(EORTC QLQ-C30 & H&N35), and penetration aspiration scale (PAS) scores for modified barium swallow studies.

Results: The study population is 43 patients. The pCR rate was 86% (37/43). All 6 non-pCR cases were limited to microscopic foci of residual cancer: 1 primary site, 5 nodal. All patients are alive with no evidence of disease (median follow-up 21.3 months, range 4-41 months). Thirty-eight patients had a follow-up of at least one year. The incidence of acute CTCAE Grade 3/4 toxicity and PRO-CTCAE severe/very severe symptoms were: mucositis 34%/45%, pain 5%/48%, nausea 18%/52%, vomiting 5%/34%, dysphagia 39%/55%, and xerostomia 2%/75%. Grade 3/4 hematological toxicities were 11%. Mean pre and 6 month post CRT EORTC QOL scores were: Global 80/71 (lower worse), Pain (mouth, jaw, throat) 19/21 (higher worse), Swallowing 11/16, Coughing 17/26, Dry Mouth 16/68, and Sticky Saliva 6/49. Six months post CRT mean PRO-CTCAE scores for swallowing and dry mouth were mild and moderate, respectively. No patients reported their swallowing or dry mouth symptoms to be severe or very severe. 39% of patients required a feeding tube (none permanent) for a median of 15 weeks (5 - 22 weeks). There were no significant differences in PAS scores for thin, pureed, and solid foods before and after CRT.

Conclusion: Pathological CR rate with decreased intensity of therapy with 60 Gy of IMRT and weekly low-dose cisplatinum is very high in favorable risk OPSCC with evidence of decreased toxicity compared to standard therapies. (ClinicalTrials.gov, NCT01530997)

OC-0454

Clinical outcome in nasopharyngeal carcinoma patients with post-radiation detectable plasma EBV DNA

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Purpose or Objective: To investigate the long-term clinical behavior of nasopharyngeal carcinoma (NPC) patients with persistently detectable plasma EBV (pEBV) DNA after curative radiotherapy (RT) with/without chemotherapy.

Material and Methods: We screened 931 newly diagnosed NPC patients who finished curative RT and found 125 patients (13.4%) with detectable pEBV DNA one week after finishing RT. The clinical characteristics, treatment modality, subsequent failure patterns and survivals were analyzed.

Results: The levels of post-RT pEBV DNA for the studied population were in a very lower copy number (median 21, interquartile range 8-206 copies/mL). After a minimal follow-up of 52 months, the subsequent relapse rate was 64.8% (81/125) with distant failure predominantly and the median time to progression is 20 months for all 125 patients. Thirty-two of 39 (82.1%) patients with post-RT pEBV DNA ³ 100 copies/ml developed tumor relapse later, whereas 57.0% (49/86) patients with post-RT pEBV DNA < 100 copies/ml had tumor relapse (*P*=0.0065). The 5-year rates of overall survival (OS) were 20.5% and 62.9% for the patients with post-RT viral load ³ and < 100 copies/mL (HR, 0.22; 95% CI, 0.12 to 0.38; *P*<0.0001). Patients who received adjuvant chemotherapy (AdjCT) with oral tegafur-uracil experienced significant reduction in distant failures (66.2% vs. 31.6%; *P*=0.0001) but similar locoregional recurrences (*P*=0.234). The 5-year OS rates were 69.4% for the patients who received AdjCT compared with 33.2% for those of without AdjCT (HR, 0.38; 95% CI, 0.24 to 0.61; *P*<0.0001).

Conclusion: NPC patients with persistently detectable pEBV DNA after finishing RT have a higher rate of treatment failure. Levels of the post-RT pEBV DNA and administration of AdjCT affect the final outcome. Future trial should consider post-RT pEBV DNA levels as a stratification factor and investigate the role of AdjCT for the target population.

Proffered Papers: Physics 11: Dose measurement and dose calculation II

OC-0455

Development of activity pencil beam algorithm using nuclear reaction for innovative proton therapy

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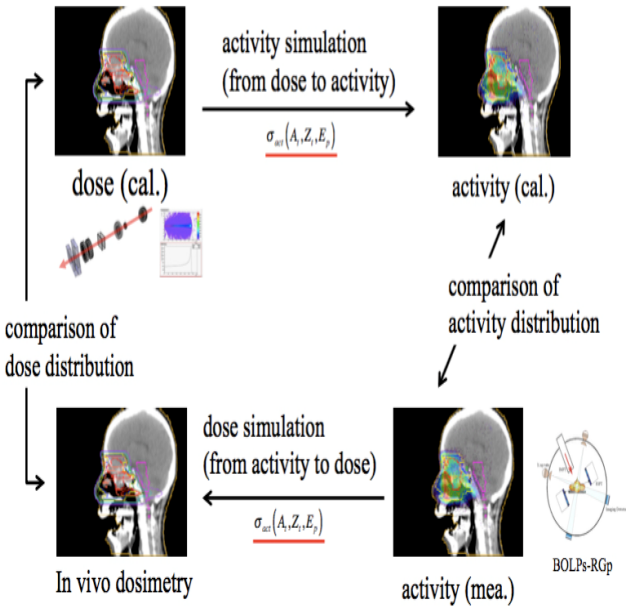
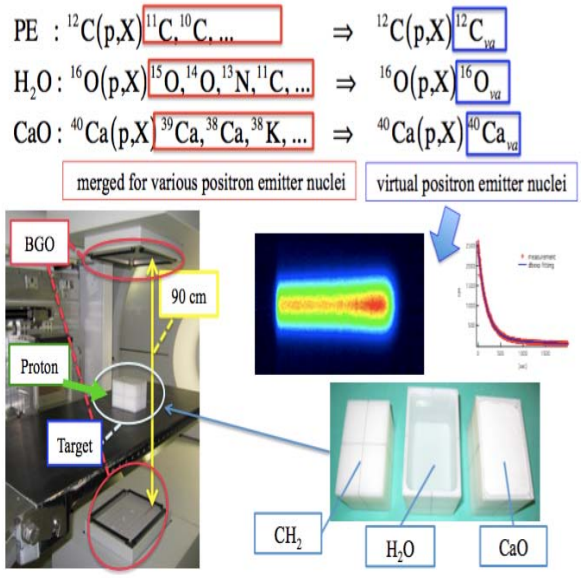
Purpose or Objective: Proton therapy is a form of radiotherapy that can be concentrated on a tumor using a scanned or modulated Bragg peak. To use this radiotherapy efficiently in a clinical context, it is necessary to evaluate the clinical proton-irradiated volume accurately. Therefore, a beam ON-LINE PET system (BOLPs) has been developed for activity imaging of various positron emitter nuclei generated from each target nucleus by target nuclear fragment reactions with irradiated proton beam. The purpose of this study is to develop an activity pencil beam (APB) algorithm for a simulation system for proton activated positron-emitting imaging in proton therapy.



