Impact of different setup approaches in image-guided radiotherapy as primary treatment for prostate cancer: a study of 2940 setup deviations in 980 MVCTs.

The goal of this study was to assess the impact of different setup approaches in image-guided radiotherapy (IMRT) of the prostatic gland. In all, 28 patients with prostate cancer were enrolled in this study. After the placement of an endorectal balloon, the planning target volume (PTV) was treated to a dose of 70 Gy in 35 fractions. A simultaneously integrated boost (SIB) of 76 Gy (2.17 Gy per fraction and per day) was delivered to a smaller target volume. All patients underwent daily prostate-aligned IGRT by megavoltage CT (MVCT). Retrospectively, three different setup approaches were evaluated by comparison to the prostate alignment: setup by skin alignment, endorectal balloon alignment, and automatic registration by bones. A total of 2,940 setup deviations were analyzed in 980 fractions. Compared to prostate alignment, skin mark alignment was associated with substantial displacements, which were $\geq 8$ mm in 13%, 5%, and 44% of all fractions in the lateral, longitudinal, and vertical directions, respectively. Endorectal balloon alignment yielded displacements $\geq 8$ mm in 3%, 19%, and 1% of all setups; and $\geq 3$ mm in 27%, 58%, and 18% of all fractions, respectively. For bone matching, the values were 1%, 1%, and 2% and 3%, 11%, and 34%, respectively.
prostate radiotherapy, setup by skin marks alone is inappropriate for patient positioning due to the fact that, during almost half of the fractions, parts of the prostate would not be targeted successfully with an 8-mm safety margin. Bone matching performs better but not sufficiently for safety margins<= 3 mm. Endorectal balloon matching can be combined with bone alignment to increase accuracy in the vertical direction when prostate-based setup is not available. Daily prostate alignment remains the gold standard for high-precision radiotherapy with small safety margins.