Optical surface scanner, indexed patient support and IGRT make skin markers obsolete for patient positioning in external beam radiotherapy

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Purpose and Objective
In recent years, conformal treatment techniques fitting dose very close to the target for better sparing of adjacent normal tissue have become standard in radiotherapy. As treatment planning is usually based on one or very few snapshots of the anatomical relations, various IGRT concepts aim to meet the pre-treatment conditions during planning- CT for any single treatment fraction. However, uncertainties like patient deformation or rotation still influence the final accuracy and emphasize the importance of a consistent patient support. Many clinics still use markers on patient’s skin and external lasers for the first positioning step applying a patient related coordinate system.

With our investigation, we suggest a different way of patient positioning based on an idea of [1] using an external coordinate system, i.e. absolute couch coordinates in combination with an optical surface scanner. We retrospectively compared the “old” marker based method (MBM) with the new marker-less method (MLM) for 10 patients in each group in two anatomical regions (abdomen and chest) respectively.

Material and Methods
The new MLM consists of three steps. (1) Patient support (Omniboard, MacroMedics) is completely indexed to couch allowing the calculation of treatment table position depending on isocenter location. The support device is prepared and the patient placed on table.

(2) The couch is moved to the calculated position and the optical surface scanner (Catalyst, CRAD) used to correct deformation and rotation.

(3) IGRT is applied for final isocenter positioning based on bony anatomy (OBI, Varian Medical Systems).

The traditional MBM was performed using the identical (indexed) support device but the positioning was done according to tattoos on patient’s skin and external lasers as common practice. Again, IGRT was used for final isocenter correction.

Based on orthogonal IGRT images the remaining pitch and rotation after each fraction were calculated and monitored for the two patient groups.

Results
Our investigation shows no significant difference between the two methods regarding the remaining rotational deviations, MLM performs slightly better for chest and inferior to MBM for abdomen, although not significantly (see image (1)). As both methods presume correlation between patient’s surface and bony anatomy the final accuracy is still strongly patient-dependent. However, with treatment workflow and patient comfort in mind the MLM includes several advantages:

(1) no skin markers required,
(2) higher patient safety due to independent and consistent support device positioning,
(3) deformations can be corrected efficiently using information of the surface scanner and
(4) after a training period the workflow is fast and straightforward.

Conclusion
The presented new method (MLM) allows positioning of patients at least as accurate as the common used practice with skin marks. Our clinic is applying this method since 01/2016.