Material and Methods: The APB algorithm was developed as a calculation algorithm of the activity distributions formed by positron emitter nuclei generated from target nuclear fragment reactions. Depth activity data of 12C nuclei, 16O nuclei, and 40Ca nuclei were measured with BOLPs after proton beam irradiation whose energies were 138, 179, and 223 MeV. Measurement time was about 5 h until the measured activity reached the background level.



Results: Data of measured depth activity distributions were prepared using the measured depth activity data. Activity pencil beam kernels needed for the APB algorithm were constructed using the data of measured depth activity distributions and calculations in lateral direction. Gaussian form was used for the lateral distribution data to take the effect of multiple Coulomb scattering into consideration.

Conclusion: A method of obtaining the depth activity distributions and the APB algorithm were developed. The simulation system with the APB algorithm can be used in clinical proton therapy.

OC-0456

Translation of a prompt gamma based proton range verification system to first clinical application

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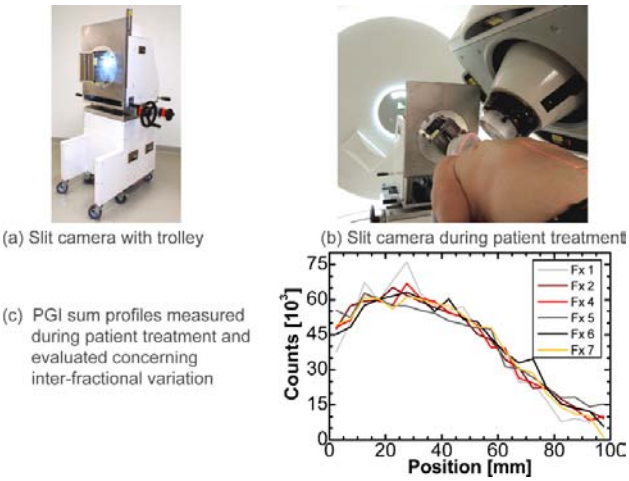
Purpose or Objective: To improve precision of particle therapy, in vivo range verification is highly desirable. Methods based on prompt gamma rays emitted during treatment seem promising but have not yet been applied clinically. Here we report on the translational implementation as well as the worldwide first clinical application of prompt gamma imaging (PGI) based range verification.

Material and Methods: Focused on the goal of translating a knife-edge shaped slit camera prototype into clinical operation, we first systematically addressed remaining challenges and questions. A robust energy calibration routine and corresponding quality assurance protocols were developed. Furthermore, the positioning accuracy of the system was determined. The slit camera, intentionally developed for pencil beam scanning, was applied for double scattered (DS) proton beams. Systematic phantom experiments with increasing complexity have been performed.

In the next step, the knife-edge shaped slit camera was applied clinically to measure the spatial prompt gamma ray distribution during a proton treatment of a head and neck tumor for seven consecutive fractions. Inter-fractional variations of the prompt gamma profile were evaluated. For three fractions in-room control CTs were acquired and evaluated for dose relevant changes.

Results: In translational phantom experiments it was shown that proton range shifts can be visualized with the camera system for DS proton irradiation, proving its applicability under conditions of increased neutron background. Moreover, prompt gamma profiles for single iso-energy layers were extracted by synchronizing time resolved measurements to the rotation of the range modulator wheel of the DS treatment system. Furthermore, the position precision of the slit camera has been determined to provisionally be 1.1 mm (2σ).

With this preparatory work, the first clinical application of the PGI slit camera was successful. Based on the PGI information, inter-fractional global range variations were in the range of ±2 mm for all evaluated fractions. The results of the iso-energy layer resolved prompt gamma profile analysis were in consistence with the sum profile analysis. Also the control CT based dose reconstruction revealed negligible range variations of about 1.5 mm. No influence of DVH parameters for target volume and organs at risk was found.



Conclusion: This work demonstrates for the first time that prompt gamma ray based range verification can be applied for clinical treatment of patients. Further plans include the continuation of the clinical study to perform systematic evaluations based on an appropriate patient number. With the translation from basic physics experiments into clinical operation, the authors are confident that a prompt-gamma ray based technology is capable of range verification and can be used in the near future for online quality assurance as well as in midterm for potential margin reduction.

OC-0457

Towards analytic dose calculation for MR guided particle beam therapy

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Purpose or Objective: The importance of MRI steadily increases in radiation oncology not only as multimodality imaging device but also as an implemented online imaging