2015 Conference
Australasian Brachytherapy Group

12th–14th March 2015

Rydges World Square, Sydney

Programme and abstracts

Programme overview

Thursday, 12 March 2015

12:00 p.m.	**Registrations Open**
1:00 p.m.	**Welcome to ABG 2015:** Dr Joseph Bucci
1:05 p.m.	**Nucletron Workshop: 3rd Oncentra Brachy Australia and New Zealand Users Meeting** **ACE™ Advanced Collapsed Cone Engine – Model-Based Dose Calculation Algorithm See The Whole Picture** This workshop will cover the following topics: • Model Based Dose Calculations as recommended by the TG186 • What does this mean for us in a Clinical Situation • Clinical Validation and Evaluation of the ACE algorithm • Implementation in Oncentra Brachy • Report from the TG 186 Working Group • Fletcher CT/MR Shielded Applicator – New algorithm, new applicators! Peter Douglas and Kirsten Bell, Nucletron Pty Ltd
3:00 p.m.	**Afternoon tea**
3:30-4:30 p.m.	**Nucletron Workshop (continued)**
4:30 p.m.	**Nucletron Presentation**
5:00 p.m.	**Day 1 Concludes**
6:00 p.m.	**Welcome Reception, Exhibition area**

Friday, 13 March 2015

7:30 a.m.	**Registration Desk Open**
7:30-8:30 a.m.	**Breakfast with The Professor Teaching Session** **Chairs:** Dr. Nadine Beydoun, Prof. Anatoly Rosenfeld **Breast Cases:** Associate Professor P. Devlin **Physics Cases:** Associate Professor K. Tanderup
8:30 a.m.	**Welcome:** Dr. Joseph Bucci
8:35 a.m.	**Chairs:** Annette Haworth, Joseph Bucci **Brachytherapy history from Australian perspective and future visions** Associate Professor Graeme Morgan
9:05 a.m.	*Keynote Speaker* **Advanced image guidance for pelvic brachytherapy back to the future** Associate Professor Phillip Devlin
9:50 a.m.	**3T MR image-guided cervix brachytherapy with novel immobilisation – initial 4-year experience** Dr. Mark Stevens
10:00 a.m.	**Morning tea**
10:30 a.m.	**Chairs:** Viet Do, Emily Flower *Proffered Papers* **Implementation of an afterloaded low-dose-rate brachytherapy technique for prostatic rhabdomyosarcoma** Gemma Busuttil

10:40 a.m.	**The initial experience of plesiotherapy technique for scalp treatment** Florence Ko
10:50 a.m.	**Brain dose verification in scalp brachytherapy** Judith Martland
11:00 a.m.	*Keynote Speaker* **Challenges and promises in image based brachytherapy in cervical cancers** Associate Professor Umesh Mahantshetty
11:45 a.m.	*Proffered Paper* **Inter-observer reliability of obtaining measurements of the cervix and uterus with brachytherapy applicators in-situ using transabdominal ultrasound** Sylvia van Dyk
11:55 a.m.	**Housekeeping**
12:00 p.m.	**Lunch**
1:00 p.m.	**Chairs:** Andrew Howie, Annette Haworth *Keynote Speaker* ***In vivo* dosimetry** Associate Professor Kari Tanderup
1:45 p.m.	*Proffered Papers* **Brachyview for high-dose-rate (HDR) brachytherapy** Zhangbo Han
1:55 p.m.	**A near water equivalent beryllium oxide ceramic dosimetry system for high-dose-rate brachytherapy** Alexandre Santos
2:05 p.m.	***In vivo* rectal dose measures compared to planned and reconstructed doses in US-based HDR prostate brachytherapy** Anatoly Rosenfeld
2:15 p.m.	***In vivo* treatment delivery error trapping in HDR prostate brachytherapy** Ryan Smith
2: 25 p.m.	**Evaluation of HDR prostate brachytherapy catheter displacement between planning and treatment using a flat panel detector** Natasha Mason
2: 35 p.m.	*Keynote Speaker* **Dose reporting (upcoming ICRU report) and uncertainties in intracavitary brachytherapy** Associate Professor Kari Tanderup
1:00-3:15 p.m.	**Nurses & RT Workshop Concurrent Session** **Vaginal dilators for patients post brachytherapy and radiation** Letitia Lancaster **Breast brachytherapy treatment delivery and care of the patient** Kris Schreiber **Developing brachytherapy nurses network and planning for the next meeting** Pauline Thomson
3:15 p.m.	**Afternoon tea**
3:45 p.m.	**Annette Haworth**: ABG Summary of Activities **Development of benchmarking cases to assist early users commissioning of model based dosimetry calculation algorithms in brachytherapy treatment planning systems**
4:00 p.m.	**Chair:** Annette Haworth **ABG Annual General Meeting**
5:00 p.m.	**Day 2 Concludes**

6:30 p.m.	**Coach transfers from Rydges World Square to Doltone House, Jones Bay Wharf**
7:00 p.m.	**Conference dinner – Doltone House, Jones Bay Wharf**
10:00 p.m.	**Coach transfers return to Rydges World Square**

Saturday, 14 March 2015

7:30 a.m.	**Registration Desk Open**
7:30-8:30 a.m.	**Breakfast with the Professor Teaching Session** **Chairs:** Dr Catherine Clark, Nadine Beydoun **Prostate Brachytherapy:** Clinical Professor William James Morris **Gynaecology Cases:** Associate Professor Umesh Mahantshetty
8:30 a.m.	**Chairs:** Prof. Peter Graham, Joseph Bucci *Keynote Speaker* **Breast brachytherapy indications controversies and innovations** Associate Professor Phillip Devlin
9:15 a.m.	*Keynote Speaker* **ASCENDE-RT: Outcomes from a Randomized Phase III Trial Comparing Low-Dose-Rate Brachytherapy to Dose-escalated External Beam Radiation Therapy for Intermediate – and High-risk Prostate Cancer** Clinical Professor William James Morris
10:00 a.m.	**Morning tea**
10:30 a.m.	**Chairs:** David Malouf, Bronwyn Matheson *Proffered Papers* **Prostate cancer control after seed brachytherapy** Dr. J Millar
10: 40 a.m.	**Second malignancies in seed brachytherapy** Dr. Ana Fernandez-Ots
10:50 a.m.	**HDR prostate. Reducing the risk of urethral strictures at Peter Mac** Dr. Sarat Chander
11:00 a.m.	*Keynote Speaker* **Focal brachytherapy and aspects of imaging and pathology** Clinical Professor William James Morris
11:45 a.m.	**Biologically based inverse planning for low-dose-rate focused brachytherapy of the prostate** Annette Haworth
11: 55 a.m.	**ABG Focal Seed Prostate Brachytherapy Trial – updated progress** Anna Fernandez-Ots
12:05 p.m.	**Lunch**
1:05 p.m.	**Chairs:** Keynote Speaker **Modern interstitial brachytherapy techniques in gynaecological cancers** Associate Professor Umesh Mahantshetty
1:50 p.m.	**Implementation of Interstitial needles for intra-uterine HDR brachytherapy** Scott Penfold
2:00 p.m.	**The interstitial ring applicator for cervix cancer: when is it useful and how much difference does it make?** Claire Dempsey

