radiotherapy of the chest wall as well as additional hormone therapy (n = 8) and/or chemotherapy (n = 3). Tumor distribution by stage was as follows: stage 0 (9.7%), stage I (22.6%), stage II (32.2%) and stage III (35.5%). Histopathologic study revealed invasive ductal carcinoma in 27 pts, 1 invasive lobular carcinoma and 3 ductal carcinoma in situ.

**Results:** The mean follow-up was 77.6 months (range, 7.3–231.8). Only one infield local relapse was observed. Eight patients (25.8%) experienced metastatic tumor spread, in 7 patients (22.6%) a second malignancy was observed. Kaplan-Meier estimates of OS and DFS at 5 years were 77% (95%CI, 0.61–0.93) and 73% (CI, 0.57–0.91), respectively. Risk factors that reached statistical significance on DFS in the Cox regression model were stage of disease (p = 0.020), lymph node involvement (p = 0.026) and histopathological grading (p = 0.017). None of the prognostic factors were found to be of statistical value for OS.

**Conclusion:** Stage of disease, lymph node involvement and histological differentiation are of prognostic impact on disease free survival.

310 PUBLICATION

### Male breast cancer – New prognostic factors?

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**Purpose:** Male breast cancer (MBC) is a rare disease and this explains our little knowledge in prognosis. Research around MBC is inspired in findings for this cancer in females. In a population of patients with histologically confirmed MBC, known in its clinical characteristics, we purposed to test the expression of the v6 isoform of CD44 protein and its impact in prognosis.

**Population and Methods:** For MBC patients treated in our institution we review the main clinical characteristics with a possible effect in prognosis and their survival patterns. In the biopsy tissue we checked the immuno-expression of CD44v6 protein. The statistical analysis focus was to find relations between classical clinical and pathological variables and the CD44v6 expression, in order to define the contribution of this new factor for survival in the context of MBC.

**Results:** We tested CD44v6 protein in 31 cases of MBC. In 19 (59%) it was positive. A significant difference between expression of CD44v6 and histological grade was found with a greater percent of expression in undifferentiated tumors (p = 0.03). In tumors with positive estrogens receptors we found a greater expression of CD44v6 (p = 0.03). The CD44v6 expression in 16 lymph nodes with tumor invasion was positive in 9, with some of discordance between expression of CD44v6 in the primary tumor and in lymph bode metastases, in one case only the lymph node was positive for CD44v6, in 4 cases the lymph nodes metastases had a greater expression than the primary. There was no difference in survival between the two groups, with and without expression of CD44v6.

**Conclusions:** The expression of CD44v6 in our group of patients with MBC is similar to that found by other authors in female breast cancer. It seems that CD44v6 expression is present in more aggressive tumors and, although without statistical significance, associated with a worse survival and shorter disease free survival. Lymph node expression for CD44v6 is occasionally higher than in the primary tumor. Our results support the ongoing research for new prognostic factors in MBC, being necessary larger series of patients in order to identify independent prognostic factors.

## Radiotherapy techniques

311 ORAL

### Tomotherapy with peacock: The University of California, Irvine experience

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**Purpose:** Intensity modulated radiotherapy (IMRT) offers unique advantages in radiation treatment planning and delivery. In this work, our experience using the NOMOS Peacock system for IMRT is summarised.

**Methods:** Dosimetric data were acquired to commission the system for clinical use. To date, 80 patients were treated using this system which is fitted to a Clinac 600C linac. Cranial as well as extracranial lesions have been treated using this modality. Immobilisation is achieved either with the "Talon" system for cranial sites or an acquaplast mask. Target volumes up to 500 $cm^3$ have been treated. Multiple lesions (up to 3) were treated in one set-up. The range of dose/fractionation schemes used was 15Gy/1f–70Gy/35f. Dose validation was carried out using film and TLD dosimetry.

**Results:** Optimal dose distributions were attainable using inverse treatment planning for IMRT delivery. These were found to encompass the target volumes accurately using dose validation phantom studies. Immobilisation methods used were accurate to within 2 mm as evidenced by weekly portal films.

**Conclusion:** IMRT using the Peacock system offers the advantages of delivery of conformal therapy to high doses safely and accurately. This provides the opportunity for dose escalation studies, re-treatment of previously treated tumours as well as treating multiple targets in one set-up. The system may be fitted to a conventional linac without major modifications.

