Paul Scherrer Institut
Center for Proton Therapy
Newsletter #34_04/2025

Dear Reader

Welcome to the April edition of our SpotOn+ Newsletter. Proton craniospinal irradiation (CSI), delivered to children and adults, enables to substantially spare multiple organs at risk from unnecessary radiation delivery. For the former group, it is an important therapeutic modality for the management of brain tumors such as medulloblastomas, pineoblastomas, germ cell tumors and metastatic ependymomas or ATRTs to name a few malignancies. In this edition, we present the analysis of Bolsi *et al.* on the clinical outcome of 71 children and adolescents/young adults treated at PSI on two treatment units. Initially, patients were treated in prone position in Gantry 1 which triggered usually some concerns from the anesthesia team for young children. Supine positioning however improved accuracy and was a lot easier for children and physicians alike. Importantly, local failures were not associated with dosimetric uncertainties, which is always a concern when one uses very conformal radiation delivery. Interestingly, due to the smaller spot size, Gantry 2 radiation delivered showed a significant better coverage to the target volumes.

PSI has been the first center in Europe to treat eye tumors with protons in 1984. The experience of our center is phenomenal, and we have treated roughly one fifth of all uveal melanoma (UM) patients managed with proton therapy worldwide. Thanks to physicists such as Emmanuel Egger, Jon Verwey and now Jan Hrbacek, the delivery of proton radiation therapy has improved substantially from the early days on. I would like to bring your attention to a recently

published white paper by Dr. Hrbacek and colleagues from PTCOG's Eye Tumor Subcommittee, which explores the current and future management of this challenging tumor. Our eye treatment program is undergoing a significant transformation as we prepare to transition from EyePlan to RayOcular, which is set to become our clinical treatment planning system in 2026.

Last but not least, another PT symposium is scheduled during the SASRO annual conference on Thursday, 11th September (Davos). Be sure you do not miss this opportunity to participate at this meeting which will be focused on head and neck cancer.

That being said, I hope this newsletter is of interest to you and I stay tuned for the next edition in about 4 month's time.

Sincerely,
Prof. Damien C. Weber,
Chairman Center for Proton Therapy,
Paul Scherrer Institute

Medical-Physics News

Craniospinal irradiation using pencil beam scanning: The PSI experience

Background

Craniospinal axis irradiation (CSI) with proton therapy is highly conformal and allows the sparing of anterior organs at risk and healthy tissue. This retrospective study evaluates the dosimetric outcomes of CSI delivered at the Paul Scherrer Institute (PSI), with a focus on local recurrences and late toxicity. The work complements previous clinical outcome analysis by Vázquez et al. 2023.

Materials and Methods

We analyzed data for 71 children, adolescents, and young adults (c-AYA) scheduled for or treated with pencil beam scanning proton therapy (PBS-PT) for CSI at PSI between 2004 and January 2021. The most common primary tumors were medulloblastoma (42 patients), ependymoma (8 patients), and germ cell

tumors (6 patients). Nine patients received CSI following local failure, after prior fractionated radiation therapy. Treatments were delivered on Gantry1 (G1) until 2017, with patients positioned prone, while the patients treated in Gantry2 (G2) were positioned supine. A comparison of setup accuracy between prone and supine positioning was performed. Among 59 patients (excluding three who did not receive CSI and nine previously irradiated), CSI treatment plans were compared based on gantry and planning technique. Detailed evaluations were carried out on eight patients with local failures (four of whom also had distal failures) and on selected cases showing grade 2–4 toxicities or asymptomatic radiation-induced radiological changes.

Results and Conclusions

Supine positioning improved accuracy, reducing systematic errors from 0.4 mm to 0.25 mm and random errors from 1.8 mm to 1.4 mm in the post-ant direction. G2 CSI plans showed significantly better V95% for both PTV and CTV (figure), a benefit attributed to a reduced spot size from the automatic range shifter insertion for specific spots. Only minor differences were found in organs-at-risk doses, favoring G2. Importantly, local recurrences were not linked to dosimetric uncertainties, and toxicities did not correlate with increased linear energy transfer (LET). Overall, PBS-PT CSI treatments are safely deliverable, but further studies in larger cohorts are needed to validate these findings and refine treatment protocols.

