

value of 0.502, 0.518, 0.826 and 0.203. In the other hand, the γ values of lens and optic chiasma were smaller than MatriXX's with p value of 0.014 and 0.022. In the comparison, the γ value of PTV were in good co-ordinate with MatriXX's, with p value of 0.838.

Conclusion: The comparison data showed that, because of small volume, lens and optic chiasma didn't represent uniform. However, the COMPASS as 3D QA tool could achieve good measurement totally as traditional 2D planar technique dose. As the lightspot, multi-organ dosimetric analysis could be very helpful for physicists and clinical oncologists.

2025

POSTER

Electron Energy Monitoring Using a 2D Ionisation Chamber Array and a Metallic Wedge Shaped Absorber

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Background: The purpose of this study was to implement a 2D ionisation chamber array and metallic wedge shaped absorber as a quality assurance device for linear accelerator electron beams.

Materials and Methods: Water tank measurements of the electron depth dose were performed and beam adjustments were made to match the depth dose data in the planning system. Following this, electron beam profiles for all energies were obtained with a 2D ionization chamber array (MatriXX, IBA) and a wedge shaped absorber placed on the surface of the array. The maximum ionisation on the profiles was normalized to 100% and the chamber position values corresponding to 90% and 50% ionisation were calculated using the OmniPro ImRT (IBA) software. Difference in the chamber position values (K-value) was used as an indicator of electron energy constancy. Monthly electron beam profiles were obtained for three consecutive months to obtain average K-values for each of the six electron beams with similar setting as described earlier. These K-values were compared with the K-values obtained from water tank measurements. The resulting average K-values for all energies were also plotted against the depth of 50% dose (R_{50}) obtained from water tank measurements for all the energies to obtain the energy variation tolerance limits for each electron beam.

Results: Table 1 shows the average of three K-values obtained from the 90% and 50% ionisation values measured with 2D array and metallic wedge. The figures in parenthesis are standard deviations of each measurement. The K-values obtained from 2D array and metallic wedge shaped absorber and those measured with water tank and ionisation chamber show similar trend of variation with energy. The reproducibility of the K-values was approximately 2% for all beams. Since the metallic wedge has higher atomic number than water, the magnitude of variation of K-values from lowest to highest energy is not of similar proportions but still sensitive enough for the purpose of monthly quality assurance of electron beam energies.

Table 1. Measured K-values and comparison with Water Tank measurements

Energy	R_{50} (mm)	K-value			
		As obtained		Normalised to 6 MeV beam	
		Array & wedge	Ionisation chamber & water tank	Array & wedge	Ionisation chamber & water tank
6 MeV	22.6	1.54 (± 0.031)	5.4	1.00	1.00
8 MeV	30.5	1.94 (± 0.058)	6.9	1.26	1.28
10 MeV	39.2	2.12 (± 0.042)	8.7	1.38	1.61
12 MeV	46.0	2.29 (± 0.057)	9.8	1.49	1.81
15 MeV	58.9	2.99 (± 0.045)	13.9	1.94	2.57
18 MeV	70.9	3.49 (± 0.070)	19.1	2.27	3.54

Conclusion: The device described above is simple and gives excellent agreement with water phantom measurements and can be used to perform monthly quality assurance of linear accelerator electron beam energies.

2026

POSTER

A Correlation Study on Position and Volume Variation of Primary Lung Cancer During Respiration by 4D-CT

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Objective: To investigate the correlation of position movement of primary tumour with interested organs and skin markers, and to investigate the correlation of volume variation of primary tumours and lungs during different respiration phases for patients with lung cancer at free breath condition scanned by 4D-CT simulation.

Materials and Methods: 16 patients with lung cancer were scanned at free breath condition by simulation 4D-CT which connected to a respiration-monitoring system (RPM). A coordinate system was created based on

image of T5 phase, GTVs and normal tissue structures of 10 phases were contoured. The three dimensional position variation of them were measured and their correlation were analyzed, and the same for the volume variation of GTVs and lungs of 10 respiratory phases.

