

[Room/Salle : Campaign B]

Chair: P. Dunscombe, Tom Baker C.C.

SU-P6-1 15h30

Licensing, Construction and Radiation Safety of Canada's First Gamma Knife(R)*, Harry Johnson and A. Berndt, *CancerCare Manitoba* — The Department of Neurosurgery, Winnipeg Regional Health Authority and University of Manitoba, installed Canada's first Leksell Gamma Knife® in 2003. This unique stereotactic radiosurgery tool uses 201 cobalt-60 capsules (initial activity 244 TBq) to treat inaccessible cranial lesions in a single session. Source collimators are aligned to a common isocentre. Patients are positioned within a collimating helmet fixed to the bed such that their cranial target coincides with isocentre. Following remote opening of the shielding doors, bed, helmet and patient move into alignment with the source collimators to deliver doses up to 140 Gy. The design, construction, radiation protection measurements and radiation safety experience will be reviewed. The dedicated single-story GK® suite consists of concrete walls and concrete ceiling. Shielding was based on the vendor's radiation field data. A single lead-lined door (1 cm) permits patient entry in line with the self-shielding of the irradiator unit and perpendicular to the bed direction. Licensing followed CNSC C-120. CNSC officers attended to observe the source loading. The vendor's team loaded the sources using a special loading cell mated to the source-shipping flask. Source capsules were remotely transferred to collimation channels using a detailed loading procedure to balance the field at isocentre. Radiation protection tests yielded radiation fields well within design targets, and less than anticipated at the shielded doors due to newly improved irradiator internal shielding.

* The authors acknowledge J. Sandeman's shielding and initial licence documentation.

SU-P6-2 15h45

Gamma Knife® Commissioning Report, Anita Berndt and J. Beck, *CancerCare Manitoba* — The Gamma Knife® (GK) provides a minimally invasive treatment alternative for patients with brain tumors, vascular malformations and some debilitating functional conditions. Radiation is delivered with sub-millimeter accuracy to the affected region, allowing doses ranging from 10 – 140 Gy to be safely administered, even near critical structures. This presentation summarizes the measurements made during commissioning of the first Canadian GK. The GK is very different from conventional radiotherapy equipment in that it consists of 201 fixed radiation sources rather than a single source on a moving gantry. In addition, only four fixed field sizes ranging from 6 to 24 mm in diameter are available. Dose profiles were measured at the center of an 8 cm radius plastic phantom (dosimetry sphere) using EDR-2 films. The 50% isodose line was found to agree with the treatment planning system calculations to within 0.4 mm. The agreement between the mechanical and radiation isocentre was measured using a precisely machined test tool which pricks a film at mechanical isocentre; the agreement between the center of the 4 mm collimator helmet profile (radiation isocentre) and the pinprick was found to be within 0.11 mm. Helmet factors which determine the relative output for different field sizes were measured using individually calibrated TLDs placed at the center of the dosimetry sphere, resulting in agreement of better than 3% with the helmet factors used by the planning system. Absolute calibration was performed by applying the TG21 formalism to ionization measurements at the center of the dosimetry sphere.

SU-P6-3 16h00

An Algorithm for Independent Verification of Gamma Knife® Treatment Plans, James Beck and Anita Berndt, *CancerCare Manitoba* — A formalism for independent treatment verification has been developed for Gamma Knife® radiosurgery in analogy to the second checks being performed routinely in the field of external beam radiotherapy. A verification algorithm is presented, and evaluated based on its agreement with treatment planning calculations for the first 40 Canadian Gamma Knife® patients. The algorithm is used to calculate the irradiation time for each shot, and the value of the dose at the maximum dose point in each calculation matrix. Data entry consists of information included on the plan printout, and can be streamlined by using an optional plan import feature. Calculated shot times differed from those generated by the treatment planning software by an average of 0.3%, with a standard deviation of 1.4%. The agreement of dose maxima was comparable with an average of -0.2% and a standard deviation of 1.3%. Consistently accurate comparisons were observed for centrally located lesions treated with a small number of shots. Large discrepancies were almost all associated with dose plans utilizing a large number of collimator plugs, for which the simplifying approximations used by the program are known to break down.

