

72.0 Gy in 42 fractions/6 weeks). The primary endpoint was the treatment completion rate of patients who completed  $\geq 70\%$  of the cetuximab planned dose administration (in terms of the relative dose intensity of cetuximab) and the full dose of radiotherapy  $\leq 2$  weeks over the planned schedule (in terms of radiotherapy duration  $\leq 8$  weeks).

**Results:** From Mar 2009 until Jan 2010, 27 pts were screened. Of them, 22 pts were enrolled and treated (ITT population). Patients characteristics of ITT population: median age (years), 67.0 (range, 53 to 81); male/female, 21/1 pts; oropharynx/hypopharynx/larynx, 6/8/8 pts; stage III/IV, 12/10 pts. The median duration of cetuximab treatment was 7.9 weeks (range, 7 to 9), and that of RT was 44.0 days (range, 40 to 52). All 22 pts completed the treatment, and the completion rate was 100% (95% CI: 84.6%, 100.0%). The response rate (CR+PR) post RT was 81.8% (assessed by the independent committee). All pts experienced AEs. Most common AEs with grade 3/4 were mucosal inflammation (16pts, 72.7%), dermatitis (6pts, 27.3%), infection, radiation skin injury and stomatitis (each in 5 pts, 22.7%).

**Conclusions:** The completion rate (100%) and the response rate (81.8%) are comparable to those of the cetuximab + RT group in the multinational randomized phase III study (Bonner et al. 2006). AEs were consistent with the underlying disease, administration of RT or cetuximab. The study results demonstrate that cetuximab + RT is well-tolerated, a feasible and efficacious treatment in Japanese pts.

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POSTER

### Helical Tomotherapy in the Treatment of Locally Advanced Squamous Cell Oral Carcinoma

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**Background:** The aim of this study is the evaluation of toxicity and response to the treatment of patients affected with locally advanced carcinoma of the oral cavity, irradiated by Helical Tomotherapy.

**Materials and Methods:** From February 2008 to January 2011, 87 patients with head-neck cancer were treated by Helical Tomotherapy. Among them, 20 presented locally advanced squamous cell carcinoma of the oral cavity and were treated with radical intent: 12 underwent concomitant radiochemotherapy with weekly administration of Carboplatin and 8 exclusive radiotherapy for comorbidities.

Median age was 67 years (39–87) and male/female ratio 3:1. Regarding anatomic subsite, oral tongue, floor of the mouth, gingiva, retromolar trigone primary tumours, were 8, 6, 1, 5, respectively. Stage of disease at diagnosis was III in 2, IVA in 16 and IVB in 2 cases.

Simultaneous Integrated Boost (SIB) technique in 30 fractions was used, delivering 66 Gy (RT-CT)/67.5 Gy (RT) to PTV1 (PET positive oral region), 60–63 Gy to PTV2 (oral cavity and PET positive nodes), 54 Gy to PTV3 (negative cervical nodes). Contouring was performed on the basis of a CT/PET/MR image fusion. Planned Adaptive module was used in consideration of anatomical changes occurred during the therapy.

**Results:** All patients completed radiotherapy, without any interruption due to the treatment. Concerning acute toxicity, G2 dermatitis, dysphagia and mucositis were registered in 25%, 40% and 55% of cases, respectively. Median follow up was 16 months (range 3–29). Response on primary tumour and positive nodes was achieved in all patients, in terms of clinical and nuclear/radiological findings: complete in 16 (80%) and partial in 4 (20%). One year after the end of the treatment, no significant difference between RT-CT and RT was noted.

**Conclusion:** Helical Tomotherapy allows to obtain favourable local control and low acute toxicity in locally advanced squamous cell carcinoma of the oral cavity.

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POSTER

### Results of Postoperative Radiotherapy in Patients With Salivary Duct Carcinoma of the Major Salivary Glands

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**Background and Purpose:** Salivary duct carcinoma (SDC) is a rare malignancy of high grade pathologic type. Currently, there are no confirmed prognostic variables in the management of SDC. We evaluated clinical

outcomes and prognostic factors in 35 patients with SDC treated with postoperative adjuvant radiation, and investigated postoperative adjuvant RT role.

**Materials and Methods:** We retrospectively assessed overall survival (OS), locoregional control (LRC), and disease-free survival (DFS) in 35 patients with SDC of the major salivary glands who underwent surgery. Neck dissection was performed in 31 patients (88.6%). All patients received postoperative adjuvant RT to tumour bed and ipsilateral neck node. Prescribed median dose was 59.4 Gy (range, 50.4–71.4 Gy). Factors evaluated for prognosis included gender, age, symptom duration, tumour site, tumour size, TNM classification, and pathologic features; perineural invasion (PNI), lymphovascular invasion (LVI), extra-parenchymal invasion, and resection margin status. The median follow-up period was 43 months (range, 7–155 months).

