PATIENT POSITIONING IN SIGMA APPLICATORS: TRANSFERING THE POSITION OF THE PLANNING MODEL INTO THE TREATMENT SITUATION

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Background
In the hyperthermia treatment planning process a certain relative position of the patient with respect to the applicator is chosen for the calculations. In order to apply the planning data for a treatment the simulated patient positioning has to be reproduced in the real treatment situation.

Methods
A retrospective analysis of patient positions in a BSD SIGMA Eye Applicator during MR-controlled hyperthermia showed that the position in the x-axis (left-right) is always within a tolerance of 1 cm. The position in the y-axis (anterior-posterior) and z-axis (cranial-caudal) varies from treatment to treatment. Two new functions were included in the AMIRAHyperPlan treatment planning program: a tool for centering the SIGMA applicators to a chosen slice of the planning model and a second tool for measuring the distance between applicator shell and patient models surface on the cranial and caudal ends of the applicator. With 7 healthy volunteers we tested the method and the reproducibility of the patient position. The distance between patient surface and applicator shell was measured with a simple mechanical device. After positioning the patient the position was additionally controlled by MR imaging. The position of the applicator along the z-axis was adjusted using a vertical laser beam. The center plane -- chosen from MR or CT images — was marked on the skin surface using an anatomical landmark (upper edge of the symphysis of the pubic bone). The patient was positioned on the SIGMA base with the surface mark matching the laser beam. The applicator was positioned over the patient with its center plane matching the laser beam.

Results
We found that the reproducibility of the positioning was within the -- arbitrary chosen -- tolerance of 1 cm (mean 0.8 cm) for y-axis and 0.5 cm (mean 0.4 cm) for the z-axis. The maximum deviation from patient model and MR-controlled patient position was also below 1 cm (mean 0.9 cm). Accuracy of the palpation of the anatomical landmarks follows a learning curve. This is also true for the measurements of the distance between patient’s surface and applicator. Additionally the distance at the cranial end is dependent on respiration. However the position of the patient in y-axis cannot be adjusted before filling the water bolus.

Conclusion
With quite simple methods the position of patients in the SIGMA applicators can be adjusted corresponding with the patient model in the hyperthermia treatment planning software. A method to pre-estimate the patient position in the y-axis before filling the water bolus will be investigated further.

This work was supported by grant no. KU 0481101KRK3 from the German Federal Ministry of Economics and Technology.