SU-P6-4 16h15

Initial Experiences with a Commercial Helical Tomotherapy Unit, Marc MacKenzie, G.C. Field and B.G. Fallone, *Cross Cancer Institute, University of Alberta* — Helical tomotherapy (HT) is a modality which represents a convergence of diagnostic imaging and radiation therapy, with the potential for enabling a highly integrated approach to image guided adaptive radiotherapy in the clinic. This device has integrated megavoltage CT (MVCT) capability, as well as being inherently a platform for delivering inverse planned Intensity Modulated Radiation Therapy (IMRT). Our institution has recently had one of the two original HT units (Hi-Art 1) upgraded to the latest commercial version (TomoTherapy Hi-Art IEC System). The implementation of this system has spurred on a number of research projects locally, such as Monte Carlo simulations for absolute dose calibration of the unit, novel approaches to small field dosimetry as well as alternate MVCT detectors. In this presentation, we shall describe clinical aspects of implementation, which have employed several new software tools; some developed and provided by the manufacturer (TomoTherapy Inc.), and some developed in house. As well, there are a number of clinical trials which will begin shortly, and these will also be described.

SU-P6-5 16h30

Helical Tomotherapy Fan Beams and Craniocaudal Penumbra Improvement, Adam Gladwish, Tomas Kron, Andrea McNiven, Glenn Bauman and Jake VanDyk, *London Health Sciences Centre* — In helical tomotherapy (HT), an intensity modulated fan beam with fixed thickness delivers radiation dose to a patient in a helical beam trajectory. The most significant limitation with a constant fan beam thickness (FBT) is the penumbra width in the craniocaudal direction, which, due to a 'ramp up effect' is equivalent to the FBT. We propose to employ a half-blocked fan beam at the start and stop locations of treatment delivery to reduce the penumbra width by half. The choice of starting with a half-blocked beam rather than a completely shut collimator maintains the same constant couch movement as in standard HT and results in a minimum FBT of half the normal treatment FBT. We studied the impact of this technique on dose distributions in phantoms and a patient using a HT beam model implemented on a commercial treatment planning system (Theraplan Plus v3.0). We show that the dose distribution delivered using a 25mm fan beam can be improved significantly, resulting in a dose reduction of ~30% just superiorly and inferiorly of the target. In a sample brain cancer patient, we demonstrate that this approach could reduce the probability of cataract formation dramatically.

SU-P6-6 16h45

Using Isocentre Corrections in Treatment Planning to Improve Accuracy in Stereotactic Radiosurgery, Jason Schella and J.I. Robar, *Nova Scotia Cancer Centre* — One of the limitations in linear accelerator based Stereotactic Radiosurgery/Radiotherapy (SRS/SRT) is the mechanical accuracy of the treatment unit. Gantry, couch, and collimator should rotate about a single point in space. In reality, however, the centres of rotation for each of these motions differ slightly. Typical tolerances for this "wobble" of the isocentre are on the order of ±1mm for SRS/SRT. However, ±1mm is still a relatively large variation for some targets treated with SRS. When treating such functional disorders as trigeminal neuralgia a 1 mm shift in a 1-5mm diameter target may certainly compromise the treatment. In other treatments, critical structures may closely abut the target. In such cases a shift of 1mm toward the structure could deliver unwanted dose to this structure. When such factors are deemed critical one solution would be to re-centre the patient for every treat-

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ment port. This can be very time consuming and could significantly increase the time required to treat a patient. Another option would be to account for these uncertainties when developing the treatment plan. By modeling the mechanical isocentre location for gantry, couch, and collimator rotations one can then modify the treatment plan by placing the isocentre of each beam at the “actual” position. The shielding is then modified appropriately. An overall improvement in the accuracy of dose delivery was shown. In one case, volume receiving 50% dose was reduced from 56% to 22%. The volume of the target receiving 80% dose was increased from 95% to 98.6%.

17h00 Session Ends / Fin de la session