2:10 p.m.	*Keynote Speaker* **MRI Guided Imaging in Cervix and Prostate** Associate Professor K. Tanderup
3:00 p.m.	**Afternoon tea**
3:30 p.m.	**Chair:** Nadine Beydoun, James Mackean *Keynote Speaker* **From bedside to bench and back again. New understanding of the role of ultra low-dose brachytherapy as an immune modulator in the management of cutaneous T cell lymphoma** Associate Professor Phillip Devlin
4:15 p.m.	*Keynote Speaker* **Future trials in prostate cancer: the art of the possible** Clinical Professor William James Morris
4:55 p.m.	**Closing remarks**
5:00 p.m.	**Day 3 Concludes**

3T MR image-guided cervix brachytherapy with novel immobilisation – initial 4-year experience

Mark J Stevens, Judith Martland, Florence Ko, Lesley Guo

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Abstract

Purpose: To present the techniques and early clinical outcomes for MRI-based adaptive HDRB using 3T-image guidance and the EMBRACE protocol.

Material and methods: From July 2010 to end-Dec 2014, 34 consecutive women (median age 51 yrs, range 31-77 yrs.) with carcinoma of the uterine cervix (FIGO Stage IA2-IVB, 76% SCC) were treated definitively with pelvis only (8/33, 24%) or extended field IMRT (26/33, 76%), and synchronous weekly cis-platinum chemotherapy. This was followed by 2 HDR brachytherapy (HDRB) insertions separated by 1 week. For each HDRB insertion, a utero-vaginal Vienna ring and tandem applicator set was inserted under general anaesthesia. The HDRB component delivered 4 fractions of 7 Gy to the high-risk CTV (HR_CTV). The weekly fraction pairs (i.e. Fx1 + 2 and Fx3 + 4) occurred on consecutive days, and required overnight in-patient admissions and multiple bed-couch transfers. In order to maintain the intra-insertional fidelity of the HDRB dosimetric process, we devised a novel applicator-patient immobilization system. Adaptive (4-D) contouring and planning were performed for each fraction utilizing images acquired on a networked 3T MR unit for each HDRB fraction. Using the BPS (Oncentra v.4.3, Nucletron Corporation), measurements were made of the distances between the sacral promontory and both the tandem tip ("Tandem Shift") and the ring channel ("Ring Shift") for each fraction pair to assess the magnitude of intra-insertional movement (drift) of the implant in 3-D. Changes in the anterior-posterior angulation of the implant described by the vectors denoting tandem and ring shift ("Angle Shift") induced by multiple patient transfers and internal organ filling were also assessed. Finally, intra-insertional rotation shift (roll) of the implant within the fraction pairs was measured via the BPS extra-co-ordinate system ("ECS Shift") in the patient's y-plane as per ICRU 42 formalism. EMBRACE defined DVH objectives for CTV coverage and OAR restraints were recorded and correlated with local control and toxicity.

Results: Median follow-up was 40 months (1-54 month). Detailed geometric outcomes (outlined below) and dosimetric data will be presented for 131 HDRB fractions and 333 patient couch-bed transfers. Insertion 1: Cut points for distance shift ± 4mm, or ECSS ± 4-degrees, (1) TS: No significant inter-fractional differences were detected for either HR-CTV or OAR dosing. (2) RS: No significant inter-fractional differences were detected for either HR-CTV or OAR dosing. (3) ECSS: No significant inter-fractional differences were detected for HR-CTV coverage but significant variation in both Rectal D1cc. and Rectal D0.1cc was noted due to subtle inter-fractional rectal filling differences. Insertion 2: Cut points for distance shift ± 3mm, or angle shift ± 5-degrees, (1) TS: No significant inter-fractional differences were detected for HR-CTV coverage but significant variation in Bladder D1cc due to minor filling variation. (2) AS: No significant inter-fractional differences were detected for HR-CTV coverage but significant variation in Rectal D1cc and Bladder D0.1cc due to minor inter-fractional filling variations. EMBRACE defined dosimetric objectives were easy to achieve and HR_CTV and IR_CTV were predictive for local cancer control.

Conclusions: Pelvic and applicator immobilization during HDRB for cervical cancer can be achieved with excellent intra-insertional and paired inter-fractional geometric stability despite multiple patient transfers and external transport to the brachytherapy unit. OAR D1.0 and D0.1cc mean exposures were shown to be potentially sensitive to applicator re-construction in women with significant geometric uncertainties related to ECSS (Insertion 1), and for both TS and AS (Insertion 2). Minor over-night variations in organ filling were implicated. Overall local control was > 90% with minimal though important late radiation complications.

Implementation of an afterloaded low-dose-rate brachytherapy technique for prostatic rhabdomyosarcoma

Gemma Busuttil[1], Joseph Bucci[2], Emily Flower[1], Komiti Enari[2], Edgar Estoesta[1], Andrew Howie[2], Hang Nguyen[1], Alicja Wach[1], Dean Cutajar[3], Linda Martin[1], Verity Ahern[1]

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Abstract

Purpose: A four year old boy with prostatic rhabdomyosarcoma achieved an excellent response to chemotherapy. A multi-centre multi-disciplinary team was formed to manage his local therapy. Prostatectomy and external beam radiotherapy were undesirable due to the associated long term morbidities and side effects. After assessing the merits of HDR and LDR brachytherapy in the paediatric setting, a temporary LDR implant combining the radiobiological effect of an Iodine125 LDR source with manual afterloading was chosen and we present the implementation of this technique.

Material and methods: This novel technique needed to be established and adapted from current practices, including treatment planning and verification, seed calibration, quality assurance procedures, and radiation safety guidelines. The Iodine125 source was modelled in the Brachyvision planning system and independent calculation programs. The necessary equipment to perform the procedure was acquired, adapted from available equipment or custom-made.

Results: Sixteen plastic needles were implanted trans-perineally into the tumour under trans-rectal ultrasound guidance and held in place with a custom-made grid. Ultrasound, MRI, and CT datasets were acquired and an initial plan produced on Variseed to deliver a prescribed dose of 60 Gy in 96 hours with sixty 4.4 mCi Iodine125 seeds. The seeds were manually loaded into catheters, which were then inserted into the needles embedded in the tumour. A post-implant CT and verification plan on Brachyvision necessitated a plan modification and adjustment of the loading pattern of six of the catheters in order to optimize the CTV coverage. Hourly catheter measurements and daily pelvic x-rays confirmed the placement of the needles for the remainder of the treatment.

Conclusions: A multi-centre tripartite team collaborated to develop and deliver an afterloaded LDR brachytherapy treatment for a paediatric patient with prostatic rhabdomyosarcoma. A focus on treatment planning and verification, quality assurance, and radiation safety ensured treatment quality, accuracy and safety.