**Results:** Of the 35 patients, 30 (85.7%) were male: median age at initial diagnosis was 62 years (range, 38–75 years). The parotid gland was mainly affected in 22 patients (62.9%). Eighteen patients (51.5%) had pathologic T3/T4 tumours, and 26 patients (74.3%) showed pathologic nodal involvement. The actuarial 3-year locoregional control, disease-free survival, overall survival rates were 75.8%, 55.7%, and 79.5%, respectively. Cause specific death rate was 31.4% (n = 11). Pathologic nodal involvement was correlated with distant metastasis ( $p = 0.011$ ). Lymphovascular invasion was significant prognostic factor of distant metastasis-free survival ( $p = 0.049$ ), locoregional control ( $p = 0.012$ ), and overall survival ( $p = 0.003$ ) in the Cox proportional hazard model, whereas perineural invasion was significant prognostic factor only of overall survival ( $p = 0.005$ ).

**Conclusions:** Despite high nodal involvement rate, loco-regional control was successful. Surgery and postoperative radiotherapy were effective for locoregional control. Lymphovascular invasion and perineural invasion were significant prognostic factors for patients with SDC.

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POSTER

### Treatment Outcomes of Radiotherapy for Tonsillar Carcinoma in the Era of Intensity-modulated Radiotherapy

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**Background:** We performed this study to analyze treatment outcomes and to evaluate prognostic factors in patients with tonsillar carcinoma who were treated with radiotherapy (RT).

**Materials and Methods:** We retrospectively reviewed 164 patients with tonsillar carcinoma treated with RT between January 1979 and September 2009. Of the 164 patients, 91 were treated with 2-dimensional RT (2D-RT), 46 were treated with 3-dimensional conformal RT (3D-CRT), and 27 were treated with intensity-modulated RT (IMRT). When patients were treated with IMRT, simultaneous integrated boost was used. Thirty patients were treated with RT alone, 40 patients were treated with chemotherapy and RT (CRT), 66 patients were treated with surgery and RT and/or chemotherapy (SRT), and 28 patients were treated with concurrent chemoradiotherapy (CCRT). Bilateral neck irradiation was delivered to 141 patients, and ipsilateral neck irradiation to 23 patients. In definitive RT, median dose was 70 Gy (range, 51–71), 70 Gy (54–74), and 67.5 Gy for 2D-RT, 3D-CRT, and IMRT, respectively. In postoperative RT, median dose was 64.8 Gy (range, 54–70.2), 66 Gy (54–70), and 63 Gy (60–67.5) for 2D-RT, 3D-CRT, and IMRT, respectively. Acute and late toxicity were graded according to the Radiation Therapy Oncology Group radiation morbidity scoring criteria.

**Results:** The median follow-up time was 42 months (range, 2–288). The 5-year locoregional progression-free survival (LRPFS), distant metastasis-free survival (DMFS), disease-free survival (DFS), and overall survival (OS) rates were 86%, 94%, 82%, and 80%, respectively. In the univariate analysis, 5-year DFS rate was associated with the RT technique (2D-RT, 77%; 3D-CRT, 82%; IMRT, 100%,  $p = 0.035$ ), T stage (T1–2, 87%; T3–4, 74%,  $p = 0.036$ ), and treatment modality (RT alone, 55%; CRT, 78%; SRT, 92%; CCRT, 92%,  $p < 0.0001$ ). In the multivariate analysis, advanced T stage and treatment modality were statistically significant prognostic factors in DFS rate. None of the patients who were treated with ipsilateral neck irradiation experienced relapse in contralateral neck nodes. After the completion of RT, patients who were treated with 2D-RT, 3D-CRT, IMRT, ipsilateral neck irradiation, and bilateral neck irradiation experienced grade  $\geq 2$  xerostomia 91%, 58%, 59%, 35%, and 78%, respectively. At least 6 months of follow-up, patients who were treated with 2D-RT, 3D-CRT, IMRT, ipsilateral neck irradiation, and bilateral neck irradiation experienced grade  $\leq 1$  xerostomia 52%, 76%, 78%, 98%, and 63%, respectively.

**Conclusions:** In selected patients with well lateralized tonsillar carcinoma, ipsilateral neck irradiation can be an alternative to bilateral neck irradiation, regarding DFS rate and complications. There was no failure when patients were treated with IMRT, but long-term follow-up is needed to evaluate the

superiority of IMRT. Our results were not able to confirm which treatment regimen is most optimal. So, further study is needed to confirm the optimal therapeutic regimen.

