departments, however, will lead to essentially no access to traditional radiographic film and wet developer systems. An alternative is dosimetry without film processors using radiochromic films. Starting with the MD-55 (mainly used in brachytherapy) these polymere based dosimeters attracted attention in the radiotherapy community in the last decade. Some issues like low radiosensitivity, low homogeneity, small film size and time and temperature dependencies prevented a wide clinical use. Further developments lead to increased radiosensitivity and the three generations of the scanner are widely used in radiotherapy clinics. This teaching lecture will therefore focus specifically on radiochromic film dosimetry and its practical aspects for quality assurance purposes in radiotherapy.

The advantage of radiochromic film dosimetry is that they don’t need chemical or physical processing and are self-developing. In addition to suboptimal results. During the teaching lecture pitfalls in handling and parameters of influence on the read out signal are pin pointed. Few examples are scanning orientation, post-irradiation darkening and UV sensitivity. A new generation of EBT films (EBT 3) are currently available and the changes related to the new design are specifically addressed.

The characteristics of EBT films define their application as QA tool in proton therapy. The teaching lecture is tailored to those who want to know about the three generations of EBT films, which are nowadays available and the changes related to the new design are specifically addressed. For example - What are the essentials I need? How should I handle the film? What do I need to know about scanning? Which scanner should I use? What colour channel should I use? What is the difference between EBT2 and EBT3? How can I get rid of uniformity issues of the film and the scanner? How to deal with Newton’s ring artifacts? What is the achievable accuracy with radiochromic films? The characteristics of EBT films define their application as QA tool in highly conformal and complex treatment strategies like IMRT, VMAT or protons therapy. The teaching lecture is tailored to those who want to set up a radiochromic film dosimetry protocol. Questions, which will be discussed, are for example - What are the essentials I need? How should I handle the film? What do I need to know about scanning? Which scanner should I use? What colour channel should I use? What is the difference between EBT2 and EBT3? How can I get rid of uniformity issues of the film and the scanner? How to deal with Newton’s ring artifacts? What is the achievable accuracy with radiochromic films?

**SP-0197**

Delineation of normal structures: Where are we and what we are aiming for

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In the 3D-era the organs at risk (OARs) were contoured and evaluated by the Radiation Oncologist (RO) with the aim to report the dose delivered to the normal structures, without any significant impact on the calculation of dose distribution on treatment plan. The introduction of imaging, diagnostic imaging and TMS imaging management tools brought to a better definition of OARs. Moreover, the introduction of new techniques of radiation delivery, such as IMRT, and the possibility to register during the treatment the accumulated dose, is challenging both for RO and RTT. However this improved definition of the high-dose volume to the OARs could bring to a better definition of OARs with an intrinsic high resolution contrast (bones and lungs) with a good reliability and a significant time spacing, the delineation of the other OARs is still manual. Moreover, due to the even more importance of OARs in the treatment definition, an Independent Check (IC) should be warranted. The possibility given by IMRT to sculpt the dose around the target yielded to a greater attention to OARs in all the phases of treatment:

1. **Prescription**
2. **Delineation**
3. **Dose calculation**
4. **Evaluation of Treatment**
5. **Verification during treatment**

**1. Prescription**: the RO has the possibility to prescribe the dose both to the target and to OARs.

**2. Delineation**: a growing number of structures have to be manually delineated by the RTT to account for toxicities in irradiated healthy organs (swallowing muscles in head and neck, bladder trigone in the pelvis, brachial plexus in axillary lymph nodes irradiation...). Many are described in the guidelines of the procedure: it is time consuming and not well standardized, indeed there are no international published ATLAS to guide in the delineation: for H&N cancer, just institutional experiences (Christianen ME et al., RO 2011, van deWater TA et al., RO 2008), whereas the delineation of OARs in pelvis and RTOG atlas has recently been published (Gay HA et al., UROBP 2012), usually there isn’t an IC procedures.

**3. Dose calculation for IMRT plan requests the definition of dose constraints both on PTVs and OARs**

**4. Evaluation of TP**: in the evaluation of the treatment planning the RO has to evaluate the distribution of dose not only in the target volumes, but also in the OARs, with the possibility to modify the TP in order to respect the constraints.