The initial experience of plesiotherapy technique for scalp treatment

Florence Ko, Mark Stevens, Judith Martland, Tony Lee, Kate Orme

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Abstract

Purpose: A 64 year old man presented with multiple nodules of metastatic cutaneous squamous cell carcinoma diffusely involving the scalp. FDG-PET staging and limited lymph node dissection confirmed cervical lymph involvement only. Due to the geometric complexity of the target tissue, a plesiotherapy technique was devised using a customized surface mould. This was followed by external beam radiotherapy to the involved neck at another institution.

Material and methods: Following the delineation of a gross tumour volume (GTV) and clinical target volume (CTV) on the scalp, a custom made clear plastic cast was constructed. 1 cm of wax bolus was placed on the plastic cast to secure 20 flexible closed-end catheters, which were aligned parallel to each other and covered most of the scalp/forehead. The open-end of the catheters were positioned caudally to enable loading in the recumbent position. A CT scan (1 mm slice thickness) of the entire head was performed before exporting the data to the Oncentra V4.3 brachytherapy planning system. Ten fractions of 4 Gy to the defined GTV and 3.4 Gy to the CTV were scheduled bi-daily for 5 days. The in-vivo Gaf film used on the first day of treatment was to verify the dose to the surface of the scalp, right, and left outer canthus, and the scatter dose to the patient. Photos were taken prior to the first treatment of the day to monitor the skin reaction during treatment and follow-up.

Results: The dosimetry showed that the dose to the surface of the scalp was within tolerance compared with the planned dose. Erythema started to develop two days after treatment and resolved three weeks post-brachytherapy without moist desquamation.

Conclusion: This treatment modality offers an effective alternative to external beam radiotherapy for patients with varying anatomical curvature, as a short course of treatments can be administered with minimal side effects.

Brain dose verification in scalp brachytherapy

Judith Martland, Alexandra Quinn, Mark Stevens

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Abstract

Purpose: Between 2010 and 2014, our department treated three patients with brachytherapy to the scalp: two patients having haemangiosarcoma and one patient with SCC. The treatment plans show parts of the brain to be irradiated to significant dose levels, however, we know that the TG43 based algorithm is not accounting for the presence of the skull when calculating dose in areas of the brain. This study aims to compare doses calculated in a phantom using the Oncentra™ planning system with doses measured in the phantom using GAF film dosimetry, in order to estimate the inaccuracies in calculated doses to brain in cases of scalp brachytherapy.

Material and methods: A flat phantom was constructed using solid water, 1 cm bone surrogate and a flat surface mould in order to simulate the scalp brachytherapy situation. The mould was constructed using 17 plastic catheters and a plan created to deliver a representative dose distribution to a 5 mm depth of tissue overlying 1 cm of bone equivalent material. Strips of GAF film were then placed at a number of depths within the phantom and the treatment plan was delivered to the phantom. The resultant film doses were compared with the planned doses from Oncentra™ and the results used to estimate the inaccuracies in brain dosimetry in the clinical situation.

Results: The film dosimetry measurements indicate that the actual doses behind 1 cm bone are up to 15% lower than those indicated by the planning system. In addition, the results suggest that the dose to the target tissue proximal to the bone is also reduced by approximately

10%, possibly as a result of reduced backscatter through the bone layer.

Conclusions: For a flat phantom simulation of a scalp brachytherapy surface mould, the measured doses were up to 15% lower than those indicated by the Oncentra™ TG43-based algorithm. By extension, the true patient brain dosimetry in the (non-flat) scalp brachytherapy cases could be expected to be up to 15% lower than indicated by the treatment plan.

Inter-observer reliability of obtaining measurements of the cervix and uterus with brachytherapy applicators in-situ using transabdominal ultrasound

Sylvia van Dyk[1], Margaret Garth[1], Amanda Oates[1], Sri Kondalsamy-Chennakesavan[2], Michal Schneider[3]

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Abstract

Purpose: Ultrasound is not the usual purview of brachytherapy personnel and so may not be considered as a viable imaging modality for use in brachytherapy. Training and education are required to effectively use ultrasound. This study will illustrate that with specific training radiation therapists can reliably utilize ultrasound for use in gynaecological brachytherapy. The aim of the study was to validate the reproducibility of this technique by measuring the inter-operator reliability of obtaining an ultrasound image that depicts the whole applicator and uterus; to validate the reproducibility of this technique by measuring the inter-operator reliability of obtaining measurements of the cervix and uterus.

Material and methods: Patients who underwent MRI with applicators *in-situ* after the first insertion were included in the study. Three RT sonographers had to be present at the first brachytherapy insertion. A longitudinal view along the intra-uterine applicator was obtained with ultrasound and MRI. Measurements were taken at the anterior and posterior surface of the uterus and cervix at 2.0 cm intervals along the applicator, from the external OS, to the tip of the applicator. Imaging was performed by three Radiation Therapists (RT1, RT2, RT3) with varying degrees of ultrasound experience. RT1 (expert, formal training), RT2 (clinical experience 7 years+), RT3 (new recruit, weekend training course, 6 months clinical experience). All RT's were required to obtain a longitudinal planning image depicting the applicator in the uterine canal, and take measurements to the anterior and posterior uterine surface. Each RT was blind to the previous measurements. The MRI scan, taken one hour after the ultrasound, was used as the reference standard against, which all measurements were compared. Measurements were analyzed with ICC and Bland-Altman plots.

Results: All RT's were able to obtain a suitable longitudinal image for each patient in the study. The image had to depict the whole applicator and the posterior surface of the uterus and cervix. Mean differences (SD) between MRI and ultrasound measurements obtained by RT's ranged from 3.5 (3.6)-4.4 (4.23) mm and 0 (3.0)-0.9 (2.5) mm on the anterior and posterior surface of the cervix, respectively. ICC for absolute agreement between MRI and RT's were > 0.9 for all posterior measurement points in the cervix and ranged from 0.41-0.92 on the anterior surface. Measurements were not statistically different between RT's at any measurement point.

Conclusions: RT's with different levels of skill and training were able to acquire an appropriate image on which to measure the anterior and posterior uterine and cervix surface. There was no significant difference between the measurements obtained with ultrasound by the RT's and those obtained from MRI on the posterior surface of the uterus and cervix. There was good agreement between the RT's at all measurement points. This study demonstrated good reliability of specific raters who will continue to use ultrasound in our institution.

BrachyView for high-dose-rate (HDR) brachytherapy

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Abstract

Purpose: HDR brachytherapy is an effective radiotherapeutic method for treating prostate cancer, where a high activity source is driven using automatic afterloading. The success of the treatment is highly affected by the accuracy of placing the source in its predefined positions and its dwelling time, in accordance with the treatment plan. Various sources of error may result in missing the treatment volume while causing severe damage to the healthy tissue. A high spatial and timing resolution in-body imaging technique for real-time monitoring of the source, throughout the procedure is the only completely independent method to check the source position in relation to the treatment volume.

Material and methods: A prototype in-body imaging system, HDR BrachyView is used to track the position of the Ir-192 source in three dimensions in real time from multiple images of the source, projected onto an imaging

plane through pinholes in a 4 mm thick cylindrical-shell tungsten collimator. Images are recorded using a 14 x 56 mm^2 pixellated silicon detector array, encapsulated within the collimator. HDR BrachyView was placed beneath a 9 x 9 x 10 cm^3 solid water phantom. A 10 Ci Ir-192 source was moved through a series of positions in a catheter positioned within the phantom. The source position was reconstructed using images acquired within an acquisition time of 0.5 s. By comparing the tracked source positions with planned source positions and film measurements, a comprehensive analysis of the accuracy of the probe in source tracking was performed. In addition, the dose enhancement caused by the backscattered radiation from the tungsten probe was simulated and measured experimentally.

