**2056** POSTER

**The Determination of the Individual Margins and Individual Internal Gross Tumour Volume in Hepatocellular Carcinoma Radiotherapy Using 4D-CT**

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**Purpose:** To research the deficiencies of conventional margins in hepatocellular carcinoma radiotherapy comparing to the individual internal gross tumour volume (IGTV) and the individual margins which were obtained by 4D-CT.
**Methods:** 12 hepatocellular carcinoma cases were selected, achieved the 4D-CT scan after 3D-CT scan under free breathing (FB). 4D-CT were sort in10 phases and named $CT_0$, $CT_{10}$, ... $CT_{90}$. GTVs were contoured manually on 3D-CT and 4D-CT (labeled as $GTV_{FB}$, $GTV_0$, $GTV_{10}$, ... $GTV_{90}$). $IGTV_1$ was obtained from $GTV_{FB}$ using conventional margins (2 cm in Z-axial, 1.5 cm in X-axial and Y-axial), and $GTV_0$, $GTV_{10}$, ... $GTV_{90}$ were merged into $IGTV_2$, the individual margins in three axial were obtained from $GTV_{FB}$ to $IGTV_2$, and $IGTV_3$ were obtained from $GTV_{FB}$ using the individual margins. The volume of GTVs and IGTVs were compared.
**Results:** The individual margins of every axial were not symmetrical in particular in Z axial: +X axial 0.67±0.26 cm, −X axial 0.50±0.26 cm, +Y axial 0.65±0.28 cm, −Y axial 0.70±0.29 cm, +Z axial 1.18±0.66 cm, −Z axial 0.70±0.49 cm, and there were two patients' +Z-axial margins were not sufficient, all conventional margins of others were larger than individual margins. The volume difference among GTVs was not significant ($p > 0.05$); the volume of $IGTV_3$ (125.75±35.95 $cm^3$) was larger than $IGTV_3$ (71.97±28.65 $cm^3$), and $IGTV_2$ was larger than 50.77±14.37 $cm^3$, the volume difference among three IGTVs was significant ($\chi^2 = 22.00$, $p = 0.00$). The value of $IGTV_3/IGTV_3$, $IGTV_3/IGTV_2$ and $IGTV_3/IGTV_1$ were 3.61±0.82, 2.41±0.42 and 1.73±0.37.
**Conclusion:** The symmetrical conventional margins for hepatocellular carcinoma could include partial tumour off-target or too much normal liver tissue accepted irradiation. The individual margins and individual IGTV were very necessary in hepatocellular carcinoma radiotherapy.

**2057** POSTER

**Insufficiency Fractures of the Sacrum Following Stereotactic Body Radiotherapy for Sacral Tumours**

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**Background:** There is little data on the incidence of sacral insufficiency fractures following pelvic radiation therapy and existing studies are based on conventional fractionation. Stereotactic body radiotherapy (SBRT), characterized by dose escalation with hypofractionation, may pose even greater risks to sacral skeletal integrity. This study aims to define the incidence and risk factors for sacral insufficiency fractures following single-fraction and hypofractionated SBRT to the sacrum.
**Methods:** Hospital records of 43 consecutive patients who underwent SBRT for sacral malignancies between September 2005 and May 2009 were reviewed.
Baseline information (age, gender, menopausal status, body mass index, use of bone-thinning agents, presence of osteoporosis) were recorded. In addition, tumour characteristics (histology, lesion appearance and extent) and treatment parameters (dose/fractionation, prior radiation/surgery) were documented.
The primary end-point was development of new fractures or progression of pre-existing fractures at the treatment site. To obtain this information, pre- and post-treatment CT and/or MRI scans were reviewed with an experienced neuro-radiologist. Secondary end-points included pain scores, analgesic use, impact on function, and local tumour control.
**Results:** Median follow-up was 17 months. Common tumour histologies included sarcoma, renal cell, and prostate carcinoma; 47% of sacral lesions were lytic, 37% were sclerotic and the remainder were mixed. All patients were treated with SBRT (18−24 Gy/1# to 30 Gy/5#) with 45% receiving single-fraction regimens. 14% had a history of prior radiation (median dose: 30 Gy/10#).
Of the 43 patients, 5 developed sacral insufficiency fractures. In 4 of these cases, fracture progression occurred in the context of controlled local disease. Median time to fracture development was 8.2 months (range: 3.6–24.9 months). Symptoms varied from minimal pain requiring no intervention to severe pain refractory to standard analgesics and impacting on functional ability. Two of the five patients eventually underwent sacroplasty due to intractable pain, with both obtaining good pain relief. As the number of events was low, it was not possible to perform meaningful univariate/multivariate analyses to identify predictive factors for fracture progression. Radiographic local tumour control rates at 1 year were excellent (91.7%).
**Conclusion:** In this study, the actuarial incidence of sacral insufficiency fractures at 1 year was 8.2%, suggesting that the rate of fracture associated with sacral SBRT is low. However, larger prospective studies with longer follow-up are needed to better characterize incidence, clinical course and risk factors. In addition, novel therapeutic interventions such as sacroplasty need further study to determine their safety, efficacy and to establish indications for their use.

