Conclusions: The presented analytical dose calculation algorithm is applicable for any type of heterogeneity. The high calculation speed of the algorithm makes it feasible for use in clinical real-time treatment planning and thus for improving treatment quality.

PO-0967
Loose seeds vs. stranded seeds in permanent prostate brachytherapy: dosimetric comparison of intraoperative plans
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Purpose/Objective: To evaluate and compare the dosimetric parameters of intraoperative treatment plans in prostate seed implants performed with loose seed and stranded seed techniques.

Materials and Methods: Permanent prostate brachytherapy with 1-125 seeds as a monootherapy for patients with low and intermediate risk prostate cancer was implemented at our institute in 2009, and since then 147 patients have been treated. The first 79 patients were implanted with loose seeds (seedSelect, Nucletron) and the next 68 groups.

Results: On average, 54 and 47 seeds were implanted in the prostate with individual median seed activities of 0.49 and 0.56 mCi for LS and SS technique, respectively. The median needle number was 15 and 17, correspondingly. The mean prostate volumes were practically identical (33.4 vs. 33.9 cm³). The dose coverage was similar (V100: 96% vs. 97%, D90: 167 Gy vs. 169 Gy) in the two groups, and the dose homogeneity was identical (DHI: 0.39). The conformity of dose distributions was better for LS (COIN: 0.70 vs. 0.65). Regarding the dose to urethra all dosimetric parameters were significantly lower (p<0.05) for LS (Dmax: 138% vs. 154%, D0.1 cm³: 126 vs. 140 %, D10: 125 vs. 136 % and D00: 199 vs. 128 %). The rectum received less dose with the LS technique (Dmax: 101% vs. 112 %, D2 cm³: 82 Gy vs. 97 Gy, D0.1 cm³: 127 vs. 143 Gy, and D10: 75% vs. 86%) (p<0.05 for all).

Conclusions: In permanent prostate seed brachytherapy the dose to urethra and rectum is less with LS technique compared to SS technique in the intraoperative plans. Moreover, the conformity of dose distributions is also better with LS along with the same homogeneity of dose distributions. Probably the more flexible loading pattern for LS technique results in the more favourable dose distributions.

PO-0968
Available guidance, current UK practice, and future directions for HDR brachytherapy quality control
A. Nisbet, A.L. Palmer, D.A. Bradley
Royal Surrey County Hospital & Surrey University, Medical Physics, Guildford, United Kingdom

Conclusions: The only contemporary benchmark survey of HDR QC practice has been undertaken. The outcome of this work is a review of current practice against available recommendations, relevant recent changes in clinical brachytherapy techniques, and the use of modern quality process assessments. Recommendations for appropriate, optimised QC for HDR brachytherapy are made.

PO-0969
Air kerma rate measurements for Ir-192 and Co-60 HDR sources using three different international protocols.
F.W. Hensley, H.A. Azhari, W. Schütte, G.A. Zakaria
Univ. Klinikum Heidelberg, Department of Medical Physics, 69120 Heidelberg, Germany

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**Purpose/Objective:** Since several years, Co-60 HDR afterloading sources are commercially available. The long half-life of Co-60 together with its comparable dose distributions to Ir-192 makes this type of sources economically attractive, especially in developing countries. However, to date protocols for brachytherapy dosimetry provide no explicit guidelines for verification of Co-60 source calibration by the clinical physicist. The purpose of this work was twofold: first, the verification procedures recommended for Ir-192 in three existing dosimetry protocols were applied to both Co-60 and Ir-192 sources in order to test their applicability with Co-60 sources. Second, the evaluation of the experiments was performed together with medical physicists trained in a joint education program between Universities in Germany and Bangladesh. Purpose of this step was to add practical experience in Brachytherapy physics, a subject for which the Bangladesh University so far has only very little access to treatment facilities.

**Materials and Methods:** Three existing dosimetry protocols (IAEA-TECDOC-1274, DIN 6809-2, AAPM Report 41) were applied to Co-60 and Ir-192 sources to measure reference air kerma rate with ionization chambers using the procedures recommended for Ir-192. Wherever the protocols give no correction factors for the chamber readings from Co-60 sources, equivalent factors from literature were used. Verification measurements were performed with three different experimental methods (with a cylindrical ionization chamber both in a solid phantom and free in air, and with a well chamber) and evaluated with all three protocols. The measurements were performed at two hospitals in Germany and evaluated in parallel in by the groups in Germany and Bangladesh. The results are compared to the reference air kerma rates given in the source certificates.

