the current-driven temperature controller. No field size dependence was observed down to 2 x 2 cm².

Table I. Estimated uncertainty budget for the GPC’s constant power and constant temperature modes of operation in high-energy photon absolute dose to water measurements.

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Constant power mode</th>
<th>Constant temperature mode</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type A (%)</td>
<td>Type B (%)</td>
</tr>
<tr>
<td>Heat transfer</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Reproducibility</td>
<td>0.6</td>
<td>-</td>
</tr>
<tr>
<td>Bridge calibration</td>
<td>-</td>
<td>0.1</td>
</tr>
<tr>
<td>Thermistor calibration</td>
<td>-</td>
<td>0.2</td>
</tr>
<tr>
<td>Electrical power</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Specific heat capacity</td>
<td>-</td>
<td>0.8</td>
</tr>
<tr>
<td>Mass</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Positioning</td>
<td>0.2</td>
<td>-</td>
</tr>
<tr>
<td>Perturbation+ dose conversion</td>
<td>-</td>
<td>0.4</td>
</tr>
<tr>
<td>Other not considered</td>
<td>-</td>
<td>0.3</td>
</tr>
<tr>
<td>Quadratic summation</td>
<td>0.6</td>
<td>1.0</td>
</tr>
<tr>
<td>Combined uncertainty</td>
<td>1.2</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Conclusion: This work demonstrates the feasibility of using an ion chamber-sized calorimeter as a practical means of measuring absolute dose to water in the radiotherapy clinic. The potential introduction of calorimetry into the clinical setting is significant as this fundamental technique has formed the basis of absorbed dose standards in many countries for decades. Considered as the most direct means of measuring dose, a “calorimeter for the people” could play an important role in solving the major challenges of contemporary dosimetry. In particular, investigations into the use of the GPC for MR-linac dosimetry are currently underway.

OC-0286
From pixel to print: clinical implementation of 3D-printing in electron beam therapy for skin cancer
R. Canters1, I. Lips1, M. Van Zeeland1, M. Kusters1, M. Wendling2, R. Gerritsen1, P. Poortmans1, C. Verhoef1
1Radboud University Medical Center, Radiation oncology, Nijmegen, The Netherlands
2Radboud University Medical Center, Dermatology, Nijmegen, The Netherlands

Purpose or Objective: Build-up material is commonly used in electron beam radiation therapy to overcome the skin sparing effect and to homogenise the dose distribution in case of irregular skin surfaces. Often, an individualised bolus is necessary. This process is complex and highly labour-intensive, while adaptation of the bolus is time consuming. We implemented a new clinical workflow in which the bolus is designed on the CT scan in the treatment planning system (TPS). Subsequently a cast with the bolus shape is 3D-printed and filled with silicone rubber to create the bolus itself [1].

Material and Methods: In the new workflow (figure 1), a patient-specific bolus is designed in the TPS. A 2 mm expansion is used to create a cast around the bolus. Subsequently, this cast is smoothed to remove CT scan resolution effects. After conversion to a STL file, the cast is printed in polyactic acid (PLA) with a filament printer and filled with silicone rubber. After removal of the PLA cast, the bolus is ready for clinical use.
Before clinical implementation we performed a planning study with 11 patients to evaluate the difference in tumour coverage with a 3D-print bolus in comparison to the clinically delivered plan with a manually created bolus. During clinical implementation of the 3D-print workflow, for 7 patients a second CT-scan with the 3D-print bolus in position was made to assess its geometrical accuracy and the resulting dose distribution.

Results: The planning study showed at least equal coverage of GTV and CTV: 95% of the GTV was on average 97% (3D-print) vs 84% (conventional). 85% of the CTV was on average 97% (3D-print) vs 88% (conventional).

Comparison of the dose distributions at the planning CT scan to dose distributions at the second CT scan with the 3D print bolus in position showed only small differences (median difference in 95% GTV and 85% CTV at zero interquartile range: -12% to 0% and -1.6% (interquartile range: -3.8 to 0.5%), respectively).

Time efficiency of the 3D-print workflow is likely to increase in comparison to the conventional workflow, with one less patient visit, and up to 3 hours less mould room time.

Conclusion: The implemented workflow is feasible, patient friendly, safe, and results in high quality dose distributions. This new technique increases time efficiency and logistically aligns electron with photon external beam treatments.

Figure 1: Illustration of the clinically implemented 3D-print workflow with designed bolus(A) and cast around the bolus(B) at the planning CT scan, smoothed cast (C), 3D model of the cast (D), printed cast (E) and silicone rubber final bolus (F).

SP-0287
How to finish your residency / PhD project with a job offer

S. Rivera
Institut Gustave Roussy, Villejuif, France

Radiation oncology is a rapidly evolving profession requiring continuous learning on the top of all routine activities. Residency is a unique period in a professional life where the main objective is to learn. Residency is full of research and educational opportunities for young radiation oncologists to gain know-how and expertise in clinical practice, patient care, fundamental, translational and/or clinical research and innovative technologies in the various aspects of our specialty. Through local, national and international programs, trainees gain valuable clinical and research experience and skills during and rapidly get the opportunity to disseminate information and update colleagues in their home institution. Playing a proactive role in the training will not only give access to the best training opportunities but will motivate as well supervisors in supporting trainee’s career development.
In a competitive world with limited resources, building up a good curriculum vitae with a number of publications and presentations is a major advantage that should be
considered and kept in mind early and during the whole residency. This will not only be of value when applying for a job but will open a number of collaborations as well introducing the trainee in a virtuous circle which will tremendously facilitate future projects, recognition, satisfaction and professional pleasure.

