(b)

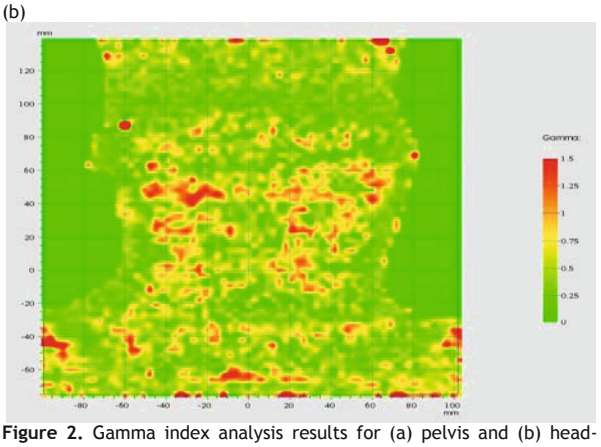
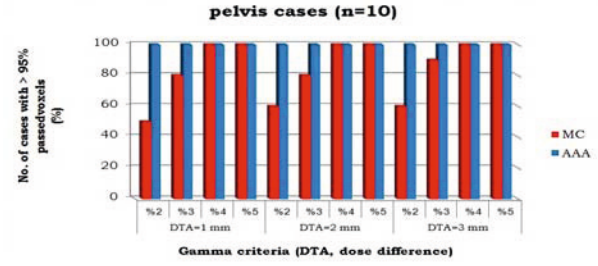
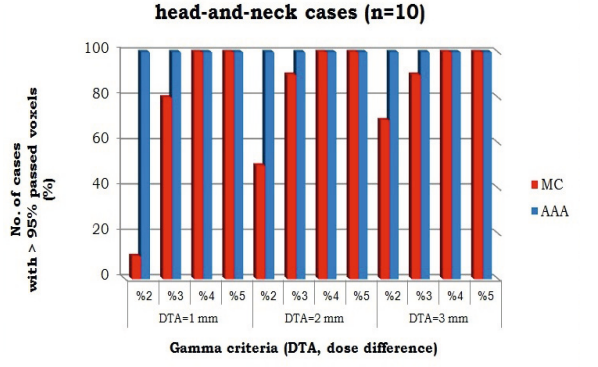


Figure 2. Gamma index analysis results for (a) pelvis and (b) head-and-neck cases

(a)



(b)



Conclusions: The presence of intravenous contrast agent does not significantly affect the dose calculation in CT-based 3D-CRT planning of pelvis and head-and-neck.

EP-1200

Evaluation of inter-operator variability in Tomotherapy planning for head and neck cases

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Purpose/Objective: The dosimetric aspects of radiotherapy treatment plan quality are evaluated with isodoses and dose volume histogram (DVH) values. Usually, the reporting consists in some particular values for target volumes (TV) and organs at risk (OAR). However, due to the complexity of the IMRT dose distributions, given a patient and treatment goals, several operators produce their own optimal plan depending on their experience and their tradeoffs between TV and OAR DVH endpoints. The aim of this study was (1) to evaluate the operator variability in our institution and (2) to improve the relevancy of the DVH endpoints. The study focused on Tomotherapy planning for head and neck cases.
Materials and Methods: Ten patients with bilateral lymphatic node irradiation were selected from our database. Prescribed doses for planning target volumes PTV(tumor) and lymphatic nodes PTV(nodes) were 70Gy and 56Gy in 35 fractions respectively. For each patient, seven physicists of our department produced their own plan based on the same set of contours and the same treatment goals. For plan validation, DVH endpoints were related to the following organs: GTV (D98%), PTV(tumor) (D98%, D2%), PTV(nodes) D(98%), spinal cord (D2%), parotid glands (Dmean, V45Gy, V30Gy), larynx (V50Gy), oral cavity(V50Gy). The inter-operator variability was studied by comparing the DVH values. Three groups of values were evaluated (i) PTVs, (ii) principal OARs for which the respect of endpoints is mandatory and (iii) secondary OARs for which the respect of endpoints improves the patient quality of life.
Results: Physicists had an experience with Tomotherapy planning software ranging from 1 to 5 years. 70 plans were generated and were evaluated by a single physician. For all patients, all plans were clinically acceptable despite some discrepancies. For group (i), the main difference concerned D98% for PTV(tumor) and PTV(nodes) that were lower for two planners. For group (ii), the D2% to the spinal cord never exceeded 38Gy. Large differences were observed but they were considered minor by the physician. For group (iii), experience and tradeoffs of the planners yielded different dosimetric results, especially in the larynx and in the ipsilateral parotid gland. This organ sparing can lead to an slight undercoverage of the PTV(tumor). Whatever the group, differences were particularly observed for the first patients studied, but were reduced during the study.
Conclusions: This work showed inter-operator variability in Tomotherapy planning for head and neck cases. However, all plans were acceptable by the physician. This comparison allowed to better define the priority of the endpoints to evaluate the quality of a plan and to narrow the variability over the study.

