’Digital Film’ for highly precise Radiation Therapy - Accuracy, Speed and Efficiency for best cutting-edge therapy results

Stereotactic Body Radiation Therapy (SBRT): A new challenge for the Medical Physics team

Stereotactic Body Radiation Therapy is an innovative treatment modality which can be used to irradiate multiple small target areas (e.g., brain metastases) with extremely high precision and best sparing of healthy tissue. This is often done in conjunction with hypo fractionation, i.e., delivering a low number of fractions (typically 3… 8) with higher doses than in the classical fractionation scheme, called normofractionation (30-40 fractions). The integral doses in the treatment can be kept lower in this way.
These features of SBRT offer an enormous therapeutic advantage, but inherently offer more risks when not delivered in an extremely precise way. The sharp dose fall-off bears a risk of missing partly the (small) targets or exposing healthy tissue unnecessarily to higher doses. Moreover, the small number of fractions with high doses will avoid an averaging-out of delivery errors like in the normofractionated case.

Therefore, the requirements for a QA detector used in these treatment modalities are rather demanding:

- very high spatial resolution
- Relatively large area, > 100 cm^2
- High dynamic range
- Fill factor close to 100%, i.e. no blind spots on detector

A radiographic (Silver Halide crystals as light-sensitive structure and chemical development after exposure) or radiochromic film (formation of color dyes after exposure, self-developing) is a detector ideally matching these requirements, but scanning, calibration, and development are extremely time consuming, moreover, a correct handling of film dosimetry requires very experienced operators. Therefore, application of film dosimetry for SBRT treatment verification is limited to sample cases only and not applied for each patient treated with this modality.

Therefore, an electronic detector device is needed for daily routine plan verification (irradiation of the patient’s plan on a detector device), which can deliver data immediately and without the need of daily calibration. Ion chambers and diode detectors are well-suited for this purpose, but they can deliver dose information only for one point in a measurement phantom.

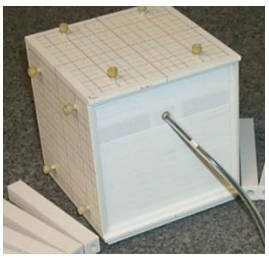

Fig. 1 Ionization Chamber in a measurement phantom as used for SBRT (CyberKnife®) patient plan verification

A deeper insight into the complexity of these highly sophisticated treatments can be given with an array of ionization chambers or diode detectors. Existing solutions, however, still have a limited resolution with typically some 1,000 active elements. Moreover, these active pixels only cover a very limited fraction of the whole detector's area, typically below 5%.

IBA Dosimetry has developed a novel device which overcomes all these restrictions. A monolithic silicon area detector with 105,000 active pixels covers a 12x14 cm^2 active area. The fill factor is virtually 100%, i.e., there are no blind spots on the detector.

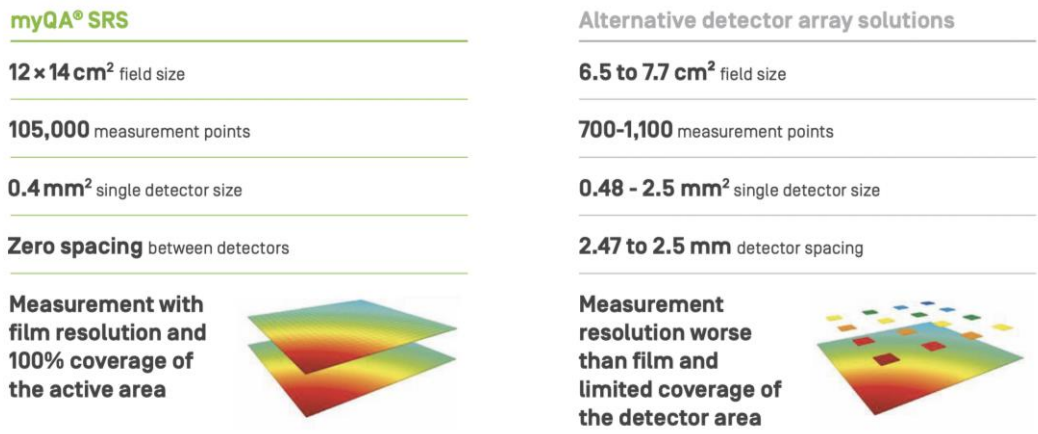

Fig.2 Comparison of the novel myQA SRS detector with existing array detectors on the market

SBRT treatments are often used to treat multiple metastases, e.g., in the brain, in a single run. The large area of myQA SRS allows an easy, precise and fast QA of these plans as the detector can measure the whole treatment area, whereas smaller area detectors require taking single measurements for each metastasis, and a re-positioning of the detector for QA of the next targeted metastasis.

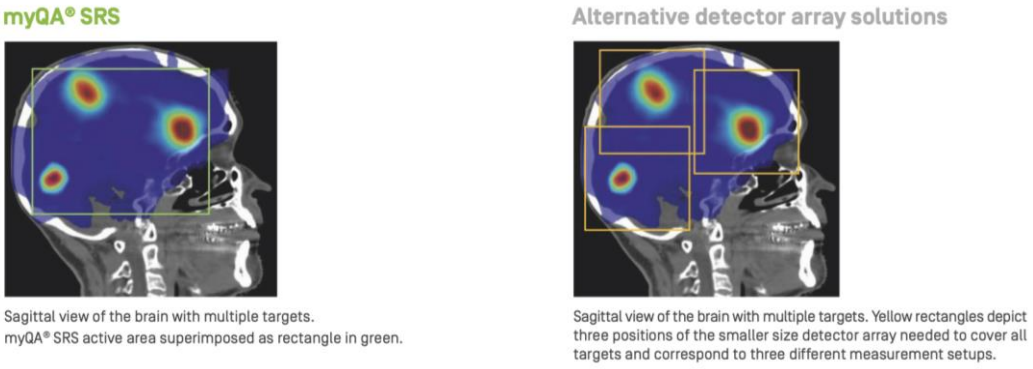

Fig.3 A multiple metastasis treatment can be verified in a single measurement with the myQA SRS detector.

Customer experience with myQA SRS:

Experience with myQA SRS in the UK

"The high resolution of myQA SRS detector gives us high confidence in our stereotactic treatments, including SBRT spine, prostates and liver. We have achieved ***excellent Gamma Analysis QA results at 2 % and 2mm****. The detector matched the performance of our ionisation chambers and compared excellently to film. The* ***detector, phantom and software package is easy to use*** *and integrates seamlessly into our myQA Platform. Obtaining instant high-resolution results without the need for lengthy film measurements is a big advantage."*

Sally Fletcher, Head of Radiotherapy Physics
Bristol Haematology and Oncology Centre
University Hospitals Bristol and Weston NHS Foundation, UK

Read the myQA SRS user validation article

Experience with myQA SRS in the USA

"Patient-specific SRS and SBRT QA results look great using the myQA SRS even for very tight parameters of 2mm/2%. The digital detector QA workflow with myQA SRS is 10x times faster and easier compared to using film. The film-equivalent resolution for our QA measurements is the basis for better and more meaningful SRS patient plan verification with a high sensitivity and specificity to detect real dosimetric issues."

Yun Yang PhD, DABR
Department of Radiation Oncology
Rhode Island Hospital, USA

For any further questions you may contact us here.

Article by Dr. Lutz Müller (†), Medical Physicist @ IBA Dosimetry GmbH

Life.
Science.