original GTV when contouring the GTV on the anatomy of the second CT scan.SIB created two plans. One is 1st CT / 1st Plan and the other is SIB sum (25 fractions (deformed CT) and 5 fractions (2nd CT)) . A deformed CT (dCT) with structures was created by deforming the 1st CT to the 2nd CT. We summed up dose used in 1st Plan and 2nd Plan using a commercially software (MIM Maestro 6.3). The two types of plans were compared with respect to DVHs for other dosimetric parameters of the PTVboost, PTVel, brainstem, spinal cord and parotid gland.

Results: The mean dose for the brainstem, the spinal cord and the parotid was lower for SEQ. The D95of PTVboost and PTVel were significantly lower for SIB sum than for SIB (p<0.003, p<0.02).The D95 of PTVboost and PTVel were significantly lower for SIB sum than for SEQ-SIB (p<0.03, p<0.03). The difference between the CI of PTVboost of SIB sum and that of SEQ-SIB was not significant (p=0.03). The CI of PTVel was significantly lower for SIB sum than for SEQ-SIB (p<0.001).

Table 1. Dosimetric Parameters (means of 10 cases)

	brainstem max (Gy)	spinalcord max (Gy)	mean parotid dose ipsi (Gy)	mean parotid dose contra (Gy)	PTVboost D95 (Gy)	PTVel D95 (Gy)	PTVboost CI	PTVel CI
SIB	36.9	36.2	32.5	23.2	66	54.6	1.11	1.1
SIB sum	37.5	36.4	33.6	24.2	64.9	53.7	1.04	1.07
SEQ-SIB	34	34.2	32.4	22.4	65.7	50.8	1.08	1.19

Conclusion: SEQ-SIB is an approach for resolving the fraction size problem posed by SIB. The dosimetric parameters for OARs showed some variation between SIB and SEQ-SIB, especially for the parotid glands. SEQ-SIB is good in the point of coverage of PTV, because of replanning. The mean dose for ipsilateral and contralateral parotid was lower for SEQ-SIB, because of the lower elective dose. The availability of SEQ-SIB using replanning was suggested.

OC-0270

Development of a model to produce reference parotid dose from anatomical parameters in IMRT of NPC

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Purpose or Objective: Dose to parotid glands in IMRT depended on the setting of constraints during inverse planning and could be varied by planners' experience. This study aimed to tackle the problem of IMRT plan variability by the development of a multiple regression model to associate parotid dose and anatomical factors. By measuring a few anatomical factors before performing inverse planning, reference parotid dose would be suggested by the model to guide planners to undergo the inverse planning optimization process.

Material and Methods: 25 NPC subjects who previously received radical IMRT (70Gy/60Gy/54Gy in 33-35 fractions) were randomly selected. Optimized IMRT plans produced by a single planner were used for data collection. Multiple regression was performed using parotid gland Dmean, and D50% as the dependent variable, and various anatomical factors as the independent variable. The anatomical factors included (1) gland size, (2) %volume with 1cm gap from PTV60, (3) volume with 1cm gap from PTV60, (4) %volume overlap with PTV60, (5) volume overlap with PTV60, (6) %volume overlap with PTV70, (7) volume overlap with PTV70 (8) max. distance from PTV60 and (9) max. distance from PTV70. Gland size was measured using the "measure volume" function. Volume with 1cm gap was measured by using "crop structure" function and cropping the parotid with 1cm gap from the PTV60. Volume overlap with PTV was measured by using the "Boolean operator" which created the overlapped volume. Max. distance was measured by the magnitude of expanding the PTV using the "margin for structure" function until the PTV covered the whole parotid gland. Multiple regression was performed using the stepwise method which eliminated independently variables with least effect.

Results: Anatomical factors statistical significantly predicted parotid gland Dmean and D50%. For Dmean, gland size, %volume overlap with PTV60 and %volume with 1cm gap from PTV60 were included in the model. ($F(3, 46) = 44.244$, $p<0.0005$, $R2 = 0.743$). For D50%, volume overlap with PTV60, %volume with 1cm gap from PTV60 and gland size were included in the model. ($F(3, 46) = 37.709$, $p<0.0005$, $R2 = 0.711$).