Results: The maximum error in measuring the source position was estimated to be 1.4 mm, while more than 90% of the source positions were measured with sub-millimeter accuracy. While a dose increase of 80% was measured immediately adjacent to the tungsten collimator's outer surface, no dose enhancement was observed beyond 1 mm from the tungsten surface. Therefore, all backscatter-enhanced radiation dose will be absorbed by the probe's tissue-equivalent plastic shell.

Conclusions: HDR BrachyView probe is capable of providing real-time and reliable measurements of the source positioning during the HDR prostate brachytherapy. The backscatter dose study validated the safety of placing the BrachyView probe in patient's rectum during the treatment.

A near water equivalent beryllium oxide ceramic dosimetry system for high-dose-rate brachytherapy

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Abstract

Purpose: Beryllium oxide (BeO) ceramics have an effective atomic number, z_{eff} ~7.1, closely matched to water, z_{eff} ~7.4. Therefore, it is expected that there is little energy dependence. We developed and evaluated the first BeO ceramic fibre-coupled luminescence dosimeter, named RL/OSL BeO FOD, for high-dose-rate (HDR) brachytherapy dosimetry. In our dosimetry system, the radioluminescence (RL) of BeO ceramics is utilized for dose-rate measurements, and the optically stimulated luminescence (OSL) can be read post exposure for accumulated dose measurements.

Material and methods: The RL/OSL BeO FOD consists of a 1 mm diameter x 1 mm long cylinder of BeO ceramic coupled to a 15 m long silica-silica optical fibre. The optical fibre is connected to a custom developed portable RL and OSL reader, located outside of the treatment suite. The X-ray energy response was evaluated using superficial X-rays, an Ir-192 source and high energy linear accelerators. The RL/OSL BeO FOD was then characterized using an Ir-192 source.

Results: The RL/OSL BeO FOD shows an under-response at low energy X-rays as expected. Though at higher X-ray energies, the OSL response continues to increase, while the RL response remained relatively constant. The dose response for the RL is found to be linear up to doses of 15 Gy, while the OSL response becomes more supralinear to doses above 15 Gy. Little angular dependency is observed and the depth dose curve measured agreed within 4% of that calculated based on TG-43.

Conclusion: With the RL/OSL BeO FODs current size, it is capable of being inserted into intraluminal catheters and interstitial needles to verify HDR treatments. Based on the small probe size and dosimetric response, the RL/OSL BeO FOD system is shown to be adequate for in-vivo brachytherapy dosimetry.

In vivo rectal dose measures compared to planned and reconstructed doses in US-based HDR prostate brachytherapy

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Abstract

Purpose: To study if real time *in vivo* dosimetry, performed on the rectal surface with MO*Skin* detectors included on the trans rectal ultrasound (TRUS) probe, may evaluate possible discrepancies between calculated and delivered doses during US-based HDR prostate brachytherapy.

Material and methods: MO*Skin*s are a specific type of MOSFET dosimeter, optimized to measure dose in steep dose gradients. Their sensitive volume, defined by the volume of the gate oxide, is 4.8 x 10^{-6} mm^3. In this study, two MO*Skin* dosimeters were calibrated and assembled on the surface of a TRUS-probe, used for real time on-

line treatment planning in HDR prostate brachytherapy. During the treatment, the TRUS-probe was left inside the rectum and real time measures of the delivered dose were performed over 14 treatment sessions (prescribed dose to the target surface: 14 Gy). Measured doses were compared to the doses calculated by means of the treatment planning system in the estimated detector position both on pre-treatment images (i.e., acquired 1-2 hours before treatment and used for treatment planning) and on post-treatment images (i.e., acquired within 3 minutes after treatment). In the latter case, the delivered dose distribution was retrospectively reconstructed and assumed as the reference.

Results: Comparison between planned, reconstructed, and *in vivo* measured doses, in terms of average absolute differences and maximum discrepancies, are given in the following table. Data reported in the table shows that the highest accordance resulted between MOS*kin* readings and doses obtained on reconstructed plans, suggesting that in particular cases *in vivo* dosimetry might be a better instrument to estimate the dose to the rectum rather than the original treatment planning system itself. Comparing pre- and post-treatment images, it can be demonstrated that the high observed discrepancy between treatment and reconstructed plans is mainly due to anatomical variations of the prostate shape (i.e., prostate swelling with expanding inter-needles distances) and position (i.e., shift towards the rectal wall). This discrepancy is correlated with the treatment planning time.

Conclusions: Doses delivered to the organs at risk during HDR prostate brachytherapy might differ significantly from what is calculated in the treatment planning phase, providing the need for *in vivo* dosimetry in this particular radiotherapy application. MOS*kin* dosimeters integrated to the TRUS-probe proved to be an accurate instrument to perform real time measurement of the dose delivered to the rectal wall. The use of the dosimeters was incorporated in our department into clinical practice; actions protocol are still under study to potentially use the information acquired on-line.

In vivo treatment delivery error trapping in HDR prostate brachytherapy

Ryan Smith[1], Jeremy L Millar[1], Annette Haworth[2], Michael L Taylor[1], Rick D Franich[1]

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Abstract

Purpose: Independent routine treatment delivery verification is important to identify potential errors and ensure patient safety in high-dose-rate (HDR) brachytherapy. We have previously reported on a novel, non-invasive flat panel detector (FPD) system to provide source position information and the potential for treatment verification. Here, we demonstrate the use of the system as an *in vivo* error trapping device in the clinical environment for HDR prostate brachytherapy.

Material and methods: The FPD was integrated into a standard operating theatre couch and used during our clinical HDR prostate treatments. At treatment each patient was aligned over the sensitive region of the detector and images were acquired of the HDR source, as it progressed through the treatment delivery. Post processing of the images was performed to determine the dwell positions inside the patient and these were compared to the planned dwell positions to establish treatment verification. A radiograph acquired prior to treatment provided absolute localization of the implant in the reference frame of the detector. We then simulated potential treatment delivery errors to highlight the sensitivity of the FPD verification system to the identification of errors in a clinical scenario. Errors simulated included incorrect indexer length, incorrect transfer channel connection (interchanged channels), and incorrect treatment fraction plan selection.

Results: The measured dwell positions from the simulated indexer length error were clearly offset from the planned positions in the long axis of the implanted catheters in the absolute comparison, but would not be visible in a registered relative comparison alone. The incorrect connection of two transfer channels was apparent in each of the relative and absolute spatial comparisons (Fig. 1) and in the catheter time comparison. Incorrect treatment fraction plan selection resulted in absolute and relative source position discrepancies for all catheters delivered.

