Therapy and Pediatrics Rhabdomyosarcoma

Acute Toxicities Experienced by Pediatric Patients Undergoing Proton Therapy for Head & Neck Cancers



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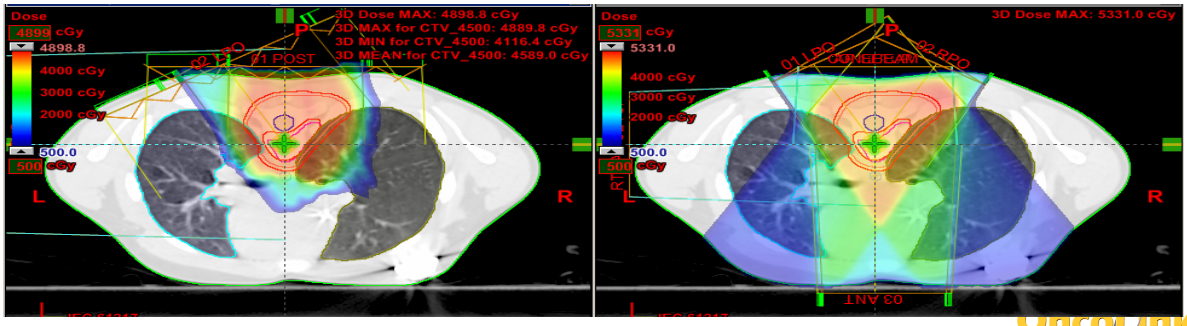
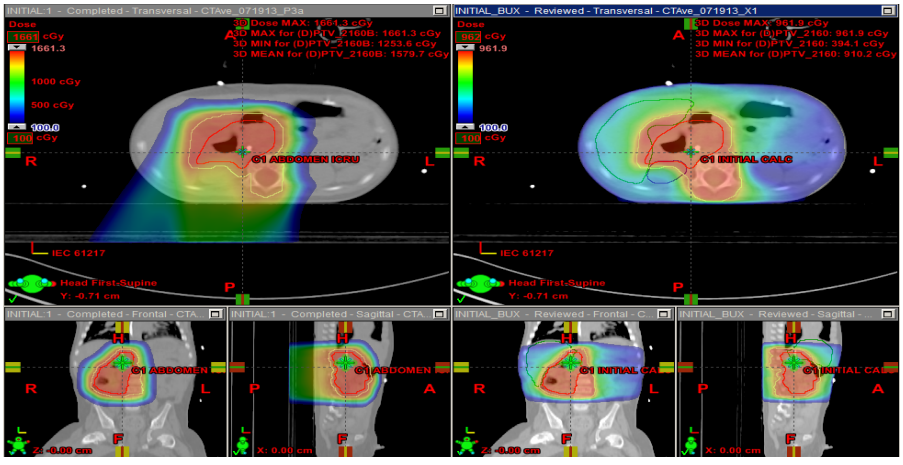
Proton Therapy and Pediatrics: Spinal Ewing Sarcoma

- Spinal Ewing Sarcoma
  - Allows elimination of exit dose through heart and lungs



Proton Therapy and Pediatrics Neuroblastoma

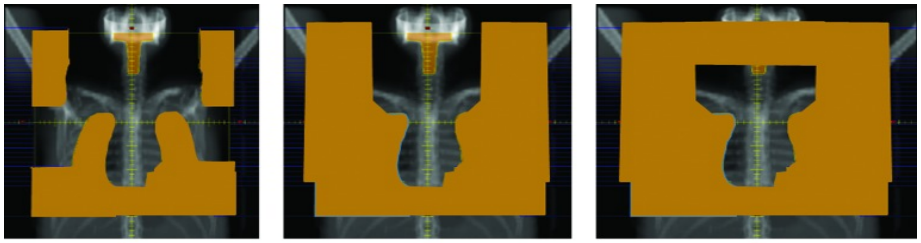


Proton Therapy and Pediatrics: Hodgkin Lymphoma

- Stage I-II Hodgkin Disease requiring mediastinal radiation
  - Survival approaches 95%
    - Mantle radiation is strongly associated with:
      - **Stroke risk**: RR late-occurring stroke 5.62 (95% CI, 2.59 to 12.25; P < .0001) (Bowers, JCO, 2005)
      - **Heart disease**: Increased risk of bypass, need for cardioverter defibrillator or pacemaker, valve surgery, and pericardial surgery (Galper, Blood, 2011)
      - **Breast cancer risk**: RR breast cancer 6·2 if > 40 Gy, 2·6 for <40 Gy (Tinger, IJROBP, 1997)
      - Also associated with **lung cancer risk** (van Leeuwen, JCO, 1994)