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POSTER

# **Preliminary Results of IGRT Treatment in Head Neck Squamous Cell Carcinoma – a Jaslok Hospital and Research Centre Experience**

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**Background:** Head and neck cancer (HNC) is an ideal site for high precision radiotherapy technique like IMRT for optimal clinical outcome with reduction in normal tissue toxicity. We report our preliminary results of consecutive head and neck Squamous cell carcinoma (HNSCC) patients treated with intensity modulated radiotherapy (IMRT) with Image guidance by MV cone beam CT scan (CBCT). Analysis was done for the period of February 2009 to October 2010 after the installation of Siemens onco expression machine in early 2009.

**Materials and Methodology:** Seventy patients of HNSCC were treated with 6 MV step and shoot IMRT simultaneous integrated boost technique with daily CBCT. The target volumes and organs at risk (OAR) were contoured appropriately as per consensus guidelines. The doses varied from 50 Gy to 70 Gy. Patient factor, tumour factor, treatment parameters and overall survival were analyzed.

**Results:** IMRT was used in 70 HNSCC patients, 53 (75.7%) males and 17 (24.3%) females. The median age was 57.5 years (range: 28–85 years). The common primary site was oral cavity 22 (31%), followed by larynx 18 (26%), hypopharynx 13 (18%), oropharynx 10 (15%) and the remaining others were para-nasal sinuses 7 (10%). The 76% of patients were in stage III and IV (16, 38) with remaining in stage I & II (2, 14).

Of 70 patients 46 patients were treated with definitive radiotherapy and the remaining 24 received adjuvant radiotherapy. The radiation dose varied from 50 Gy-70 Gy with a median of 70 Gy (70 Gy for definitive and 60 Gy for the adjuvant radiotherapy respectively. Cisplatin based induction chemotherapy (ICT) and concomitant chemotherapy (CRT) was administered in 17 and 26 patients respectively. Sixty seven (96%) patients completed the intended IMRT doses with 2 patients each required hospitalization and gap in radiation due to toxicity. The remaining 3 patients (4%) did not complete the planned treatment doses due to toxicity. Acute Grade 2&3, skin and mucosal toxicity was seen in 41 (60%), 5 (7%) and 45 (66%), 15 (22%) respectively.

After a median follow-up of 10 months, 46 (66%) had no disease, 12 (17%) patient had either persistent disease or locoregional recurrence, 3 (4%) developed distant metastases, 2 (3%) had second primary and 7 (10%) patients were lost to follow up. Grade 1&2 xerostomia was seen in 69% and 6% patients. The overall survival at 18 months is 67% in definitive group and 83% in adjuvant group.

**Conclusion:** Preliminary results of this cohort of patients show excellent control with acceptable toxicity, using IMRT with image guidance.

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POSTER

# **To Compare Effect of Two Different IMRT Planning Techniques on Parotid Doses in Patients With Nasopharyngeal Carcinoma**

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**Purpose:** To compare effect of two different imrt planning techniques on parotid doses in patients with nasopharyngeal carcinoma.

**Material and Methods:** Ten patients with nasopharyngeal carcinoma referred to University of Istanbul Cerrahpasa Medical School were planned with arc and static 7 field imrt techniques. Simultaneous integrated boost technique was used to give 70 Gy (2.12 per fraction) to primary tumour and involved nodes 60 Gy (1.81 p/fr) to entire nasopharynx and 54 Gy (1.63 p/fr) to elective lymph nodes. While achieving this, parotid mean dose was less than to 26 Gy and maximum doses to spinal cord and brain stem were limited to 45 and 54 Gy respectively. Mean parotid doses were compared for two planning techniques with paired t test. Target coverage and dose inhomogeneity were also evaluated by calculating conformity index (CI) and homogeneity index.

**Results:** Target coverage and dose homogeneity were identical and good for both planning techniques. CI:  $1.05 \pm 0.08$  ve  $1.05 \pm 0.08$  – HI:  $1.08 \pm 0.02$  ve  $1.07 \pm 0.01$  for arc and static field imrt respectively. Mean contralateral parotid doses  $25.73 \pm 4.27$  ve  $27.73 \pm 3.5$  ( $p = 0.008$ ), where as ipsilateral parotid doses were  $30.65 \pm 6.25$  ve  $32.55 \pm 5.93$  for arc and sttic field imrt plans. Mean MU for ten patients was considerably lower for arc treatment  $540.5 \pm 130.39$  versus  $1288.4 \pm 197.28$  ( $P < 0.001$ ).

