Implementation of the first Surface-Guided Radiotherapy system in Greece in pelvic patients and comparison to 3-point markers

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Introduction

Surface-Guided Radiotherapy (SGRT) is a technique based on non-ionizing radiation to reproduce the 3D patient's surface in real time for patient positioning. This surface is compared with a reference 3D patient's surface, which originated from computed tomography of simulation, with submillimeter accuracy. The system provides the 6-Degree-of-Freedom (6-DoF) corrections that should be done so that the two surfaces are in agreement.

Moreover, monitoring of the patient's intrafraction motion is provided with automated beam holding when at least one of the 6-DoF parameters is out of the limit. The aim of this study is to compare patient positioning with tattoos and tattooless technique with SGRT. Additionally, PTV margins were calculated for each positioning technique.

Objectives

- Set-up errors reduction.
- PTV margins reduction.
- Tattooless treatments.

Materials and Methods

Twenty-pelvic radiation therapy (RT) patients are randomized in two groups of ten patients each. Group_A comprises 286 fractions positioned according to the AlignRT Advance system. Group_B comprises 316 fractions positioned according to the tattoos. Statistically significant differences in translational and rotational CBCT-based set-up errors were evaluated with Mann–Whitney U test, with significance level of <0.05.

The Root-Mean-Square (RMS) was calculated. PTV margins were calculated according to Van Herk's formula:

