Case Report

Simple method for correcting imperfectly placed fiducial markers for image-guided radiotherapy technologies of the prostate cancer

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Abstract

One of the main method of treating prostate cancer is radiotherapy . Contemporary techniques as IGRT concentrate on proper delivery and exact delineation of the target. We present the simple method of correction the visualisation of gold markers implanted before radiotherapy . In the case when one or two seeds were located imperfectly or were lost with stool or urine we implant additional seeds which create the spatial figure recognised in CT and MRI . Implantation of additional seeds is safe and very simple method which can "rescue" sense of image guided procedure in the case of unfavourable primary fiducial seeds location.

Keywords: Fiducial seeds, improper location, prostate cancer, radiotherapy

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INTRODUCTION

Radical external beam radiotherapy for prostate cancer is one of the main methods of treating this cancer in addition to radical prostatectomy. Contemporary techniques such as intensity-modulated radiotherapy have made possible to deliver a high dose of radiation to the prostate.[1,2] Implementation of image-guided radiotherapy gives us better control over the location of the target and precise delivery of radiation.[3]

To improve the results of treatment, increasing effectiveness and reducing the complications, markers worn before radiotherapy have been used for years.

CASE REPORT

From 2014, in our department, we use fiducial markers to determinate the prostate before the radiotherapy procedure. In our clinic, the markers used to mark the location of the prostate are cylindrical gold seeds dimensions of 1 mm × 3 mm (Riverpoint Medical, USA, 825 NE 25th Avenue, Portland, OR). Usually, three tags are inserted, but in some centers, four or even five tags.[4] We insert three seeds into the prostate gland.

They form a spatial figure that is localized during image-guided radiotherapy technologies (IGRT) in subsequent sessions of radiotherapy for the daily target localization.

The recommended placement of markers is one on the right side near the top of the gland, second on the left side in the middle part slightly circumferentially, and third on the gland base near the urethra on the right side.

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Tags should also be located in different planes of the Antero-posterior plane (AP), which is arranged from the pubic symphysis to the rectum.

The literature describes cases of marker migration, but these are minor movements usually up to 1–2 mm in all three dimensions.

We assume three markers in standard. Procedures are performed by residents under the care of urologist. The interval between implantation of markers and the start of radiation is usually 6 weeks. The irradiation procedure is performed on the Clinac or TrueBeam linear accelerators (VARIAN Medical Systems Inc. 3100 Hansen Way 4A, Palo Alto, CA 94304-1038 USA). It is a serious problem to improperly set up the fiducial seed – one or more seeds.[2] The marker once placed in the prostate cannot be moved, removed, or deleted. After the introduction of marker into the tissue, it is not possible to change its position.

The most common mistake when placing markers is to try to determine the prostate border by markers and put seeds circumferentially in the capsule. It results with the placement of a marker in the rectal wall, in the bladder wall, or even the loss of a marker with urine or with a stool.

In our center, we found a way to improve the prostate picture when one or two seeds are misplaced. Between February 2014, and June 2018, we implanted fiducial seeds in 410 patients. In two patients, we decided to implant two additional markers due to incorrectly placed seeds. In both cases, markers were located extremely circumferentially or outside the gland.

In the case of the Patient 1, markers were placed on the posterior surface of the prostate in the capsule [Figure 1]. Such a flat arrangement of markers did not allow them to be used as markers of prostate position control. We decided to implant additional seeds. Before inserting additional markers, we analyzed computed tomography and magnetic resonance imaging scans to determine the optimal location for new seeds [Figure 2 The badly placed seeds are marked with arrows]. After the implantation of two further seeds, they created a three-dimensional shape.

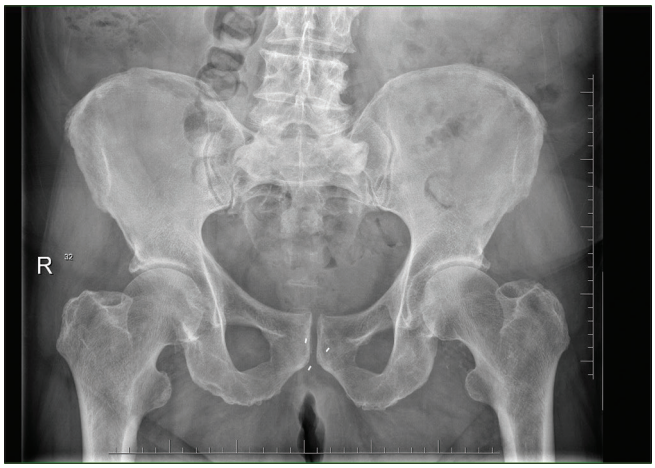

Figure 1: X-ray picture of the pelvis with three markers

The Patient 2 had one mark in the rectum wall, second close to the prostate but outside the gland on the left side [Figure 3]. The third location was as planned. We insert two additional markers into the prostate under the control of transrectal ultrasound. After putting on the markers, we performed the pelvic X-ray control. By comparing Figures 3 and 4, you can see how the position of the lower marker changes. The rotation from the longitudinal to the lateral position is also visible [Figure 4].