**Conclusion:** Normal tissue especially parotid gland are better spared with Arc technique. MU is considerably shorter with Arc than IMRT technique for patients with nasopharyngeal carcinoma.

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POSTER

# **Inter-fractional Variation of Neck Lymph Node Target Volume Delineated According to RTOG Guideline**

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**Background:** To evaluate the reproducibility of RTOG guideline based neck lymph node delineation and quantify the relative positional changes in node negative head and neck (H&N) cancer patients and normal control group.

**Materials and Methods:** Three node negative H&N cancer patients and 5 control group were enrolled in this study. Control group consisted of the healthy volunteers and they did not have any benign or malignant disease in H&N region. Eligible patients had to have a pathologic diagnosis of H&N cancer without lymph node metastasis. For setup accuracy, H&N thermoplastic masks and laser alignment were used in every acquired CT images. Both group had three sequential CT images in every two weeks. RTOG guideline based delineation of all neck lymph node level was done by one physician. C2 vertebral body was used as reference point to match in every CT images. Each sequential CT images and delineated neck lymph node levels were fused with primary image, then maximal radial displacement and differences in volume at each node levels were quantified in every 1.5 cm interval from skull base to caudal margin of neck lymph node Level IV.

**Results:** In control group and H&N cancer patients, the mean radial displacements were 2.62 mm (1.82 to 3.51 mm) and 3.00 mm (2.07 to 4.22 mm). There was no statistical significance between the groups in terms of mean displacement ( $p = 0.155$ ). Both group had maximal displacement at 10.5 cm inferior from skull base (SB) and neck node level V (control group: 7.5 mm, patients group 11.3 mm). In addition, mean radial displacement was increased with distance from SB level ( $1.53 \pm 0.10$  mm at SB,  $2.22 \pm 0.14$  mm at 3 cm,  $2.56 \pm 0.21$  mm at 6 cm,  $4.10 \pm 0.41$  mm at 10.5 cm,  $p = 0.002$ ). For mean volume differences at each node levels, between retropharyngeal and level V lymph node volume changes showed statistical significance ( $p = 0.04$ ). Weight changes in H&N cancer patients does not affect mean displacement ( $p = 0.533$ ).

**Conclusion:** The results of this study suggest that more generous radial margin should be applied to the lower part of the neck lymph node level.

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POSTER

# **Evaluation of Using CT Gantry Tilt Scan on Head and Neck Patients With Dental Structure – Scans Show Less Metal Artifacts**

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**Background:** The materials of high density create metal artifacts in the computed tomography (CT) scans used for radiation treatment planning (RTP). The metal artifacts from dental structures cause problems in head and neck cancer patients. Metal artifacts impair visualization of tumours and normal tissue, which causes error in the dose calculation by changing the CT number.

If we use CT gantry tilt scan, we can obtain images with reduced artifacts and accurately delineate the volume of various organization. By obtaining the correct CT number, we can minimize the error of dose calculation. The purpose of this paper is to evaluate the usability of the CT gantry tilt scan.

**Materials and Methods:** CT gantry tilt scanning was performed to avoid metal artifacts from dental structures and transverse images reconstructed from oblique images by gantry tilt scanning using a technique of multi-planar reconstruction (MPR). The reconstructed transverse images were used for the RTP.

By using Rando phantom with and without metal artifact, we created reduce metal artifact by gantry tilt scan image, and studied how it is affected by the metal artifact. Through using the intensity volume histogram (IVH) upon both parotid glands, we compared the homogeneity of CT number and the mean dose through dose volume histogram (DVH).

CT gantry tilt scan was applied to ten head and neck patients with dental structures. Through the acquired reduced metal artifacts images using CT gantry tilt scan, we compared and the metal artifact image, CT number and mean dose.

**Results:** In the comparison result of IVH using the Rando phantom, we could see that the influence of metal artifacts were reduced in the gantry tilt scan image, and the homogeneity of the CT number improved. In the comparison of DVH, mean dose of the both parotids is as follows; without artifact (RT: 44.9%, LT: 48.6%), with artifact (RT: 48.5%, LT: 50.2%), and gantry tilt scan (RT: 44.6%, LT: 48.2%), the influence of metal artifacts was reduced in the gantry tilt image.

In comparison result of IVH of 10 patients, the homogeneity of the CT number was improved in the CT gantry tilt scan. In the result of DVH comparison, the mean dose of the both parotid glands showed the difference of 0.2–6%. Such difference in the result is from the error in calculation, as dose distribution was changed by the metal artifacts.