Conclusion: These models explained over 70% of the dependent variables. Cross validation will be provided to support the accuracy of the model. The predicted parotid dose could be used for a guide to set dose constraints during inverse planning and as the benchmark dose during plan evaluation. Eventually the suggested model could improve the parotid sparing in the IMRT of NPC cases.

OC-0271

Positional accuracy valuation of a three dimensional printed device for head and neck immobilisation

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Purpose or Objective: Our aim was to investigate the feasibility of a three-dimensional (3D)-printed head-and-neck (HN) immobilization device by comparing its positional accuracy with that of the conventional thermoplastic mask.

Material and Methods: We prepared a 3D-printed immobilization device (3DID) consisting of a mask and headrest developed from the computed tomography (CT) data obtained by imaging an HN phantom. The CT data was reconstructed to generate the Digital Imaging and Communication in Medicine (DICOM) dataset. Then, the HN-phantom surface was determined by the Otsu segmentation method. After converting the DICOM dataset of the phantom surface to a Surface Tessellation Language (STL) file format, 3D modeling was performed. Next, the STL file was 3D printed using acrylonitrile–butadiene–styrene resin. For comparison of positional accuracy, the conventional immobilization device (CID) composed of a thermoplastic mask and headrest was prepared using the same HN phantom. Subsequently, the simulation CT images were acquired after fixing the HN phantom with 3DID. After positioning the HN phantom by matching surface marks, radiographs were acquired using the ExacTrac X-ray image system. Then, we quantified the positional deviations, including three translations and three rotations, between the coordinate origin in the localization images prepared from kV X-rays and the expected position on the digitally reconstructed radiograph from the simulation CT images. This process was repeated fifteen times to collect data on positional deviations. Afterwards, the same procedure was performed in the same HN phantom fixed with CID for comparison.

Results: The translational displacement (mean [standard deviation, SD]) in the vertical, lengthwise, and lateral directions was−0.28 [0.09], −0.02 [0.08], and 0.31 [0.27] [maximum, 0.81 mm (lateral direction)] for 3DID and 0.29 [0.06], 0.03 [0.14], and 0.84 [0.27] [maximum, 1.23 mm (lateral direction)] for CID, respectively. The rotational shift in the yaw, roll, and pitch directions was 0.62 [0.13], 0.08 [0.74], and −0.31 [0.08] [maximum, −0.41° (pitch direction)] for 3DID and−0.15 [0.17], 0.17 [0.67], and −0.09 [0.06] [maximum, −1.23° (roll direction)] for CID, respectively. The

means of the two devices were almost similar in each direction except the vertical, lateral, and pitch directions (t-test, $p < 0.0001$), whereas the maximal deviations in the three directions were slight. The SDs were not statistically different in each direction except the lengthwise and roll directions (F-test, $p < 0.05$), although the SDs were small in the corresponding two directions for CID.

Conclusion: This study suggested that 3DID could show positional accuracy almost similar to that of CID. However, further investigation is needed for use in clinical practice.

OC-0272

A comparison of CTCAE version 3 and 4 in assessing oral mucositis in oral/oropharyngeal carcinoma

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Purpose or Objective: CTCAE version 3 is an observation based grading system for oral mucositis whereas version 4 is based on function and intervention. Although version 4 has been widely adopted in clinical trials there is limited data on its correlation with version 3 from which considerable radiobiological data has been derived. The purpose of this study was to assess the frequency of discrepancy between these two grading systems.

Material and Methods: Oral mucosal reactions of patients undergoing chemoradiation or radiation alone for oral or oropharyngeal cancer were graded by three radiation oncologists in weekly on treatment and post treatment clinics. CTCAE version 3 and 4 mucositis grading and patient factors were recorded prospectively. Differences in the rate of discrepancy were compared by time since the commencement of radiotherapy, synchronous agent and patient age.

Results: 485 measurements were recorded for 64 patients. Grading from version 3 and version 4 were equal in 270 (56 %) measurements. In the 215 (44%) measurements where version 3 and version 4 were not equal, discrepancies were seen in: Week 0-4 = 79/179 (44%); Week 5-8 = 60/163 (37%); > week 8 = 76/143 (53%) (p=0.02); patients receiving platinum agents = 113/316 (36%) or cetuximab= 48/70 (69%) (p<0.01); patients > 70 years = 26/57 (46%) or < 50 years = 21/68 (31%) (p=0.09).