In the case of the wrong position of seeds, we implanted additional markers so that they form together with the best-established mark of the first procedure a spatial triangle. One or two misaligned markers are omitted in the exposure planning process. Most modern devices currently

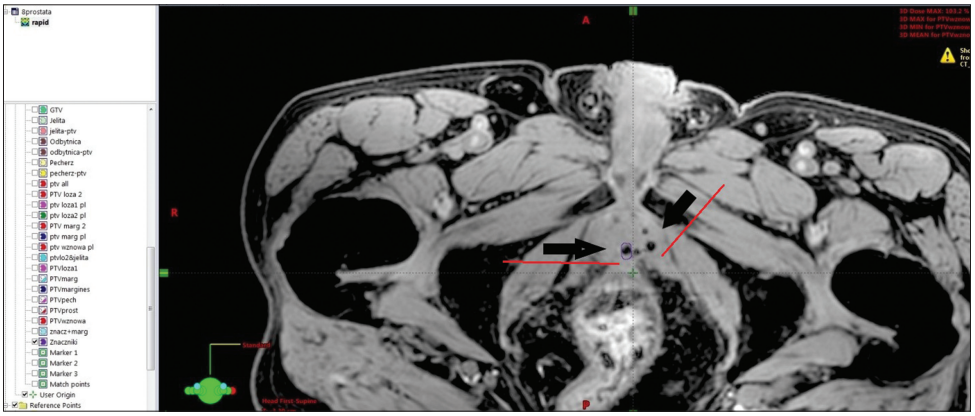

Figure 2: Magnetic resonance image before radiotherapy. Visible two markers peripherally located in the prostate capsule

Figure 3: Patient 2 after the first implantation procedure. Foley catheter in the bladder. Lower marker is located in rectum wall, left marker very laterally, in the prostate capsule

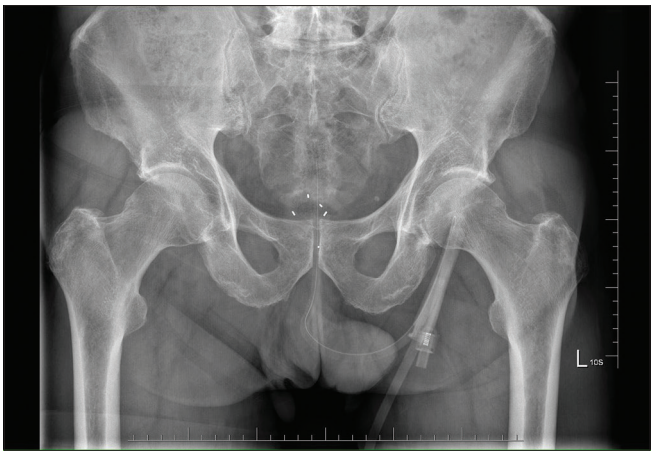

Figure 4: Patient 2 after the second procedure with five markers. Visible very large movability of the bottom marker in comparison with Figure 3

used have the ability to override parts of tags those least favorably inclined. Both patients well tolerated the second implantation. No complications were observed.

DISCUSSION

The imperfect location of fiducial markers is a rare situation but significantly affecting treatment. Browsing the available literature, we did not come across description of the procedures used in the incorrect distribution of seeds. Radiotherapy can be carried out despite badly placed markers, but we lose the ability to meticulous control of the prostate position. The ability to bypass some of the markers of modern technology is very important. Complications such as expelling the grain with stool or urine are well known, but nobody reported how to improve prostate visibility during radiotherapy when seeds are imperfectly placed.

In the case of improper implantation of markers, placing additional grains in the correct location will save the IGRT procedure. Additional tags will increase the cost of the procedure but save the sense of image-guided radiotherapy – correct positioning of the prostate during the irradiation process.

In the case of a problem that is the wrong location or displacement of the marker grains out of the prostate, a simple rescue procedure seems to be helpful. It meets the expectations of improving prostate visualization during a radiotherapy session, is well tolerated by patients, and is uncomplicated in execution.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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