312 ORAL

### Stereotactic radiotherapy in the treatment of ocular melanoma

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**Introduction:** Ocular melanoma is frequently treated by the interstitial implantation of 198Au seeds, by the application of 60Co plaques or 184Ta wire, by external beam radiotherapy using small 60Co beams or by proton therapy. The last technique, though very expensive, provides improved dose distributions and dose localizations in the treatment of tumours adjacent to critical normal tissues, thereby allowing dose prescriptions as high as 70 Gy in 5 fractions over 8–9 days.

**Purpose:** The technique of stereotactic radiotherapy on a linear accelerator is being used successfully in treating various sites in the brain such as craniopharyngioma, glioblastoma, meningioma, pituitary adenoma, etc. It combines stereotactic localization with fractionated dose delivery. It has now become possible to extend the technique to the treatment of ocular melanoma using the same fractionation scheme as in proton therapy but at a considerably lower cost.

**Methods:** Stereotactic radiotherapy treatments are delivered using the Radionics' couch mounted system on a Varian 2100C/D linear accelerator and 6 MV photons. The relocatable Gill-Thomas-Cosman (GTC) frame, with an eye fixation device developed here, is attached directly to the dental plate assembly. Treatment planning is accomplished by the new XKnife-4 software. Circular fields between 10 mm and 20 mm diameter with five arcs and a prescription of 70 Gy in 5 fractions over 10 days have been commonly used for treating five patients so far.

**Results:** The technique developed at the Princess Margaret Hospital for the treatment of ocular melanoma has yielded excellent localization and dose distributions.

313 ORAL

### Proton radiation therapy (PRT) for pediatric optic pathway gliomas: Comparison with 3D planned photon and a standard photon technique

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**Purpose:** We compared PRT and its normal tissue (NT) sparing with two photon radiation treatment techniques for localized and extensive optic pathway tumors.

**Methods:** Based on CT data sets of 7 children, previously treated with PRT, we computed 3D photon and lateral photon plans using the same treatment planning software. Radiation exposure for NT and discrete organs at risk was quantified.

**Results:** Analysis for small (<20 $cm^3$) and larger (>80 $cm^3$) tumors showed that protons encompassed the smallest volumes of NT at all isodose levels. Comparable conformity and high dose gradient were achieved for protons and 3D photons in small tumors. However, differences became larger with increasing tumor volume and complexity. At low isodose levels 3D photons encompassed the highest amount of NT. PRT reduced doses to the contralateral optic nerve by 48% and 77% compared to 3D photons and lateral photons, respectively. Dose reductions with PRT were 11% and 16% for the chiasm, 13% and 16% for the pituitary gland, and 39% and 54% for the temporal lobes.

**Conclusion:** PRT offers high dose conformity to target volumes and steep dose gradients, thus leading to substantial NT sparing at high- and low-dose levels. For small tumors 3D photons were comparable in terms of dose conformity and high dose reduction to NT. Lateral photons resulted in inferior dose distribution with high radiation exposure of clinically relevant NT.

314 ORAL

## Dosimetric imrovements following 3-D planning of tangential breast irradiation

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**Purpose:** To evaluate the dosimetric difference between a simple radiation therapy plan utilizing single contour and a more complex 3-D plan utilizing multiple contours, lung inhomogeniety correction and a dose-based compensator.

**Methods:** This is a prospective study of the RT plans of 62 patients with early breast cancer. All patients were considered for breast conserving management and treated by conventional tangentianal fields technique. Two plans were generated for each patient. The first RT plan was based on a single contour taken at the central axis and utilized two wedges. The second RT plan was generated by using the 3-D planning system to design a dose-based compensator after lung inhomogeniety correction had been made. The end point of the study was the comparison between the volumes receiving ≥105%, ≥110% of the reference dose as well as the magnitudes of the treated volume maximum dose. Dosimetric improvement produced by the use of 3-D planning was considered of potential clinical value if the volume receiving ≥105% by wedge plan was reduced by at least 50%.

Result:

| | Vol. with ≥105% range, median | Vol. with ≥110% range, median | Vol. max. dose range, median |
|---|---|---|---|
| Wedge | 3–48, 23 | 0–18, 3 | 107–121, 114 |
| Compensator | 2–30, 10 | 0–8, 1 | 107–124, 112 |
| P Value | <0.0001 | <0.0001 | <0.0008 |

The dosimetric improvement in 36 plans (58%) was considered of potential clinical relevance.

**Conclusion:** Dose-based compensator plans reduced significantly the volumes receiving ≥105%, ≥110% and volume maximum dose.

315 ORAL

## Commissioning and clinical use of a micro multi-leaf collimator for conformal radiosurgery

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Objective: The m3 micro multi-leaf collimator, developed by BrainLAB and Varian, has been commissioned and is now being used for conformal stereotactic radiosurgery. Treated targets have so far included brain metastases, an AVM, acoustic neuromas and recurrent glioblastomas.