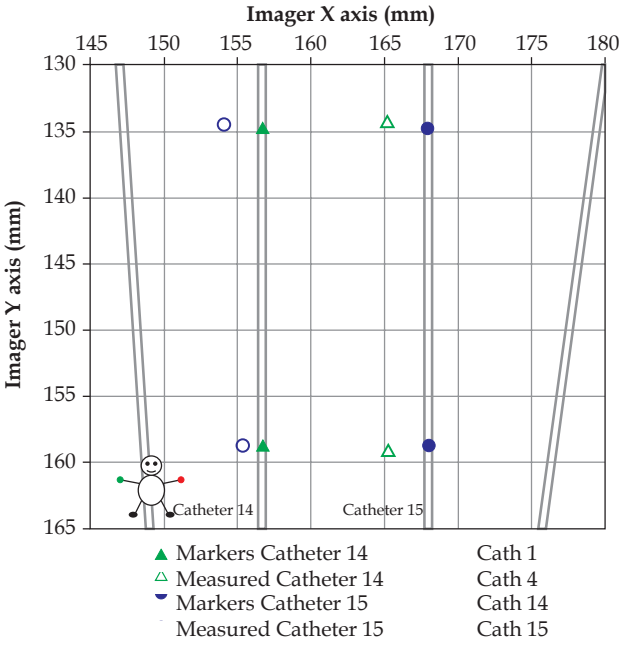

Fig. 1. The comparison of measured and planned dwell positions for a simulated error; incorrect transfer tube connection, showing the case where transfer tube channels 14 and 15 are mistakenly interchanged at treatment delivery

Conclusions: Each of the simulated errors in the clinical data produced an error signature that allowed identification of the origin of the treatment delivery error. We can show the system is capable of identifying the theoretically more probable failure modes in a clinical environment. Complete characterization of all possible failure modes and error signatures will allow automatic algorithms to specifically identify each of these, and also allow the establishment of clinically relevant treatment interrupt thresholds that detect an error that will have a detrimental impact on the patient's treatment.

Evaluation of HDR prostate brachytherapy catheter displacement between planning and treatment using a flat panel detector

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Abstract

Purpose: High-dose-rate brachytherapy (HDRB) for prostate cancer enables delivery of high doses per fraction, while minimizing the dose to the surrounding organs at risk (OAR). At our institution, HDRB is currently delivered with 17 Gy in 2 fractions on consecutive days. The high fractional dose means the position of the catheters must remain stable in the treatment volume, as planned to ensure correct and safe dose delivery. Oedema and other mechanical processes potentially cause catheter displacement because of the interval between planning CT imaging and treatment delivery (typically 2-4 hours). This potential error is not well characterized in prostate HDR brachytherapy. The aim of this investigation was to determine the frequency and magnitude of catheter displacement that occurs between CT imaging (for planning) and treatment in a cohort of our patients.

Material and methods: All patients were implanted with up to 18 plastic catheters and three gold fiducial markers under ultrasound guidance. A CT scan for planning purposes was performed and a treatment plan created. The centre of mass (COM) of the gold fiducial markers was calculated and the distance from the COM to the catheter tip measured. At treatment, the patient was setup on the treatment couch, aligned over a flat panel detector (FPD), which is integrated into the brachytherapy treatment couch. A radiographic image was acquired using the FPD, the gold fiducial markers were identified and the COM determined. The distance from the COM to the catheter tips at treatment was compared to that calculated from the planning CT data and the catheter displacement determined. The process was repeated for fraction two, including a repeat CT scan for planning purposes.

Results: We evaluated 11 treatment fractions for six patients. A positive displacement represents a relative movement of the catheters in the inferior direction. The mean catheter displacement over all patients was larger for fraction 1 than fraction 2 (Fig. 1). The mean displacement for fraction 1 was 6.3 mm (min. 0.75, max. 12.33, std.dev. 4.8 mm, n = 6) and for fraction 2 was 2.0 mm (min. –6.56, max. 9.13, std.dev. 6.4 mm, n = 5).

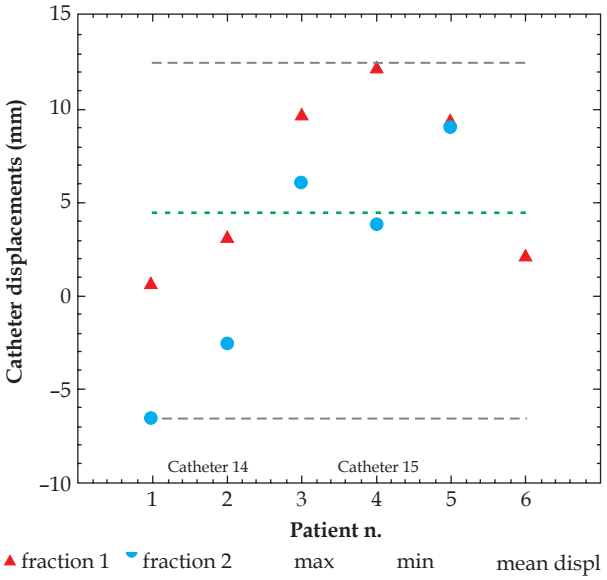

Fig. 1. Catheter mean displacements for fraction 1 (triangles) and 2 (circle). Grey dashed lines show min and max displacements, and green dashed line the mean displacement of all patients

Conclusions: The displacement observed indicates the catheters appear to be moving out of the prostate towards the template. Similar displacements were also reported by Whitaker *et al*. The study confirms there is catheter displacement that occurs between planning and treatment. The observed magnitude of displacement, if not accounted for, has the potential for under-dosing the prostatic base and over-dosing OARs.

Development of benchmarking cases to assist early users commissioning of model based dosimetry calculation algorithms in brachytherapy treatment planning systems

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Abstract

Purpose: Following the publication of recommendations for early users of model based dose calculation algorithms for brachytherapy (MBDCA)(1), the AAPM-ESTRO-ABG Working Group (WG) was commissioned to develop of a set of well-defined test case plans to assist clinical end-users of MBDCAs in the software commissioning process. We present the role of the Australasian Brachytherapy Group (ABG) in the development of these test cases, and provide preliminary results of comparisons of test cases and a clinical case with conventional dose calculation methods.

Material and methods: Virtual, vendor independent, generic Ir-192 HDR source, and shielded applicator models were designed by the WG with specifications for use with Monte Carlo codes and the two commercial treatment planning systems that offer MBDCAs. The ABG produced the defined test case plans using the collapsed cone (CC) kernel superposition algorithm and a grid-based Boltzmann equation solver (GBBS) approach from two of the commercial systems. In addition, clinical test cases including a prostate with gas in the rectum, was investigated.

Results: Test cases that incorporated simple geometry demonstrated little difference in dose distribution between conventional and the CC algorithms (< 1% in a plane perpendicular to the source up to a distance of 30 mm from the source). In contrast, the test case that incorporated a shielded applicator demonstrated significant differences around the edges of the shielding. The clinical case demonstrated minimal differences in the dose to the prostate, with variations in dose of less than 1% in the region between the posterior prostate and rectum.

Conclusion: Dose distributions using the CC and GBBS algorithms and the virtual source have been created for three test cases. These results have been submitted to the AAPM-ESTRO-ABG WG for comparison, using a range of calculation methods to produce benchmarking data sets to assist local users in the commissioning of MBDCAs.