EP-1201

A planning comparison study of VMAT and IMRT for prostate cancer.

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Purpose/Objective: Volumetric-modulated arc therapy (VMAT) is a relatively new treatment modality, in which gantry rotation and speed, dose-rate and multileaf collimator (MLC) leaves motion vary simultaneously. The aim of the study was to compare conventional intensity modulated radiation therapy (IMRT) with VMAT plans for prostate cancers.
Materials and Methods: Ten randomly selected patients with prostate cancer were included for the present study. Contours for each pts were drawn using our clinical protocol. For each patient, three plans were generated for treatment modalities using a 80 leaves MLC with the leaves of 10 mm (MLCi2 Elekta Synergy). All IMRT and VMAT plans were calculated for 6MV photons. IMRT plan were generated using Oncentra Master Plan (v 3.3), whereas VMAT plans were performed with Monaco (v 3.2). The dose prescription was 76 Gy in 38 fractions to the target volume with respect the dose volume criteria for the organ at risk (OAR) complied with QUANTEC recommendation. Dose-volume parameters of the plans were evaluated according to Rapport ICRU N° 81.
Results: All techniques: IMRT as well as VMAT result in treatment plans which comply with our current applied clinical protocol. From the DVH data, target coverage achieved similar results for IMRT and VMAT (table1): V95% - 99,3±0,7% and 99,2±0,7% for IMRT and VMAT, respectively. The average dose were 102,5±3,2% for IMRT and 102,4±3,3% for VMAT. For OAR all planning objectives were largely met. VMAT plans were superior for rectum in all dose-volume constraints ($p<0.05$). Similar results were achieved in dose-volume constraints for bladder. VMAT leads to the average reduction of about 6 Gy for the mean dose for rectum and of about 11 Gy for mean dose for bladder comparing to IMRT. There were no statistical differences between IMRT and VMAT in mean and dose-volume parameters for femurs. The average MU were 452±.81,7, and 510.9±.50,6for IMRT and VMAT, respectively.
Conclusions: VMAT achieved similar target coverage to IMRT plans for prostate cancer pts. It provided a better OAR sparing due to reduction of high-dose-receiving area of healthy tissue. Further studies are indicated to evaluated the VMAT impact on quality of life of prostate cancer pts during and after the therapy.

EP-1202

Extended fields irradiation in the upper abdomen with Tomotherapy: planning optimization and dosimetric analysis.