Proton Therapy and Pediatrics: Hodgkin Lymphoma

- Newer approaches to HD radiation have reduced these risks
  - Reduction in normal tissue exposure through blocking normal tissue and decreasing overall dose
  - Leads to decreased heart, lung, and breast dose



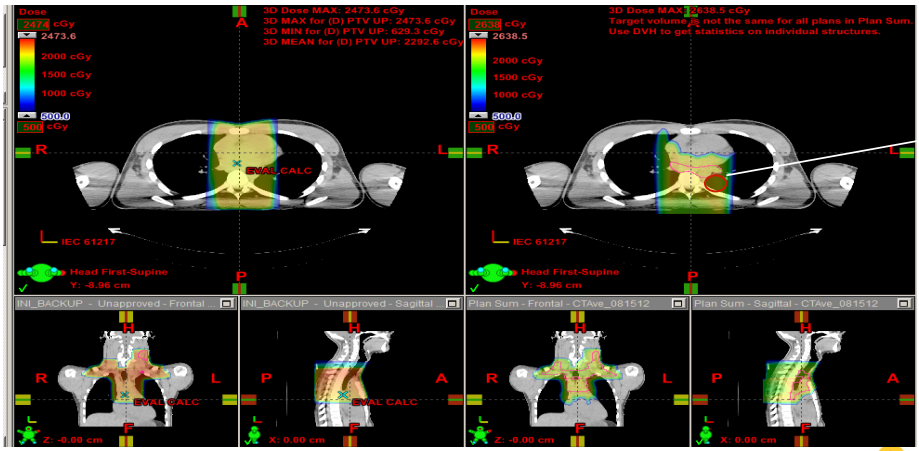
A
Classic Mantle

B
Blocking of axillary regions: reduces exposure of breast and lung

C
Blocking of high neck: reduces exposure of carotids, salivary glands, dentition

Hill-Kayser, 2012

Proton Therapy and Pediatrics: Hodgkin Lymphoma



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Proton Therapy and Pediatrics: Research

- Cooperative group studies
  - Children's Oncology Group
  - Pediatric Proton Collaborative Registry
  - Institutional Clinical Trials
    - Hypothesis: Proton radiation will increase cure rates while sparing normal brain and reducing NC deficits
    - Study objectives:
      - To assess development based 2 years post-RT with other later objectives to be measured
  - Funded study available nationally

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Proton Therapy and Pediatrics: Conclusions

- Proton therapy offers recognized normal tissue sparing expected to translate to decreased late effects for treatment of many childhood cancers
- We are well-positioned to conduct high-quality research, and this is absolutely necessary
  - Registry studies and institutional experiences
  - Prospective trials asking new questions
    - Higher doses? Novel uses? Novel techniques?
  - Collaboration is essential

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PROTON THERAPY AND PEDIATRIC CANCERS

Psychosocial and Family Concerns

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Psychosocial Considerations

- Providing support to:
  - Patients
  - Caregivers
  - Siblings
- *Child Life Specialists*: Certified professionals who work with patients and families to reduce the stress and anxiety that may be associated with the hospital experience.
- *Psychosocial Support Team*: Social Work, Nurses, Physicians, Nurse Management, Nurse Practitioners

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Considering the Pediatric Patient

- Past medical experiences
- Relocation/separation
- Schooling
- Side-effects

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Procedural Preparation

- Factors to Consider:
  - Position for treatment
  - Area targeted for treatment
  - Separation anxiety
  - Differentiating "holding still"
  - Support for Patients Getting GA

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Coping with Treatment and Side-Effects

- Factors to Consider:
  - Where patients are in their cancer treatment journey
  - Time of day being treated
  - Anesthesia v. no anesthesia
- Challenges:
  - Procedural support
  - Side-effects of anesthesia
  - Radiation burns, nausea, fatigue
  - Compliance

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Promoting Coping

- Normalizing the environment
- Providing developmentally appropriate play
- Medical play
- Therapeutic activities

Considering the Family

Potential Stressors for Families

- Financial Strain
- Relocation/Limited Support
- Schooling
- Family Restructuring

Providing Support to Families

- When separated: promoting communication (Skype/FaceTime, letters/journaling, creating art, scrapbooks)
- Through shared space: connecting family to family (while maintaining boundaries)
- Encouraging self-care and routine
- Team approach to partnering with families
- Siblings: prep, education, coping
- Assisting with transitions

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THANK YOU!

Questions?

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