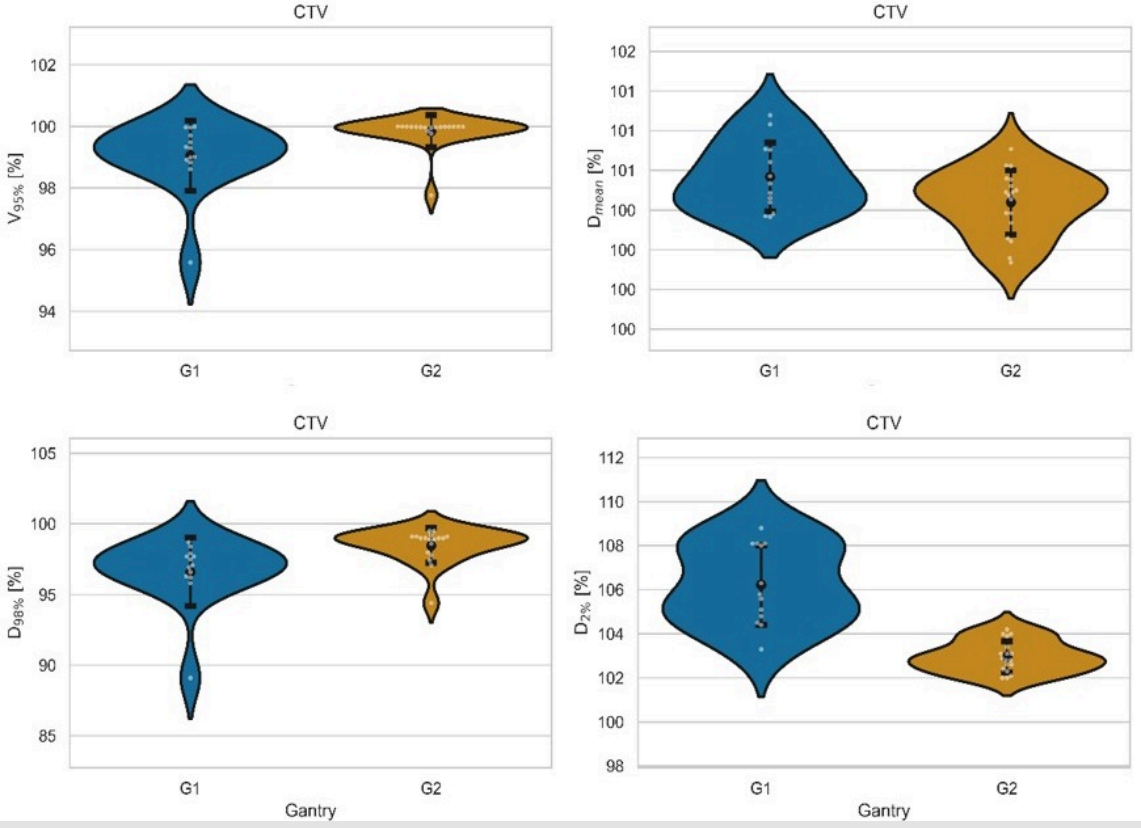


Figure: Violin plot of the dosimetric parameters (V95%, Dmean, D98% and D2%) for CTV_{CSI} plan depending on the gantry.

This work has been recently published (Bolsi et al. 2024).

Medical-Physics News

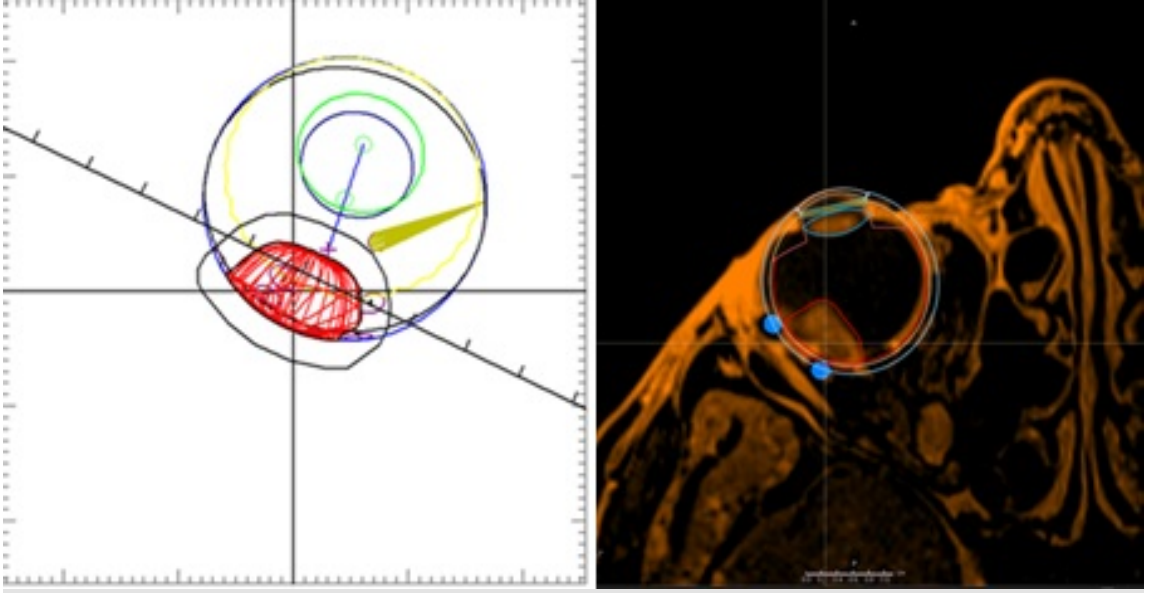
PTCOG Ocular Statement: Expert Summary of Current Practices and Future Developments in Ocular Proton Therapy

Although rare, ocular tumours pose a significant threat to vision, quality of life and life expectancy. Ocular proton therapy (OPT) represents a highly effective treatment. It is widely used for uveal melanoma and other ocular tumours and has been administered to more than 47’000 patients worldwide. Studies consistently report a 96% tumour control rate at five years and a 90% eye retention rate. With over 8’300 patients treated, the Center for Proton Therapy at PSI has established itself as one of the key players in this specialised field.