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Purpose/Objective: The extended volume irradiation, in pelvis or para-aortic volumes, presents some technique and dosimetrical difficulties when performed with 3D-CRT due to the junction and the presence of critical upper abdominal structures. Compared with 3D-CRT, Helical Tomotherapy (HT) delivers an highly conformal dose distribution with the possibility to treat extended fields (EF) without junctions. The aim of this work is to evaluate the EF technical feasibility and safety in Tomotherapy, to optimize the treatment planning parameters minimizing dose constraints. Dosimetrical data and early toxicities were evaluated.
Materials and Methods: 31 patients, suitable to EF-IMRT for local disease and/or nodal disease on pelvic or lumbar-aortic area, were treated and analyzed. The prescription dose was 50.4/54 Gy (1.7-1.8 Gy/die) for prophylactic lymph nodes (N-) and 60-66 Gy (2-2.2 Gy/die) for clinically evident gross disease in the pelvic or para-aortic chain (N+). The better parameters, in terms of modulation factor (MF), pitch and field width (FW) have been considered to optimize dose distribution and treatment time duration. DVH values were analysed in terms of D_{95}, average dose for the PTVs and mean and maximum dose for OARs. The length of the treatment field, the N+ and N- volumes and the time of irradiation were also evaluated. The V_5, V_{10}, V_{15} of body was also calculated in order to evaluate the impact of low doses. To correlate the dose values to the safety of treatment, hematological, hepatic, renal and pancreatic functions were evaluated before, during and after treatment. Acute upper gastrointestinal (u-GI) and hematological toxicity were evaluated by RTOG scale. Hepatic, renal and pancreatic functions were evaluated by changes in serological parameters.
Results: The mean FW, pitch, effective MF and gantry period were 2.5 cm, 0.287, 1.8 and 13.5 s respectively. The average length of treatment was 31.7 cm. Mean irradiation was 10.8 minutes. Average values of $D_{95\%}$ for PTVs was 96.5%, ranging between 94 and 98%. $D_{95\%}$ of PTV N+ ranged between 55.1 and 67 Gy. Doses to OARs are reported in the table. The treatment was well tolerated, without schedule interruption. Ten patients (pts) experienced G1 GI toxicity and 3 pts G2 toxicity. Hematological toxicity was G1 in 6 pts, G2 in 4 pts (2 received concomitant chemotherapy), G3 in 3 pts (all received concomitant chemotherapy). In 3 pts we observed a modest increase of pancreatic function and in 4 of liver function. There were no changes in renal function parameters.

Organs at risk	D_{mean} ± SD (Gy)	D_{max} ± SD (Gy)
Pancreas	30.4 ± 7.2	48.8 ± 10.7
Spleen	10.3 ± 6.5	25.8 ± 15.7
Stomach	16.1 ± 5.6	46 ± 10
Liver	9.3 ± 3.7	52.6 ± 10.2
Right kidney	12.1 ± 1.8	26.3 ± 7.6
Left kidney	12.8 ± 2.7	37.2 ± 13.7

Conclusions: With our treatment design and dose schedule, we found that EF- IMRT by Tomotherapy could be safely with a good dose distribution and effectively delivered with minimal toxicity in the upper abdomen area.

EP-1203
A protocol for prostate IMRT plan with step and shoot tecnique and inverse planning process
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Purpose/Objective: Prostate (P) is one of the treatment sites that is well suited for IMRT. However, radiation induced complications such as urinary incontinence and rectal bleeding are some of the side effects. The purpose of this study is to illustrate a protocol for P and P with seminal vesicles (P&SV) IMRT plan with step and shoot tecnique and Inverse Planning process (Pinnacle3 TPS) to conform the higher doses to target and to spare the more sensitive structures in the close proximity of the target.

Materials and Methods: The PTV1 is the P CTV with the addition of 1cm in all directions except 0.5 cm posteriorly.The PTV2 is the SV with the addition of the same margin and PTV1 removed from it. Rectum, femoral head, Bladder, anal canal are typical OARs. To force the dose distribution to better conform to the target, a shell ROI (1 cm thick) is created around targets. To reduce high dose regions outside the target volumes the RVR ROI iscreated, which consists of external patient contour, 0.5 cm contracted, avoiding targets, shell and OARs. The isocenter is placed in the center of targets. Five 15 MV beams are used (gantry 180°, 255°, 325°, 35°, 105° and collimator 0°,10°, 10°, 10°, 10°). The couch rotation is set at 0°. Using an odd number of beams makes it easier to avoid creating opposing beams. : The dose prescription for PTV1 is 74.25 Gy in 33 fr. (2.25 Gy single fr.) and for PTV2 is 62.04 Gy in 33 fr. (1.88 Gy). A SIB IMRT technique is used in P&SV plan. As a starting point the dose volume objectives, are used as in table.The objectives and objectives weights (relative importance) can be modified to obtain more satisfactory dose distributions. Each beam is optimized using DMPO (Direct Machine Parameter Optimization). The max number of iterations is 40, the maximum number of segments is 25 (P) or 35 (P&SV), the minimum segment area is 10 cm^2(P) or 8cm^2(P&SV). The final calculation of dose is performed with the Adaptive Convolve dose engine and 0.2x0.2x0.2 cm^3grid.

