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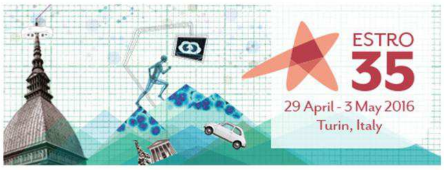
Immobilization and dosimetric performance of a MRI compatible board and mask system for the setup of Head&Neck patients



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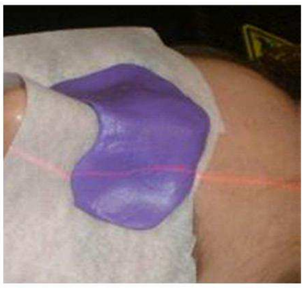
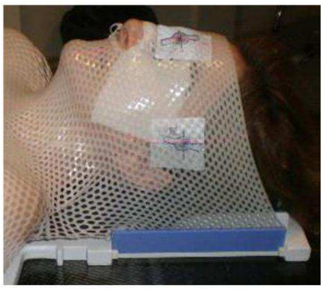
Introduction:
Use of CT/RMI image registration for Head&Neck cancers is challenging because of the difficult to maintain the same position in simulation CT and in MRI system. A number of immobilization devices used in radiotherapy are not appropiate for use in MRI because of compatibility problems with the materials or with the acquisition coils. A novel head and neck board, fully compatible with Head and neck MRI coils (ExaFrame, AnatGe®), has been presented and in this work we analyse setup accuracy of both conventional and MRI compatible board

Material y methods:
Attenuation measurements were done using a diode array (MapCheck2, SunNuclear) inside water equivalent phantom and 6MV photons (TPR20,10=0.685, Elekta Synergy) for orthogonal beams. Attenuation is evaluated in the area of mask fixation and in body area of frame.
Five consecutive patients with head and neck tumors were assigned to simulation with MRI compatible frame using head and shoulder mask with four fixation points. Immobilization and reproducibility is improved using a customized silicone mold (ExaSkin, AnatGe®) between patient's nose bridge and mask. Reproducibility Every treatment day CBCT images were acquired for treatment isocenter, and shifts in patient position were automatically measured using simulation CT as reference (xvi, Elekta). Displacements in antero-posterior (Vert), cranio-caudal (Long) and medio-lateral (Lat) directions, and rotations about major axis were calculated and compared with conventional carbon fiber immobilization. A total of 150 CBCT images were acquired for CompMRI frame. A group of 30 patients with conventional board was used as control (900 CBCT images). Distribution of displacements, rotation and 3D displacements were compared between both groups.

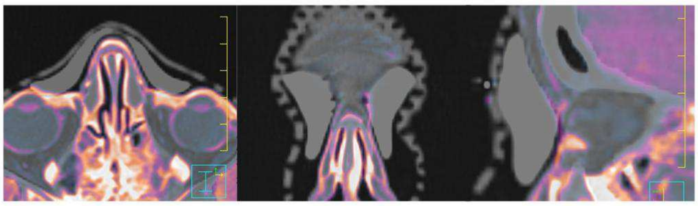

a. Base frame

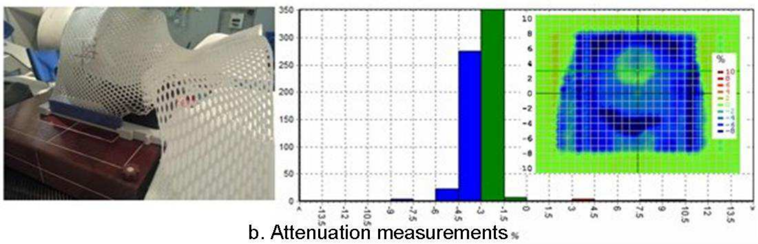

b. Customized ExaSkin mold


c. 4P thermoplastic mask

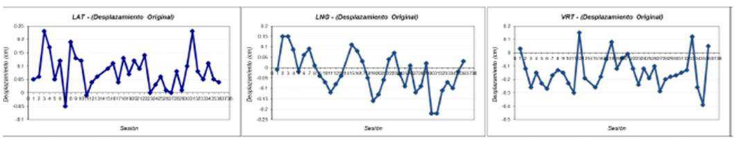

d. Frame inside MRI head coils

Results:
Attenuation measurement is shown in the image, and is lower than 4% for orthogonal incidence. No artifacts on MRI image were observed. Reproducibility between MRI and CT simulation was better than 1 mm in all cases studied, based in direct versus automatic registration.
The mean and standard deviation of shifts for the CompMRI board versus conventional board are shown in table 1. An analysis of variance differences using a Fisher test gives statistically significative differences between variances of two groups (p<<0.01). The distributions of the absolute displacements were similar in both groups .


a. Registered images and effect of customized mould


b. Attenuation measurements

Conclusions:
Our data show that the C-MRI board have low attenuation and better immobilization and reproducibility than the conventional board. Position reproducibility from MRI simulation and CT simulation was excellent. Combination of MRI compatible board with silicone fixation provided robust immobilization and can be safely used for MRI-CT registration procedures eliminating the use of deformable and complex software algorithms. These data could be used for a potential reduction of margins for the PTV



	Lat (mm)	Vert (mm)	Long (mm)	Roll (º)	Tilt (º)	Pitch (º)
C-MRI	0.8 ± 0.6	-0.3 ± 0.9	-1.5 ± 1.2	-0.7 ± 0.7	-0.1 ± 0.5	-0.1 ± 0.3
Conventional	0.8 ± 2.7	-1.7 ± 3.9	-1.0 ± 3.2	-0.4 ± 1.2	0.1 ± 1.2	-0.2 ± 1.0