Prostate cancer control after seed brachytherapy

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Abstract

Purpose: There are limited reports on the long-term disease control outcome for men treated with prostate seed brachytherapy (PSB), and factors associated with better outcomes. We reviewed the I-125 PSB program at AlfredHealth started in 1998.

Material and methods: We reviewed all men treated with PSB until 30 June 2011. Demographic, disease, and treatment factors were collected prospectively in a unit registry, with follow up closed out in October 2014. Men were implanted according to written protocols, and had postimplant CT-based dosimetry performed one month later, to derive dose-volume metrics. If the D_{90} was less than 100 Gy, we considered the addition of "topup" external beam radiation. Men were reviewed at 6, 12, 18, and 24 months, then annually. Biochemical failure was defined with the Phoenix definition. Time to prostate-cancer death, biochemical-failure, and death-from-any-cause were assessed using Kaplan-Meier (KM) methods. We assessed the affect on these by patient, disease, and treatment factors using univariate and multivariate analysis with a Cox Model. A *P*-value of < 0.05 on two-sided probability testing was considered statistically significant.

Results: We treated 764 men, median age 62 (IQR 57-67). The median PSA was 5.3 ng/mL (IQR 4-7.2), and 67% had NCCN low-risk disease, 33% intermediate-risk. 27% of men had Gleason score 7 disease. All men were pre-planned to receive a prescription dose of 145 Gy; the median D_{90} was 149 Gy (IQR 135-160 Gy). The D_{90} was < 100 Gy in 13 (1.7%), and 10 of these received additional EBRT; 5 within the first 18 months of the program and the last one in March 2007.The mean follow up was 7.3 years. There were 50 deaths including 7 deaths from prostate cancer from 52 biochemical failures. Only one of the men receiving top-up radiation had biochemical failure. The KM estimates of 12-year cause-specific, biochemical-failure-free (BFF), and overall survival were 98%, 89%, and 86%. On multivariate analysis, better BFF survival was

statistically significantly associated with lower cT category, lower PSA, and lower Gleason score, but not with age, use of prior cytoreductive androgen deprivation, the year of implant, or the D_{90}. The 12-year BFF survival for good-risk men was 91.2% and for intermediate-risk men was 78% ($p = 0.08$).

Conclusion: Long-term disease control outcomes appear favorable and, in this cohort, not influenced by patient age or D_{90}.

The risk of second malignancies after Iodine-125 prostate brachytherapy as monotherapy in a single Australian institution

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Abstract

Purpose: To report the incidence of second primary cancer (SPC) after Iodine-125 brachytherapy for early prostate cancer in a single institution, and to compare it with the cancer incidence in the Australian population.

Material and methods: This retrospective, single-institution study included 906 patients treated with Iodine-125 brachytherapy alone. Data were collected on all subsequent SPC diagnoses. SPC incidences were retrieved for all type of cancers and for cancers close to the radiation field. Interval since the implant was evaluated for potential association to the treatment. Standardized incidence ratios (SIRs) were calculated for all cancers and for bladder cancers, and matched with the general population.

Results: Patients were followed for a mean of 3.3 y (0-11) years with 226 (25 %) patients having 5 years or more follow up. 62 % patients were older than 60 years. Of the total number of patients, 37 patients (4.1%) subsequently developed a SPC; 7 were bladder and 1 rectal cancer. The 5-year cumulative incidences were 6.8 (4.6-9.9) and 1.5 (0.7-3.7), and for any second malignancy and bladder cancer, respectively. The SIR for all malignancies was 0.98 (95% CI: 0.7-1.4) and significantly higher for bladder cancer at 4.24 (95% CI: 1.7-87). In the subgroup analysis, bladder SPC risk was higher than expected for ≤60 years (SIR: 9.7; 95% CI: 2.0-28.3; AER: 23.9) and in the first 5 years of follow up (SIR: 3.76 ; 95% CI: 1.22-8.77; AER: 14.5). On multivariable analysis, older age (HR: 1.06, $p = 0.041$) and smoking status (HR: 2.81, $p = 0.017$) were associated with increased SPC risk ($p = 0.032$).

Conclusion: Overall, no increased tumor incidence was found compared with the general population. We observed a higher than expected incidence of bladder SPC after brachytherapy in the first 5 years of follow up, probably resulting from lead time or screening bias, comparable with other published data . Because of power limitations, an increase SPC cannot be formally excluded.

HDR prostate – reducing the risk of urethral strictures at Peter Mac

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Abstract

We have previously published our experience with HDR prostate, both as a boost treatment and as monotherapy for prostate cancer. We had noted an 8% crude rate of strictures for 474 patients treated between 1997 and 2005, and 12.5% between 2007 to 2010. The median time for occurrence of strictures was 22 months.

Since 2010, we have progressively made a number of changes to several aspects of our HDR brachytherapy program. These include modifications and refinement in the following areas:

Patient Selection – Careful consideration and selective exclusion of patients based on previously published results from our group.

Imaging – Improved bi-planar imaging available from new generation ultrasound machines provided clear anatomical delineation of the prostate.

Fiducial markers – Fiducial placement has been included in our program since 2007, however, we have optimized their placement to our advantage over the past 4 years, accurately placing them in the base and apex prior to completion of the implant.

Technique & Dosimetry – Offsetting the para-urethral proguides laterally allows for "urethral tunneling", resulting in a lower dose around the urethra. Two volumes are created; a horse-shoe shaped "Target", covered by 95% isodose and a "Prostate" volume covered by at least the 75% isodose line. Urethral dose are kept below 105%, with $V_{115} < 1$ cc.

Dose Intensity – We modified our HDR prostate dose protocol in 2007 to 10 Gy x 2, but we were delivering the dose with one implant. We wished to maintain the advantage of an ablative dose by retaining the 10 Gy, but drew from our SBRT experience to reduce the intensity, by delivering the fractions 2 weeks apart in an effort to allow normal tissue recovery in the urethra.

In the past four years, we have noted a dramatic decline in the incidence of new strictures to about 2%, coinciding with changes we have made.

During the course of this talk, I will examine and discuss how these factors have contributed to the apparent reduction in urethral toxicity at Peter MacCallum Cancer Centre.

Biologically based inverse planning for low-dose-rate focused brachytherapy of the prostate

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Abstract

Purpose: A biologically-based inverse-optimization approach for planning low-dose-rate focal brachytherapy treatments is described. Using clinical plans and using conventional, whole gland treatment planning for comparison, we demonstrate focal plans that can achieve significantly reduced urethral doses, whilst maintaining high tumor control probability values.

Material and methods: The treatment plans for ten patients treated with a conventional approach to prostate LDR brachytherapy (145 Gy to entire prostate) were compared with plans for the same patients created with a biologically-based inverse-optimization planning process. To demonstrate functionality of the previously validated radiobiological model, the biological optimizer applied a non-uniform distribution of tumor cell density through the prostate based on known and expected locations of tumor. Using an iterative local search approach, the algorithm determined the optimal needle and seed placement to achieve the target TCP value, whilst constraining urethral doses. Three different focal planning approaches were compared with the conventional whole gland approach for 10 clinical cases. The robustness of the plans was tested in the presence of clinically relevant (determined through modeling of post-implant dosimetry studies) random displacement of seeds.