**Results:** The measurements with all protocols and methods are in good agreement both for Ir-192 and Co-60. The measured air kerma rates show deviations from the certificate values smaller than 1.2\% for Ir-192 and 2.5\% for Co-60 Sources. The measurements with the well chamber show the lowest deviations from the certificate value. The results of the experiments were published both in a German and in an Indian medical physics journal.

**Conclusions:** Air kerma rate measurements for Co-60 HDR sources using the existing protocols are possible with accuracy sufficient to verify source calibration even though the protocols are not specifically designed for Co-60 measurements. The existing protocols for brachytherapy dosimetry are outdated. New protocols are desirable, based on measurements with ionization chambers calibrated in absorbed dose to water and providing the complete measurement procedure and correction formalism also for Co-60 sources. Joint evaluation of experiments by physicist at a teaching institution and physicists in training at a second institution can provide a valuable means to disseminate experience to institutions with missing experimental resources.

**PO-0970**

Tissue segmentation significance for individualized 192Ir brachytherapy dosimetry

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**Purpose/Objective:** A water equivalence study of different human tissue compositions is interesting to validate the segmentation schemes employed in contemporary treatment planning systems with advanced dose calculation algorithms, and assist their benchmarking against TG43-based calculations in water.

**Materials and Methods:** Monte Carlo simulations were performed for a point 192Ir source centered in homogeneous 50 cm radius spheres of different tissue compositions taken from Schneider et al (2000) and the AAPM TG186 report. Tissue density was set to 1 in all simulations. Dose was approximated by collision kerma and both water and tissue kerma in tissue (i.e. Kw,t and Kt,t) were scored using the "F2 surface flux tally. Results are expressed as % difference of Kw,t with homogeneous water (Kw,w) to quantify differences in attenuation and scatter, as well as % differences between Kt,t and Kw,w to quantify the combined effect of the attenuation and differences in mass energy absorption.

**Results:**

When the effect of density is ruled out, differences in electron density and Zm between air and water translate to negligible differences in attenuation (Kw, air is within 1% with Kw,w in contrast to Kair, air which is 10% lower due to the lower mass energy absorption of air). Dosimetric differences between lung and water are negligible regardless of kerma reporting in lung or water, albeit positive in the former case and negative in the latter. For soft tissue materials, Kw,t reporting would yield significant differences from water for high adipose content (lower O weight) only at increased distances. Kt,t reporting would yield negligible differences from water for all materials and distances. The connective and mean soft tissues all appear dosimetrically equivalent to water regardless of reporting Kw,t or Kt,t, except for mean adipose. Skeletal tissues present increasing differences from water with increasing proportion of osseous tissue to bone marrow, with negative differences for Kw,bone and positive for Kbone,bone.

**Conclusions:** Lung and average soft tissue materials set forth by the AAPM TG186 are water equivalent for the 192Ir energies regardless of kerma reporting material. Departure from water equivalence is only observed when Kw,t is reported and only for large tissue thickness. Kerma reporting material also affects the differences relative to water for skeletal materials. Tissue density is the determining parameter for individualized 192Ir patient dosimetry. A method for stoichiometric CT calibration is not required unless reporting water kerma in the inhomogeneous geometry is of the essence.

**Acknowledgement**

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**POSTER: BRACHYTHERAPY TRACK: PROSTATE CANCER**

**PO-0971**

The impact of TRUS probe type on treatment planning of I-125 permanent prostate brachytherapy

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**Purpose/Objective:** In permanent I-125 seed implants of the prostate, the quality of the implant depends, amongst other factors, on the quality of the image modality used during implantation. The image modality most frequently used in the OR is TRUS. Since 2006, a new type of TRUS probe is introduced in our clinic. This is a dual sagittal crystal probe (DSCP) with a transversal crystal in between, instead of the conventional single sagittal crystal probe (SSCP) with a transversal crystal in front.

In a retrospective study, it was investigated whether a longer sagittal view using a DSCP allowed for more accurate online-planning in I-125 permanent implant...