**5. Verification during treatment**: it is known that during RT there are modifications of the distribution of dose both in target volumes and in OARs, in addition to the error in the calculated delivered dose. Therefore it is important the re-planning in case of body modification for toxicities. Therefore it is the important time where a new PT is created based on the new anatomy of the patient. This procedure, although guarantees a better precision in the calculation of the delivered dose it is time consuming. Where new technologies can help in such complex procedures?

**SP-0198**

Effect of high doses per fraction

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Doses per fraction larger than the conventional 2 Gy are applied in curative intent e.g. in moderate hypofractionation strategies (2.5 Gy/fraction), in highly conformal external beam irradiation protocols, such as stereotactic or hadron therapies, and in brachytherapy. These regimens, however, usually do not only differ in the size of the dose per fraction, but also with regard to overall treatment time and total dose. Moreover, large doses per fraction are usually administered to (normal tissue) volumes that are clearly smaller than in conventional protocols. All these parameters need to be included into considerations concerning the biological effect of large doses per fraction protocols - independently for tumor, early and late responding tissues. The effect of dose per fraction (“recovery” for tumors was historically - with few exceptions e.g. melanoma and liposarcoma) - considered as low, as expressed by a high α/β-value in the linear-quadratic (LQ-)model. Recently, a high fractionation effect was shown for prostate and breast tumors, and is currently discussed for others. Early responding normal tissues usually show a low fractionation effect, while most late radiation effects display a high sensitivity for dose per fraction. Hence, doses per fraction must be adjusted to the respective tumor type as well as the organs at risk and the (late) morbidity pattern in order to achieve the biologically equivalent effective doses that result in optimum dissociation between treatment efficacy and adverse events. It was postulated that the LQ-model may not be applicable for large doses per fraction (>6-10 Gy), as indicated by in-vitro cell survival data. However, in most preclinical analyses of the fractionation effect large doses per fraction would be included, but with even more increased cell survival data from the respective estimates from clinical data, which barely supports the conclusions from the in-vitro studies. If at all, then the linear-quadratic model overestimates the effects of exposure to high doses per fraction. Most curative therapy protocols with high doses per fraction are associated with a shortened overall treatment time. This may also contribute to increased tumor effectiveness of the treatment. However, it also is less permissive for regenerative processes (“repopulation”) in normal tissues. These protocols therefore include a risk of increased normal tissue reactions and thus, in certain tissues, also of enhanced (“consequential”) late effects. The administration of large doses per fraction to normal tissues, particularly in stereotactic treatment approaches, is mainly facilitated by a high conformity of the high-dose volume to the target volume, and steep dose gradients in normal tissues. However, it must be emphasized that very high doses per fraction may not only change the quantity of normal tissue changes, but may also alter tissue pathophysiology and thus result in morbidity endpoints that are usually not observed with conventional or moderately hypofractionated protocols. Prominent examples are the manifestation of atrophic rather than fibrotic processes, e.g. after brachytherapy, or the occurrence of pathological rib fractures after stereotactic radiotherapy of peripheral lung tumors. In conclusion, administration of large doses per fraction may be advantageous for biological, but also for economic reasons. However, such approaches not only impact on tissue recovery, but also on radiobiological parameters (radiopathy, repopulation, volume effects) in a highly complex manner. Therefore, the patients included
in such therapeutic protocols need to be monitored very carefully not only for treatment outcome, but also for treatment-related morbidity.

SP-0199
Integral dose, the hidden danger that brachytherapy avoids
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Improvements in survival after a primary cancer diagnosis mean that the risk of radiation induced second cancer and cardiovascular disease become important survivorship issues.
As well as individual patient factors, risk of late effects is known to be related to the dose distribution, volume irradiated, total dose and dose rate. Using early prostate cancer and breast cancer as clinical examples this lecture will review risks from registry data and institutional series with particular emphasis on whether specific techniques are associated with lower risks. The physical dose distributions delivered to OAR with commonly used radiation techniques will be demonstrated with a comparison of differences in integral dose, defined as mean dose times OAR volume.
In prostate and breast cancer survivors, do brachytherapy techniques improve outcome with respect to radiation induced second cancers and cardiovascular disease?
Can risk prediction models be developed that allow customised follow up and evidence based interventions to reduce the risk of late side effects?