$$\textbf{PTV margins} = 2.5 \cdot \Sigma + 0.7 \cdot \sigma$$

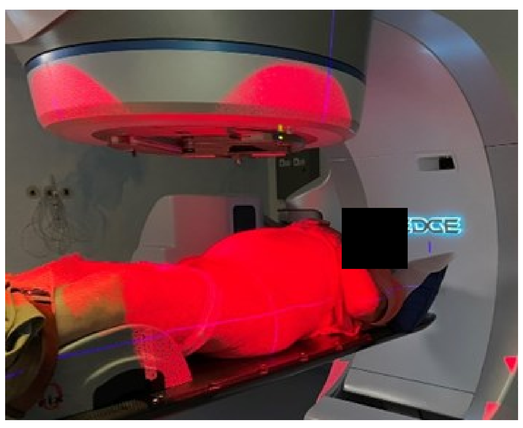

***Image 1**: Patient's set up according to AlignRT Advance*

***Image 2:** Patient's set up according to tattoo*

Results

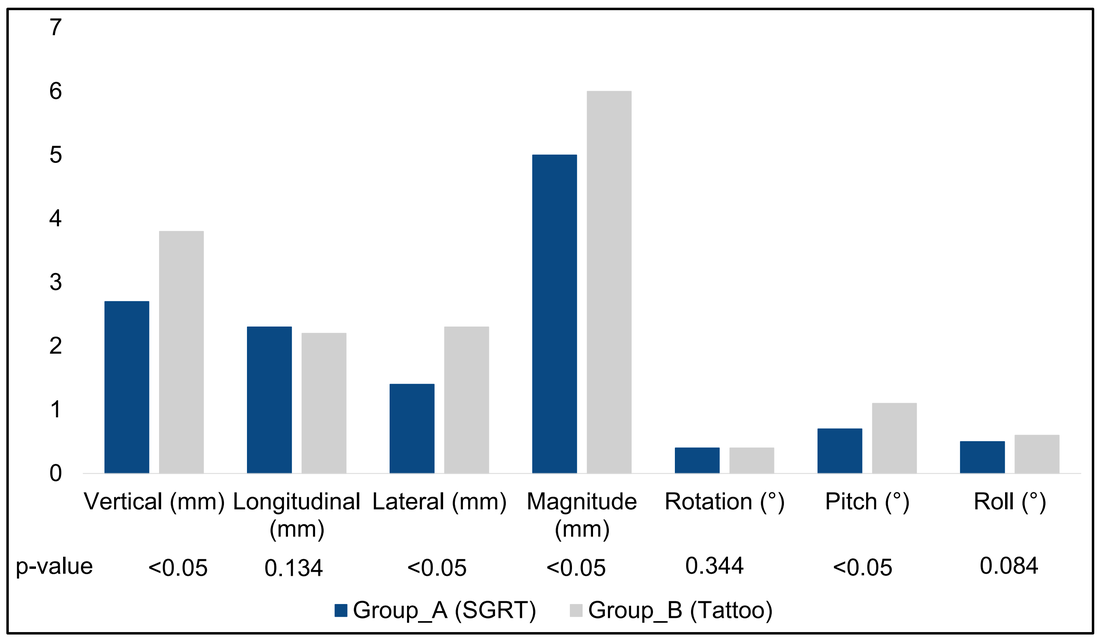

***Figure 1:** Median values of the set-up errors for two groups of patients*

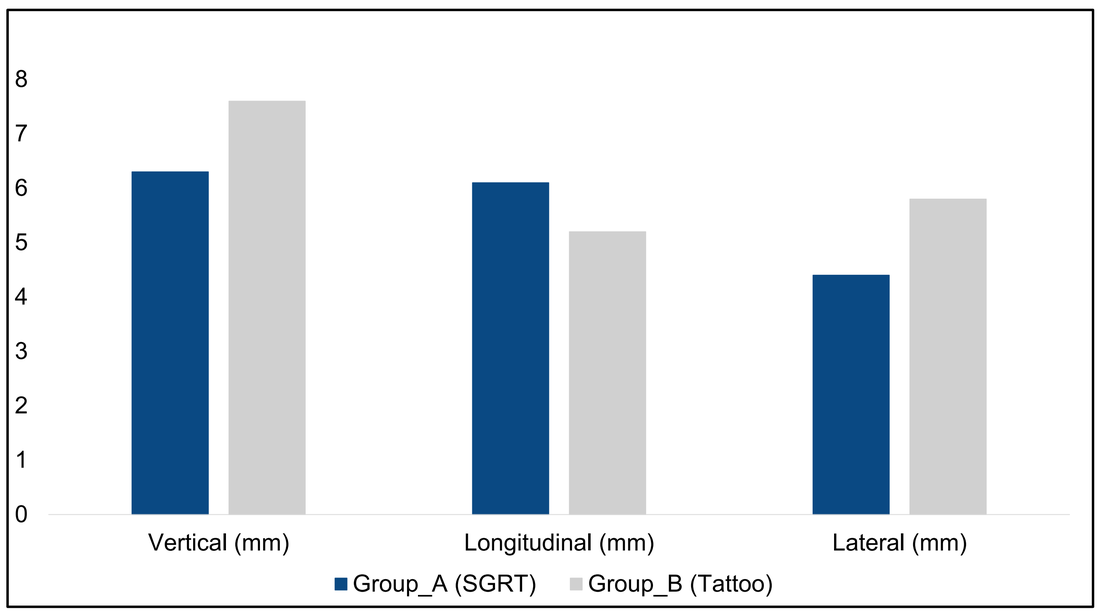

***Figure 2:** PTV Margins for two groups of patients*

The median values for Group_A were 2.7mm, 2.3mm, 1.4mm, 5mm, 0.4°, 0.7°, and 0.5° for vertical, longitudinal, lateral, RMS, yaw, pitch and roll, respectively. For Group_B the median values were, accordingly, 3.8mm, 2.2mm, 2.3mm, 6mm, 0.4°, 1.1° and 0.6°. A statistically significant reduction of set-up errors in Vertical, Lateral, RMS and Pitch was found. A marginally statistically significant reduction was found for Roll (p-value=0.083<0.1). The PTV margins for Group_A were 6.3mm, 6.1mm and 4.4mm for vertical, longitudinal and lateral directions, respectively. For Group_B, margins were 7.6mm, 5.2mm and 5.8mm

Conclusion

SGRT contribution seems to improve the patient positioning for pelvic RT patients. Furthermore, PTV margins could be reduced by the implementation of SGRT, leading to lower doses to adjacent healthy tissues. Subsequently, the conventional positioning technique of 3- point markers could be replaced by SGRT of the thousand points.

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