Organ	Type	%Volume	Dose (Gy)	Note
PTV1	Min Dose		66.85 (90% D_{PTV1})	
	Max Dose		78.00 (105% D_{PTV1})	
	Min DVH	95	70.50-72.00 (95%-97% D_{PTV1})	
	Min DVH	50	74.25 (100% D_{PTV1})	
	Uniform Dose		74.25 (100% D_{PTV1})	
PTV2	Min Dose		55.80 (90% D_{PTV2})	
	Max Dose		70.50 (95% D_{PTV2})	
	Min DVH	95	58.90-60.10 (95%-97% D_{PTV2})	
	Min DVH	50	62.00 (100% D_{PTV2})	
Bladder	Max Dose		72.0	
	Max DVH	50	62.0 Gy	
Femoral H.	Max Dose		47.5 Gy	
Penile Bulb	Max EUD		50.0 Gy	a = 1.0
Rectum and Anal Canal	Max Dose		72.0 Gy	
	Max DVH	25	66.5 Gy	
	Max DVH	40	57.0 Gy	
	Max DVH	60	38.0 Gy	
Shell	Max Dose		70.50 (95% D_{PTV1})	Prostate Target
	Max Dose		58.90 (95% D_{PTV2})	P and SV Target
RVR	Max Dose		66.85 (90% D_{PTV1})	Prostate Target
	Max Dose		55,80 (90% D_{PTV2})	P and SV Target

Results: 10 (5 P, 5 P&SV) IMRT treatment plans were analyzed. The total mean $D_{2\%}$,$D_{50\%}$ and $D_{98\%}$ of PTV1 and PTV2 are (76.8 ± 0.9) Gy, (76.8 ± 0.9) Gy, (68.9 ± 2.0) Gy and (71.2 ± 0.6) Gy, (65.6 ± 1.4) Gy, (58.4 ± 1.9) Gy respectively. $D_{50\%}$ of PTV2 is slightly larger because PTV2 is adjacent to PTV1. The total mean dose and HI of PTV1 and PTV2 are (74.1 ± 0.1) Gy, 0.11 ± 0.03 and (64.3 ±1.7) Gy, 0.20 ±0.02 respectively. PTV2 HI are higher due to the proximity of rectum and PTV1. Small regions of high or low absorbed dose inside the target may develop when avoidance of neighboring sensitive structures is considered more important than high PTV dose homogeneity. Not only the required limits for OARs are respected but organ dose and expected toxicity are reduced.
Conclusions: From the results obtained it can be said that the protocol of prostate IMRT plan with 'step and shoot' tecnique and Inverse Planning process is to be considered valid for increasing target dose and reducing toxicity in OARs.

EP-1204
The impact of parameter settings for accurate dose prescription in volumetric modulated radiation therapy.
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Purpose/Objective: In volumetric modulated radiation therapy (VMAT) for Head and Neck (H&N) cancer, the dose distribution is complicated because of the large radiation field. Therefore the number of arc, collimator angle and the maximum leaf-speed are significant parameters for irradiating the radiation accurately. The purpose of our study is to ensure the influence of these parameters for reproducing dose distribution between treatment planning system (TPS) and actual dose in patient.
Materials and Methods: Nineteen VMAT plans for third grade H&N cancers were created by Varian Eclipse TPS version.8.9. The prescription dose with 70 Gy per 35 fractions was adopted for all plans. The dose tolerance was based on RTOG0615. For comparison, the collimator angle and leaf-speed were changed for all plans by use