Results: Depending on the planning approach, the volume of the urethra receiving 125% of the conventional dose prescription (145 Gy) was reduced on average from an average of 60% to less than 13% for the focal plans, whilst maintaining high values of TCP through use of a biological optimization approach. The average number of planned needles and seeds was reduced from 85 and 28 to less than 74 and 23, respectively, in all 3 focal planning approaches. The robustness of the plans was not inferior to the conventional plans when considering contemporary seed placement techniques.

Conclusions: A biologically based inverse planning approach to LDR treatments has the potential to maintain high rates of tumor control, whilst minimizing dose to healthy tissue. The radiobiological model is intended to be informed using multi-parametric MRI techniques to provide a personalized medicine approach.

Implementation of interstitial needles for intra-uterine HDR brachytherapy

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Abstract

Most radiotherapy centers have now made the transition from LDR to HDR brachytherapy as a boost to EBRT for cervical cancer. This shift in treatment technique was generally accompanied by a move from 2D radiographic to 3D CT/MR image based planning. This has given Radiation Oncologists the ability to define Clinical Target Volumes (CTV) with greater certainty, but has also highlighted the need for improved dosimetric conformity. Use of conventional intrauterine applicators can be problematic for cases with asymmetric and irregular treatment volumes. However, utilization of applicators with interstitial needles can help to overcome the dosimetric challenges. This presentation will detail the Royal Adelaide Hospital's (RAH) experience in intra-uterine HDR brachytherapy and the implementation of interstitial needles.

Since May 2013, the Nucletron Utrecht Interstitial Fletcher CT/MR Applicator set has been used at the RAH for HDR gynecological treatments as a boost to EBRT. Implant of the applicator is performed under trans-abdominal ultrasound guidance. Contouring is performed on a 1st fraction CT scan of the patient, with reference to a post-EBRT radiology assessed MRI scan for CTV definition. A custom configuration of interstitial needles is prospectively selected by the Radiation Oncologist.

Since the introduction of interstitial needles in February 2014, 12 out of 17 patients have received one or more needles as part of their treatment plan (up until December 2014). Included within this report a retrospective analysis will be presented, comparing HR CTV D_{90} and V_{150} parameters as well as OAR (e.g. Bladder and Rectum D_{2cc}) treatment plan dosimetry for these 12 patients with plans that were re-designed without the use of interstitial needles. Results show that interstitial needles can serve as a valuable tool in allowing greater conformity in dose delivery during gynecological HDR brachytherapy.

The interstitial ring applicator for cervix cancer: when is it useful and how much difference does it make?

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Abstract

Purpose: The interstitial ring applicator for cervix brachytherapy was commissioned for use in 2012 and was first successfully used for treatment in July 2013 in our department. A study of patients treated with this applicator has been conducted to determine the physical indications for using an interstitial/intracavitary approach and any changes to dosimetry as a result.

Material and methods: Dosimetric qualities for each patient plan were gathered and compared to plans generated without interstitial needles in place. The high-risk clinical target volume (HR CTV) was considered in terms of size and volume with D_{100}, D_{90}, D_{95}, and V_{100} reported. Bladder, rectal, and sigmoid D_{2cc} doses were also collected.

Results: The number of needles used for patient treatment varied from 3 to 5 with all needles placed in lateral/posterior positions for all patients. Patient HR CTV volumes ranged from 21.74 cm^3 to 44.75 cm^3 with the distance of the edge of HR CTV from centre of the tandem (at a height superior to Point A), varying between 2.2 cm and 3.8 cm. An enhancement in dose to the HR CTV was attained for all patients when interstitial needles were used with an average increase in HR CTV D_{100}, D_{90}, D_{95} from 4.2, 6.5, 7.4 Gy to 5.9, 8.7, 9.6 Gy, respectively. The average HR CTV V_{100} increased from 81.8% to 95.2%. Bladder doses fell from an average of 8.3 Gy to 7.2 Gy, while rectal doses remained reasonably consistent when using interstitial needles compared to a standard ring applicator. Sigmoid doses increased with the use of interstitial needles due to radiation doses being pushed laterally to cover the HR CTV at distances superior to Point A, however, all sigmoid doses were within tolerance for all plans.

Conclusions: HR CTV volume is not necessarily a good indication of when it is appropriate to use an interstitial/intracavitary treatment approach. However, dosimetric improvements to both the HR CTV and the nearby organs at risk can be achieved using an interstitial ring applicator (or similar) if the distance of the HR CTV edge from the centre of the tandem is greater than 2.2 cm at points superior to Point A.

Preliminary feasibility study of using deformable image registration for bladder dose summation for cervix cancer HDR brachytherapy

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Abstract

Purpose: Locally advanced cervix cancer is treated with a HDR brachytherapy boost. Bladder toxicity following brachytherapy has been correlated with specific DVH parameters. The bladder DVH parameters for HDR Brachytherapy for locally advanced cervical cancer are simply added for the 3 fractions. This study aims to assess the feasibility of using Deformable Image Registration (DIR) for bladder dose summation for the most irradiated 2cc (D_{2cc}) by comparing the consistency two different methods of DIR.

Material and methods: Retrospectively, using data from 30 patients, deformable image registration using MIM Maestro (MIM Software) was used to deform images and their associated dose distributions from fractions two and three onto the reference image from fraction one using: a) the entire CT image set (DIR1) with free form deformation, and b) using the bladder contour to drive the DIR (DIR2). DIR1 and DIR2 were repeated with fraction two being the reference image set. For each visually acceptable DIR, the summed D_{2cc} from all three fractions was calculated. The average absolute difference for the summed D_{2cc} for each reference for both DIR methods was compared to test the consistency of the DIR method.

Results: The average (std) summed dose using DIR 1 and DIR 2 was 16.4 (4.2) and 17.0 (3.4). This compared to 17.0 (2.9) using the simple, non-DIR dose summation method. The average absolute difference between summed dose when using fraction 1 as reference compared when using fraction 2 was 3.9 and 1.62, respectively. This difference was found to be statistically significant (paired *t*-test, $p < 0.05$).

Conclusions: Contour based DIR for the bladder D_{2cc} summation gave more consistent results than deforming the entire image set indicating this method is more reliable. On average, the summed dose using DIR1 was smaller than using simple dose summation, but there was no difference when using contour driven DIR (DIR2). Further work is needed to increase the dataset size, refine the DIR methods and investigate other DVH parameters.

Commissioning of an interstitial and intracavitary applicator for gynecological treatments

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Abstract

Purpose: Commission the Utrecht gynecological brachytherapy applicator for treatment procedures at the Royal Brisbane and Women's Hospital.

Material and methods: Perform tests in accordance of recommendations by the AAPM, ACPSEM and ESTRO including, but not limited to autoradiograph, confirmation of physical dimensions, structural integrity, and evaluation of compliance with sterilization requirements. Develop an efficient and effective method for training staff in the use of the applicator for procedures at RBWH. Develop site specific treatment planning and plan checking protocols.