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**IMRT as Focal Therapy in Chemo-Reduced Group II Retinoblastoma**

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**Background:** Intensity modulated radiotherapy (IMRT) has the potential of reducing dose to adjacent critical structures, achieves better target coverage, dose uniformity and sharp dose fall-off. Therefore, aim of our present study is to assess the feasibility of IMRT as a focal therapy for chemo-reduced group II retinoblastoma with regard to target coverage and sparing adjoining critical normal structures.
**Material and Methods:** Two patients of chemo reduced group II retinoblastoma were undertaken for the study. Patients were immobilized in supine position with thermoplastic cast under general anesthesia. Planning CT was done with 3 mm slice thickness and Gross Tumour Volume (GTV) was delineated in CT images as per the post chemotherapy clinical, radiological and opthalamoscopic examination under anesthesia. A margin of 2 mm was given to generate Clinical Target Volume (CTV), a further expansion of 4 mm was given for Planning Target Volume (PTV). The delineated organs at risk (OAR) include optic nerve, temporal lobe, hypothalamo pituitary axis (HPA), lacrimal gland, orbit, cornea and the retina. Nine field non-coplanar beam arrangement was used for IMRT planning in the Pinnacle TPS for Elekta synergy linear accelerator. The planning objectives were: prescribed dose of 45 Gy/25f for PTV and HPA <37.5 Gy temporal lobes <37.5 Gy, lacrimal gland <34 Gy, orbit <20 Gy, lens <10 Gy, cornea <23 Gy and retina <40 Gy.
**Results:** IMRT achieved adequate coverage to the PTV. For both the patients, 95% of the PTV was covered by 98% of the isodose line. The calculated Conformity Indices (TVRI/VRI) were 0.9129±0.26. Homogeneity Indices ($I_{max}$/RI) were 1.1475±0.35. Quality of coverage indices ($I_{min}$/RI) were 0.80±0.30. For ipsilateral OAR doses, the maximum dose to the brain stem was 6.155±0.85 Gy and temporal lobe was 41.96±0.53 Gy. Maximum dose to the optic chiasm was 9.94±1.51 Gy. Optic nerve maximum dose was 46.81±0.74 Gy and cornea max dose was 21.98±9.32 Gy. Similarly, max dose for the lens and HPA were 19.51±0.50 Gy and 9.505±0.86 Gy, respectively. Maximum dose to the lacrimal was 42.41±2.32 Gy and mean was 21.62±1.37 Gy. Orbital mean doses were 17.04±2.34 Gy. The maximum doses to the retina were 46.50±0.72 Gy and mean doses were 31.75±0.67 Gy.
**Conclusions:** Delivery of IMRT as a focal therapy in chemo-reduced group II retinoblastoma is feasible and provides adequate dose coverage to the target volume. The IMRT spares the adjoining critical normal structures with the given priority apart from the lens.

**2059** POSTER

**Determination of PTV and ITV Margins for Pelvic Lymph Nodes Irradiation in Prostate Cancer Patients Using Multiple CBCT Imaging**

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**Background:** Pelvic lymph nodes (PLN) are commonly irradiated in men with prostate cancer. Based on the ICRU definition, the Planning Target Volume (PTV) margin added to the Clinical Target Volume (CTV) can be divided in a movement related Internal Margin (IM) and a Setup Margin (SM). Traditionally, it was assumed that PLN moved closely with bone structures. Image Guided Radiotherapy (IGRT) now enables a more precise bony anatomy positioning, reducing SM. Hence, the IM has a stronger relative impact on the PTV margin. This study determines the appropriate Internal Target Volume (ITV) margin and the global PTV margin required for the treatment of PLN.
**Materials and Methods:** Rectum, bladder and nodal CTVs of 7 patients were delineated on 70 CBCT in addition to their planning CT contours by the same clinician based on current RTOG guidelines. Volume analysis was performed following two registration techniques. First, an offline automatic