The OPT landscape has changed significantly in recent years. The Particle Therapy Co-Operative Ocular Group (PTCOG Ocular) has produced an expert review summarising current practice, emerging trends and the opportunities and challenges they present.

The vast majority of ocular treatments over the past four decades have been performed by a small number of pioneering OPT centers with accelerators and beamlines specifically adapted for this treatment. However, emerging centers, when deciding to offer a solution for OPT, typically opt for a more universal and economically advantageous solution, often associated with poorer beam characteristics and therefore reduced conformity, and potentially increased collateral damage and radiation side effects. This is in contrast to other tumor sites where we generally see improvements in plan quality associated with advanced delivery systems.

More than 90% of OPT patients have been planned with EyePlan, a dedicated TPS developed in the 1980s. Although it remains the most clinically used TPS to date, it has been discontinued and current EyePlan users are considering other options. Recently, the RayOcular module for RayStation (RaySearch Laboratories) has become clinically available. This advanced system combines the model-based approach known from EyePlan with 3D imaging (CT/MRI) and a state-of-the-art dose calculation engine. This is in line with demand, as most centers have indicated that they use some form of 3D imaging to verify eye models. PSI is currently taking preparatory steps with the goal of introducing RayOcular to clinics in 2026.



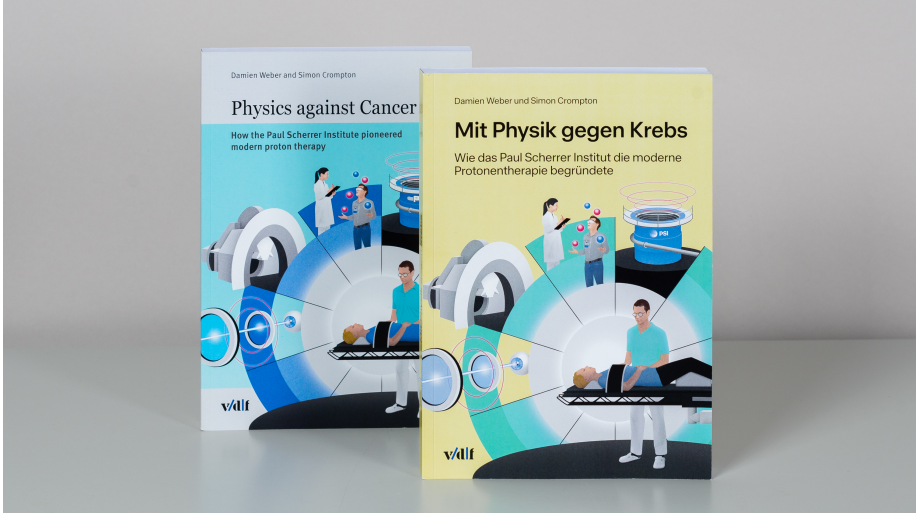
Left: a screenshot from EyePlan (geometrical eye model). Right: RayOcular, geometrical model fused with MRI.

These and various other aspects of OPT are discussed in the following open access paper: Hrbacek et al. 2024.

Announcements

German translation of the book *Physics against Cancer* availabe now

After the English version of *Physics against Cancer* was published end of 2022, we are pleased to now offer the German translation of the history of proton therapy at PSI. Thanks to the expertise and experience of science journalists Sabine Goldhahn and Andrina Bernhard, we were able to translate the book while preserving the depth and accuracy of the original English text. Spanning nearly 230 pages, and enriched with personal anecdotes and photographs, the book tells the story of PSI's journey from basic science to groundbreaking applications in the area of proton therapy that benefit mankind. The book is a combination of personal dedication, scientific innovation, and interdisciplinary teamwork which makes it accessible not only for scientists but also for anyone curious about what can be achieved.



The English and German Book were published by vdf Hochschulverlag AG at the ETH Zürich and are available as paper copy and e-book. It can be purchased in book shops and in online retail.

Don't miss: Proton Symposium at SASRO 2025 in Davos

A Symposium dedicated to proton therapy will take place on the opening day of the SASRO conference, Thursday, 11th September, from 09:15 to 10:45. The session will feature presentations on the clinical and technical aspects of the most common indications treated with proton therapy. The detailed agenda is still being finalized.

For further information, kindly refer to the official website of this year's SASRO congress. Participation in the Proton Symposium will be free of charge. Registration for both the congress and the symposium is now open.

Imprint

Editor
Dr. Ulrike Kliebsch

Chairman
Prof. Damien C. Weber

Chief Medical Physicist
Prof. Tony Lomax / Research
Dr. Arturs Meijers / Clinical

Villigen PSI, April 2025

All SpotOn+ issues can also be found on our CPT-website

Unsubscribe

Please see our private policy here

Contact

Paul Scherrer Institut
Center for Proton Therapy
CH-5232 Villigen PSI
protonentherapie@psi.ch
www.protontherapy.ch
Tel. +41 56 310 35 24
Fax +41 56 310 35 15