**Method:** Clinical commissioning involved measurement of standard characteristics (transmission, leakage, beam penumbra, etc.) as well as the accuracy of field shaping and planned dose delivery in terms of geometric and dosimetric precision. For this purpose a shaped phantom was constructed and irradiated. Multiple Portal VisionTM images were acquired to verify the spatial accuracy of the planned field shaping, 3D image reconstruction and target positioning. A cubic solid water phantom and film was also used to verify the planned and delivered dose distributions. Both tests indicated high dose was delivered with a spatial precision of £1.5 mm. Absolute dosimetry with ionisation chambers and TLDs have shown isocentre dose delivered to an accuracy of ±3.5%.

**Results:** All treated patients had both standard stereotactic arc and mMLC conformal plans calculated. Unless targets were near-spherical and/or small (£1 cm3) the conformal plans always produced more normal tissue sparing in the >50% dose region. For an elongated acoustic neuroma (volume 0.57 cm3; longest dimension 17 mm, shortest 3 mm), the arc plan required two isocentres and, therefore, lead to dose inhomogeneity within and around the GTV. The mMLC plan, using six non-coplanar fields, provided a much more homogeneous dose distribution.

**Conclusion:** DVH analysis showed improved normal tissue sparing and homogeneous PTV dose coverage for all the mMLC plans relative to those with arcs.

316 ORAL

## A comparative analysis of electronic portal image quality for patients receiving whole pelvic irradiation

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**Purpose:** To compare image quality using daily electronic portal imaging (EPI), in females receiving whole pelvic irradiation and to determine if there is a difference in image quality when comparing the standard automatic window and levelling (AWL) to a more sophisticated polynomial subtraction technique (PST). And if so are these difference clinically significant.

**Method:** Eight female patients with early stage cervical or endometrial carcinoma were selected. An objective sensitive algorithm was used and scored by three evaluators with different medical backgrounds. The scoring algorithm which has a clinical basis is adaptive to the specific treatment site and the viewing angle (AP-PA and Laterals). For each view at least 25 images were selected on a random basis. The images were displayed to the observers using AWL, polynomial subtraction and a hybrid technique using erosion (ERT) of field edges to determine the field edges and subsequent implementation of the AWL. A total of 52 images were scored and results analyzed. Additionally, a series of 316 images was scored using PST alone to estimate clinical feasibility.

**Results:** The mean scores for AWL, PST and ERT were: 3.85, 5.02 and 3.85 respectively. More in-depth comparison of the AWL and PST yields the following results: A higher score was found for PST in 80.8% of the images, while 3.8% received a lower score. Comparison of ERT and PST showed an increase in image quality in 76.9% of the cases and a lower score in 3.8% of the cases. ERT and AWL compared showed little differences the percentage of higher scores (25%) equaled the number of lowerscores. The majority of these images received identical scores (50%). The mean score for anterior images for the clinical assessment was 5.49, while lateral images received a 5.17 mean score. The lowest score (1) was given in 0.8% of the scoring instances.

**Conclusion:** The image quality increase for PST over the standard display technique (AWL) is highly significant. Moreover, the clinical evaluation showed that the enhancement introduced by the PST was robust and reliable as the image score was consistently high enough to warrant clinical use.

317 ORAL

## Impact of new technology on radiation therapy treatment deviations at TSRCC

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**Purpose:** To report the results of the radiation therapy Quality Assurance Program using a prospective database in a large ambulatory cancer centre.

**Methods and Material:** Toronto-Sunnybrook Regional Cancer Centre, is the largest Canadian ambulatory radiation therapy center treating over 4000 new cases per year. Since 1988, we have collected treatment deviations using a prospective database.

The goal of the audit was to identify trends, and document if new technology such as Muitileaf Collimator (MLC), and record and verify systems impacted on the number of shielding deviations.

**Results:** From 1995 to 1997 treatment units equipped with MLC and record and verify systems were introduced. The total number of fractions increased by 40.5% from 54,490 (1995) to 74,022 (1997), however corresponding deviations decreased by 35% from, 0.12% (1995), to 0.06% (1997). This decrease is attributed mainly to 3 out of 10 units equipped with MLC, and 7 out of 10 units equipped with record and verify systems.

**Conclusion:** MLC and recorded verify systems decrease shielding, wedged and machine set up deviations. New technology introduces new deviations such as data entry. Prospective data collection and monitoring by the Quality Assurance Program at our center has resulted in continuous improvement in quality of service, and evaluation of the impact of new technology.