Results: Movement range of lung cancer in different lobe differed distinctly: 0.8–5.0 mm in upper lobe, 5.7–5.9 mm in middle lobe and 10.2–13.7 mm in lower lobe. Movement range of lung cancer in three dimensional direction was different: Z-axis 4.31 ± 4.34 mm; Y-axis 2.19 ± 1.04 mm; X-axis 1.73 ± 1.5 mm. There was no statistical significant correlation for movement vector of GTV and interested structures, nor for volume variation of tumour and lung.

Conclusions: Based on 4D-CT, statistically significant differences of GTVs centroid movement were observed at different pulmonary lobes and in three dimensional directions. So individual 4D-CT measurement is necessary for definition of ITV margin for lung cancer.

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POSTER

Comparison of the Patient-specific Internal Gross Tumour Volume for Primary Esophageal Cancer Based Separately on Three-dimensional and Four-dimensional CT Simulation Images

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Background: Using four-dimensional (4D) CT scans for individual patients allows for the design of patient specific margins by drawing on each 4D-CT phase. We compare the position, volume and matching index (MI) of patient-specific internal gross tumour volume (IGTV) delineated by 4 different approaches based on 3D and 4D CT image data sets for primary esophageal cancers.

Materials and Methods: Thirteen patients with primary esophageal cancer underwent the 3D-CT simulation scans followed by respiration-synchronized 4D-CT simulation scans during free breathing, and the patients were divided into group A (whose cancer located in the proximal thoracic esophagus) and group B (whose cancer located in the mid- and distal thoracic esophagus). In 3D-CT and 4D-CT data sets, the IGTV were delineated using four approaches: (1) The gross tumour volume (GTV) contours from 10 respiratory phases were combined into IGTV₁₀; (2) IGTV₂ was acquired by combining the GTV contours from 0% and 50% phases; (3) IGTV_{MIP} was delineated the GTV contour using the maximum intensity projection (MIP); (4) IGTV_{3D} consisting of the 3D-CT-based GTV enlarged for each spatial direction by the 95% upper bound of confidence interval amount of motion measured in the 4D-CT. Compare the volume, position and MI between IGTV₁₀ and IGTV₂, IGTV_{MIP}, IGTV_{3D}.

Results: The maximum displacement of proximal thoracic esophageal cancer in the X, Y and Z directions were 0.11 ± 0.05 cm, 0.09 ± 0.05 cm, 0.18 ± 0.14 cm, with no statistically significant difference; mid- and distal thoracic esophageal cancer displacement in X, Y and Z directions were 0.15 ± 0.09 cm, 0.12 ± 0.09 cm, 0.47 ± 0.40 cm, target movement in Z direction was bigger than in the X and Y directions. The target displacement between IGTV₁₀ and IGTV₂, IGTV_{3D} were all less than 0.03 cm on three dimensions in group A, with no statistically significant difference. The median of the target motion in group B was less than 0.07 cm. There was no significant difference between IGTV₁₀ and IGTV_{3D}, but the target center coordinates demonstrated significant spatial difference in Y direction between IGTV₁₀ and IGTV₂ for group B ($P = 0.021$). IGTV₁₀ was bigger than IGTV₂, and IGTV₁₀ was smaller than IGTV_{3D}. In group A MI between IGTV₁₀ and IGTV₂, IGTV_{3D} were 0.88 ± 0.06 , 0.54 ± 0.12 , respectively. MI in group B were 0.86 ± 0.05 , 0.59 ± 0.10 . The volume of IGTV_{MIP} was smaller than IGTV₁₀ ($t = -2.838$, $P = 0.025$), but the position of IGTV₁₀ and IGTV_{MIP} on X, Y and Z directions were with no statistically significant difference ($P = 0.809$, 0.429 , 0.263), MI between IGTV₁₀ and IGTV_{MIP} was 0.78 ± 0.06 .

Conclusion: For thoracic esophageal cancers, IGTV₂ and IGTV_{3D} can not replace IGTV₁₀, and IGTV_{MIP} can not contain all the patient-specific information about primary tumour position, shape, and size at different phases of the respiratory cycle.

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POSTER

A Study on Correlation Between Target Displacement and Volume Variation of Primary Carcinoma in the Middle and Distal Oesophagus During Normal Respiration Based on Four-dimensional CT

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Background: To investigate the correlation between the motions of gross tumour volume (GTV) and the interested organs and skin markers, and the correlation between the volume of GTV and the volume of heat and