# **Abstract**

**Introduction:** Prostate cancer is one of the most common cancer in the men population. Radiotherapy for prostate cancer is rapidly evolving of which contributes to better control control of the disease. Accurate patient's positioning during the entire proces of RT is of crucial importance.

**The main aim:** The aim of this study was to assess the accuracy of patient repositioning during radiotherapy using two different IGRT *(image guided radiotherapy)* systems: the ExacTrac (ExT) and the EPID (*electronic portal image device).* An additional aim was to assess the usefulness of internal implants (polymers and golds) in prostate cancer patients undergoing radical radiotherapy in the pelvis area.

**Material and methods:** The study retrospectively analyzed the data of 79 patients with prostate cancer who underwent radiotherapy in the pelvis area using specialized methods: 3D CRT (*3 dimensional conformal radiotherapy)*, IMRT *(intensity modulated radiotherapy)* at the Department of Radiation Therapy at the Maria Skłodowska Curie Memorial Cancer Centre and Institute of Oncology (MCMCC) in Warsaw, Poland from March 2015 until January 2017. The patients had implants inserted in the prostate gland and their position on the treatment table was analysed using the ExT system and the EPID. Radiotherapy was performed in the linear accelerator room (Clinac V1) in accordance with all the standards and medical procedures which are effective at the Department of Radiation Therapy at the Maria Skłodowska Curie Memorial Cancer Center and Institute of Oncology in Warsaw. In addition, the accuracy of the patients therapy position was evaluated using the ExT system and the EPID, taking into consideration the following factors: the age of patients, the type of internal implants – polymers and golds, and also the number of implants inserted into the prostate gland, the type of positioner – reference star *vs* body markers, , the methods of radiotherapy: 3D CRT, IMRT, the shifts of implants in relation to the bone structures, the differences in the position of the prostate gland in relation to the bone structures in the coordinate system: X (*lateral*), Y (*vertical*), Z (*longitudinal*), the differences between the ExT and the EPID and also the presence of hip implants and their influence on repositioning during a radiotherapy session, the patient’s preparation for the treatment. The collected results of patient position reproducibility were analysed statistically.

**Results:** The biggest shifts in patient position were observed on the Z-axis and on the Y-axis for both systems, the ExT and the EPID. The values of shifts ranged from 1mm to 17 mm for the Z-axis for both systems. Moreover, greater shifts in patient repositioning were observed on the Z-axis and on the Y-axis for the ExacTrac system, which can indicate that the ExacTrac system is more accurate in verification of patient position reproducibility before a radiotherapy session. Statistical analysis shows no significant association between age and the mean shifts against bone structures and internal implants (polymers and golds) for either the ExT or the EPID. Using the reference star as a target positioner leads to significant variance of patient position shifts. The study shows that the prostate gland moves in relation to bone structures between radiotherapy sessions. There was a difference in mean shifts of internal implants in relation to rectum diameter, especially for the Z-axis and the Y-axis. In the case of the Z-axis, for the patients with rectum diameter ≤ 3.5 cm the median was - 5 mm, whereas for the patients with rectum diameter > 3.5 cm the median was nearly - 6 mm. Similar values were observed for the Y-axis. From among the studied group, 11 patients with internal gold implants had an implant rifted during treatment. As a result, verification of the prostate gland position during the RT session had to be based on the remaining two internal gold implants. No statistically significant association was found between hip implants and the average shifts in patient position reproducibility on the three axes for either the ExT or the EPID.

**Conclusions:** Non-invasive methods of patient positioning for the ExT system are highly recommended due to their confirmed accuracy and improved patient comfort. Using the reference star as a target positioner must be restricted, becouse leads to significant variance of patient position shifts. Appropriate preparation, both technical and mental, for radiotherapy is very important in the case of prostate cancer patients. The observed shifts of internal implants (both polymers and golds) could be associated with patients respiratory mobility. It is worth considering whether respiratory activity should be monitored when performing pre-treatment computed tomography and during radiotherapy sessions. It was observed that in some patients with internal gold implants one of the implants was rifted. It is worth considering the use of only polymer implants for prostate cancer patients undergoing radiotherapy in the future. The ExT system, EPID and internal implant are highly recommended regardless of age. No significant association was found between hip implants and the average shifts in patient position reproducibility on the three axes for either the ExT or the EPID.