Results: All components of the applicator were imaged and found to be geometrically accurate and free from artifacts in a CT image. The position of the source was confirmed to agree with the expected distance from the end of the applicator channels. Beaded marker wire or thin copper electrical wire were both found to be suitable for channel reconstruction, however, the size of interstitial catheters prevents use of beaded marker wire for these channels.

Conclusion: The applicator is now available for use with CT and orthogonal imaging for treatments at the RBWH.

Patterns of practice for cervix cancer brachytherapy in Australia and New Zealand

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Abstract

Purpose: The advent of image guided adaptive brachytherapy (IGABT) over the last decade or so has resulted in a paradigm shift in the treatment approach cervix cancer. The purpose of this survey was to explore the current patterns of practice for brachytherapy in cervix cancer in Australia and New Zealand (NZ).

Material and methods: Electronic survey sent to all radiotherapy centers in Australia and NZ under collaboration with the Australia New Zealand Gynaecological Oncology Group (ANZGOG), in order to identify patterns of radiotherapy practice. The survey was distributed electronically via email to all radiotherapy centres affiliated with the Royal Australian and New Zealand College of Radiologists (RANZCR) & ANZGOG across Australia and NZ. Survey responses were collated and analysed using descriptive analysis.

Results: Of the 75 radiotherapy centers in Australia and NZ, 39 replied (52% response rate). 74% of respondents offered brachytherapy to their patients. Of the 26% who did not, all referred their patients on to other centers for their brachytherapy treatment. The majority of centers offering brachytherapy used 3D imaging (79% CT, 57% MRI, 30% US). Of those that did, 90-96% contoured bladder and rectum, 64% contoured high-risk clinical target volume (HRCTV). 70-79% optimized their brachytherapy plan based on organ at risk (OAR) dose constraints and/ or HRCTV coverage. The main barriers to IGABT implementation were access to MRI, budgetary constraints, anaesthetics/ theatre access, and insufficient patient numbers.

Conclusions: Most of the survey respondents who offer brachytherapy to their cervix cancer patients demonstrate a substantial shift toward 3D IGABT techniques. Brachytherapy remains an integral component of definitive treatment, however, several barriers remain in the implementation of best practice.

Uncertainties in high-risk (HR-CTV) delineation for cervix brachytherapy: application of GEC-ESTRO guidelines in the Australian setting

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Abstract

Purpose: Since the publication of GEC-ESTRO guidelines, image-guided brachytherapy for cervical cancer has been implemented throughout many Australian and New Zealand centers. Previous studies have shown inter-observer variability in volume delineation with the most concordant volume being HR-CTV. The aim of this study was to evaluate interpretation of GEC-ESTRO guidelines by measuring interobserver variability of HR-CTV delineation amongst Australian and New Zealand radiation oncologists.

Material and methods: Seven radiation oncologists and 2 radiologists contoured HR-CTV on MRI datasets

from 10 consecutive patients treated at a single institution. The images were from a 3T MRI at first or second insertion. Participants were provided with a clinical history, diagnostic imaging results, and clinical diagram of EUA findings at brachytherapy applicator insertion. Two reference contours were created for comparison: a Simultaneous Truth and Performance Level Estimation (STAPLE), and a consensus contour (CONSENSUS) between two radiation oncologists and a radiologist. Contour comparisons were performed using the Mean Absolute Surface Distance (MASD) and Dice Similarity Coefficient (DSC).

Results: The DSC ranged from 0.60-0.86 with STAPLE reference and 0.47-0.81 with CONSENSUS reference. An acceptable DSC of > 0.7 was achieved for 8/10 cases using the STAPLE reference and 7/10 cases using the CONSENSUS reference. The MASD ranged from 1.8-9.5 mm with STAPLE reference, and 1.7-11.7 mm using the CONSENSUS reference. A mean MASD of < 5 mm was achieved in 8/10 cases using the STAPLE reference, and 7/10 cases using the CONSENSUS reference. The greatest variability was seen in patients with T3b-T4 disease and in the superior-inferior direction.

Conclusion: GEC-ESTRO guidelines have been applied in Australia and New Zealand with an acceptable range of variation in HR-CTV delineation.

Commissioning and assessment of a commercial brachytherapy plan checking program

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Abstract

Purpose: Evaluate a commercial brachytherapy plan checking program for use with Oncentra Masterplan 4.3 with Nucleltron microselectron V2 PDR and HDR plans.

Material and methods: Source specific data were submitted and a series of treatment plans of varying degrees of complexity were sent to RadCalc™ for evaluation. The transfer of plan data including, but not limited to patient demographics, dose points, catheter geometry, and dose fractionation was verified. The software does not explicitly offer a PDR source calculation option, however, it was possible to input a low strength HDR source titled PDR, which was used for comparison. The performance of RadCalc against our previously commissioned in-house checking program was within 0.2% ± 0.4%. RadCalc™ provides an option to produce a treatment schedule. That generated the dwell times required for the treatment plan corrected for source decay, which was found to be of use in saving time in patient specific QA of all multi-fraction HDR treatments.

Conclusion: The program provides a quick and user friendly method for conformance with recommended best practice in verifying treatment plan dosimetric calculations.

Clinical assessment of vaginal CT/MR multi channel applicator for brachytherapy – when and how to use the multi

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Abstract

Purpose: The Canberra Hospital (TCH) has purchased a new applicator, the Vaginal CT/MR multi-channel applicator for the treatment of vaginal vault cancer using brachytherapy. It has the ability to insert additional needles, allowing asymmetric dose distribution to treat tumors that are spread out asymmetrically, and potentially reduce the radiation dose to organs at risk and normal tissue. The current planning technique used at TCH for vaginal vault brachytherapy is point based prescription using the single channel applicator (ABS guideline). The purpose of this study was to evaluate the use of this new applicator and planning techniques to quantify the advantages (if any) over the current single channel vaginal applicator.

Material and methods: Patient plans that were previously treated with vaginal vault brachytherapy using the single channel applicator were used to evaluate the multi channel applicator. A CT scan of the multi channel applicator was performed and fused to the existing single channel applicator plan. The catheters were reconstructed, and the bladder and rectum were contoured for each plan. A 5 mm rind PTV was generated by contouring the applicator and expanding from the surface of the applicator. The patient points (ICRU bladder and rectum) were copied across and IPSA optimization was performed. The doses to patient points were compared between the two plans.

Results: Preliminary results showed the multi channel applicator has reduced dose to the proximal tip from by up to 11%. Using the set IPSA optimization solution, rectal doses were reduced, as predicted, by up to 20%. However, it resulted in compromised dose to the PTV especially in the inferior region where the rectum is nearest to the applicator.

Conclusion: The multi channel applicator provided flexibility in shaping dose and potentially useful for all clinical cases even where asymmetric dose distribution is not required. The dose to patient points were found to be lower using the multi channel applicator with IPSA optimization, however, careful evaluation will be required by the Radiation Oncologist to ensure target coverage is adequate. Review of our IPSA solution may be required to fit clinical situations once more data is collected from clinical use.