International exchanges and mobility are of utmost importance. From personal initiatives directly contacting a department head abroad via email or at a meeting to local/national or scientific societies programs there are many opportunities to gain such an enriching experience. ESTRO for instance supports short terms (few weeks) educational visits called mobility grants twice a year which allow for learning a specific technique in the context of a project propose by the candidate through a motivation letter which can be an excellent way to get some connections to look for longer term mobility. Entering a PhD program is another excellent opportunity to access the kind of international exchange and mobility that together with the scientific production and publication resulting from it will serve a career when looking for a position in a high level academic center. Indeed, having an international professional experience and a strong scientific background will be highly considered when applying for a job offer in a university hospital or a cancer center. This will even be almost mandatory when aiming at a research/teaching position.

Mentorship can be very helpful throughout a career. Benefiting from privileged dialogue, support and guidance from a more experienced person in the field considered as a mentor can enhance the effectiveness of any talent, help avoiding painful mistakes and optimizing choices that will have a major career impact and sometimes even an impact on the balance between professional and personal life which is often a fragile point in a demanding profession. Many countries across Europe are lacking of mentorship programs but in many institutions even without a dedicated program various types of mentoring are in place. Most of more experienced people are happy to share their experience and give some advices so one should not hesitate to ask for this helpful interaction. With or without a mentor here are key questions that are essential to guide one’s choices:

Who am I?
Where do I want to go?
What type of professional activity will I enjoy?
Which life will make me happy?
What questions that are essential to guide one’s choices:

To conclude, the best advice would be to always wonder how to get the most out of one’s training period. In that aspect, ESTRO offers young professionals in the field of radiation oncology a wealth of opportunities from networking, grants, educational courses, fellowships, mentorships and workshops aiming at refining skills and gaining access to the latest developments in the field that will be of value finishing your residency not only with a job offer but with the job you want.

SP-0288
How to finish your residency / PhD project with a job offer as a radiobiologist
M.C. Vozenin
Centre Hospitalier Universitaire Vaudois, Department of Radiation Oncology, Lausanne Vaud, Switzerland

PhD training/residency is a long-term and enriching experience, it requires time and commitment for scientific achievement; in addition, the future of a young scientist needs to be planned ahead. Therefore, having a clear view of your career’s perspectives at least 18 months before your defense is the way to professional success. Early during your training discuss your career aspirations and important issues in your professional development with your mentor, he/she will be able to provide you with career information and guidance. But ultimately you will be the one to define if you are seeking for an academic career, job in the industry or other professional options. In any case your mentor will introduce you to colleagues, potential employers, and other professionals who might help to advance your career. You also need to be highly proactive and present your research and creative work as often as possible in multiple forums including your department/university but also at professional conferences/meeting. You will need to apply for fellowships, awards, teaching opportunities and service committees in the scientific community. The aim is to create a strong network that will serve as the base for your job research and will provide you with multiple opportunities.

SP-0289
How to finish your residency / PhD project with a job offer as a physicist
D. Verellen
Universitair Ziekenhuis, Radiotherapy, Brussels, Belgium

SP-0290
How to finish your residency / PhD project with a job offer as a researcher
U. Gelife
Institute of Cancer Research, Department of Radiation Oncology, United Kingdom

Symposium with Proffered Papers: Standardisation in clinical practice

SP-0291
Guideline-based contouring and clinical audit systems
C. Weltens
University Hospital Leuven- KU Leuven, Radiotherapy-Oncology, Leuven, Belgium

Modern radiotherapy techniques focus on the precise irradiation of the target volume while minimizing the dose to adjacent normal tissues. Technical advances at all levels of the complex radiotherapy preparation and delivery process allowed reductions of safety margins and conformation of the high dose volume to the target volume. The introduction of these technical innovations has been supported by extended quality assurance procedures. A small part of the radiotherapy preparation process however has for a long time remained unaddressed: the quality of the delineation is still a weak link in the radiotherapy chain. Accurate, unambiguous and precise target delineation is mandatory in high conformal radiotherapy, since the treatment plan and subsequently treatment delivery are based on the delineated target volumes. Errors in target delineation will on the one hand lead to systematic errors in treatment delivery and possibly to geographical misses in clinical practice. The projected outcome will be undermined both with respect to the chances of tumor control and the risks of side effects. On the other hand, inconsistencies in target volume contouring comprise the validity of the results of clinical trials. To improve the quality of the delineations, guidelines were made for nearly all tumor sites as well as for the normal tissues. Notwithstanding these published guidelines, important inter- and intra-observer variation in target delineation have been demonstrated. Several solutions have been proposed to improve the quality of target delineation: (1) for nearly all tumor sites delineation guidelines with complementary atlases have been published, (2) the registration of CT scans in treatment position with a combination of different imaging modalities has been tested and introduced, (3) automated and semi-automated delineation software has been developed, and (4) education through hands-on workshops at radiotherapy meetings and online tutoring sessions (e.g. FALCON) is available. Studies also show that peer review can improve delineation quality. The quality of target delineation was measured in Belgium through clinical audits for rectal and breast cancer patients. We have evaluated the role of a central review platform in improving uniformity of clinical target volume delineations within a national Belgian project. All 25 Belgian radiation oncology departments were invited to participate in this QA project. CTV delineation guidelines and atlases were discussed and distributed at a national meeting. After this education of the radiation oncologists, a review process was set up. Departments were asked to delineate the clinical target volumes and to upload it to a secured server. For