Conclusion: Statistically significant discrepancies were seen when patients receiving platinum agents were compared with those receiving cetuximab and in those measurements performed following treatment completion. These initial results suggest that functional/interventional based grading systems should be used with care in dose escalation studies where the healing of acute mucositis may be related to subsequent late damage.

OC-0273

Including specific symptoms in clinical scoring: predictive modelling and nursing of swallowing pain

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Purpose or Objective: Acute esophagitis (AE) is a common side-effect of radiotherapy (RT) for lung cancer. Previous predictive modelling studies focussed on clinical criteria (such as CTC) for significant AE (such as G2 or higher). Our clinic uses an integrative patient care approach where Nurse-RTTs routinely monitor symptoms and provide nursing interventions to manage side-effects. Therefore, Nurse-RTTs include with clinical scoring a note of actual symptoms mentioned by the patient during consultations, such as swallowing pain (SP). A retrospective audit of 131 patients was used to examine correlative patterns for SP, and hence to develop predictive models for SP before the start of RT. We propose that a predictive model will facilitate nurse/RTT-led efforts to reduce the impact of SP on patient comfort, overall QoL and clinical workflow.

Material and Methods: An electronic journal audit was performed for patients commencing curative RT for lung cancer between January 2013 and March 2015. All NSCLC and SCLC patients were included, as well as various dose/fractionation, chemotherapy and medication schedules. Exported treatment plan DVHs were merged with nursing data. The highest score following weekly assessments of AE during radiotherapy was recorded, as was the appearance of SP and the time point at which it was mentioned. Predictive models of SP were developed using multivariable regression and machine learning algorithms.

Results: The most typical patient was treated for NSCLC at 60-66Gy normo-fractionated with concurrent chemotherapy. Acute esophagitis (CTC grade 1 or higher) was observed in 110/131 (84%) and patient-reported SP in 99/131 (76%). Pain medication prior to RT was marginally protective against SP but was not statistically significant in single-parameter analysis (OR 0.58, 95%CI 0.24–1.41, p=0.21). A strongly significant dose-volume response exists between SP and radiobiologically-adjusted dose to the hottest 1cc of the esophagus. Predictive models of SP with repeated cross-validation accuracy of 78-84% were developed (sensitivity 88-89%, specificity 48-75%). Trained machine learning models correctly predicted SP 76-84% of the time in an unseen validation cohort of 25 patients (sensitivity 94-100%, specificity 25-62%).

Conclusion: An integrative nursing care approach in the RT clinical workflow has been used to monitor symptoms and intervene for treatment-related pain. The risk of one particular patient-centred symptom, SP, can be sensitively predicted with nursing and treatment planning variables. A future nurse-led interventional study is planned, using predictive modelling for swallow pain, to examine the possible effects of pre-treatment pain-medication or corticosteroids on reducing dependence on additional pain medication.

OC-0274

Analysis of set-up errors in head and neck cancer treated with IMRT technique assessed by CBCT

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Purpose or Objective: The aim of this study was to investigate systemic set-up errors in head and neck (H&N) cancer treated with intensity modulated radiation therapy (IMRT) by kilovoltage (kV) cone-beam computed tomography (CBCT) evaluation.

Material and Methods: Between September 2014 and August 2015, 360 CBCT in 60 patients (pts) affected by histological confirmed H&N cancer treated with IMRT technique were analyzed. The majority of patients treated 45 (75 %) were male and only 15 (25%) were female; median age was 68 years (range 44-88 years). The type of head and neck cancer treated were, oropharynx , hypopharynx, nasopharynx, larynx , tonsil, oral cavity and parotid cancer. All patients underwent planning Computerized Tomography (CT) simulation on supine position on a GE LightSpeed RT 16 CT Simulator for 2.5 mm slice thicknesses. As immobilization system we utilized a head-shoulder thermoplastic mask (Easy Frame (Candor TM)). The CT data sets were transferred to the Focal and Varian Eclipse treatment planning system through DICOM network. The target delineation was contoured by one Radiation Oncologist and according to (ICRU62) the PTVs volumes were generated by adding a 3-mm margin in all directions to the respective CTVs. The prescribed dose was 66 Gy in 30 fractions delivered to GTVs, 54-63 Gy in 30 fractions to CTVs. The IMRT plans were created on the Varian Eclipse treatment planning system