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Case Study of the Month

# Real-Time Magnetic Resonance Imaging–Guided Focal Laser Therapy in Patients with Low-Risk Prostate Cancer

*Orit Raz* [a,*], *Masoom A. Haider* [b], *Sean R.H. Davidson* [c], *Uri Lindner* [a], *Eugen Hlasny* [b], *Robert Weersink* [c], *Mark R. Gertner* [c], *Walter Kucharcyzk* [b], *Stuart A. McCluskey* [d], *John Trachtenberg* [a]

[a] *Department of Surgical Oncology (Division of Urology), University Health Network, Princess Margaret Hospital, and the University of Toronto, Toronto, Ontario, Canada*
[b] *Department of Medical Imaging, University Health Network, Princess Margaret Hospital, and the University of Toronto, Toronto, Ontario, Canada*
[c] *Ontario Cancer Institute (Biophysics and Bioimaging Division), University Health Network, Princess Margaret Hospital, and the University of Toronto, Toronto, Ontario, Canada*
[d] *Department of Anesthesia and Pain Management, University Health Network, Princess Margaret Hospital, and the University of Toronto, Toronto, Ontario, Canada*

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**Abstract**

Two patients with low-risk prostate cancer (PCa) were treated with outpatient in-bore magnetic resonance imaging (MRI)–guided focal laser ablation.

The tumor was identified on MRI. A laser fiber was delivered via a catheter inserted through a perineal template and guided to the target with MRI. The tissue temperature was monitored during laser ablation by MRI thermometry. Accumulated thermal damage was calculated in real time. Immediate post-treatment contrast-enhanced MRI confirmed devascularization of the target. No adverse events were noted. MRI-guided focal laser therapy of low-risk PCa is feasible and may offer a good balance between cancer control and side effects.
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* Corresponding author. Division of Urology, Department of Surgical Oncology, Princess Margaret Hospital, Room 3-130, 610 University Avenue, Toronto, Ontario, Canada M5G 2M9.
Tel. +1 416 946 2000; Fax: +1 416 946-6590.
E-mail address: droritraz@yahoo.com (O. Raz).

## 1. Case report

Patients 1 and 2 were 74 and 72 yr old, respectively, with National Comprehensive Cancer Network-defined low-risk prostate cancer (PCa). Patient 1 had stage cT1c cancer, a prostate-specific antigen (PSA) level of 4.79 ng/ml, and Gleason score 6 (3 + 3) in four cores in two adjacent sectors of the right mid gland. Patient 2 had stage cT1c cancer, PSA 2.74 ng/ml, and Gleason score 6 (3 + 3) in two cores from two adjacent sectors of the left base.

Both patients wished to have curative therapy but refused conventional surgery or radiation therapy because of concern for the known adverse effects. Institutional review board-approved experimental magnetic resonance imaging (MRI)–guided focal laser therapy (FLT) was offered and agreed to by the patients. Pretreatment multiparametric MRI confirmed a well-defined single area of carcinoma involving the right medial midprostate in patient 1 and a single lesion in the left peripheral zone at the base of the prostate in patient 2.

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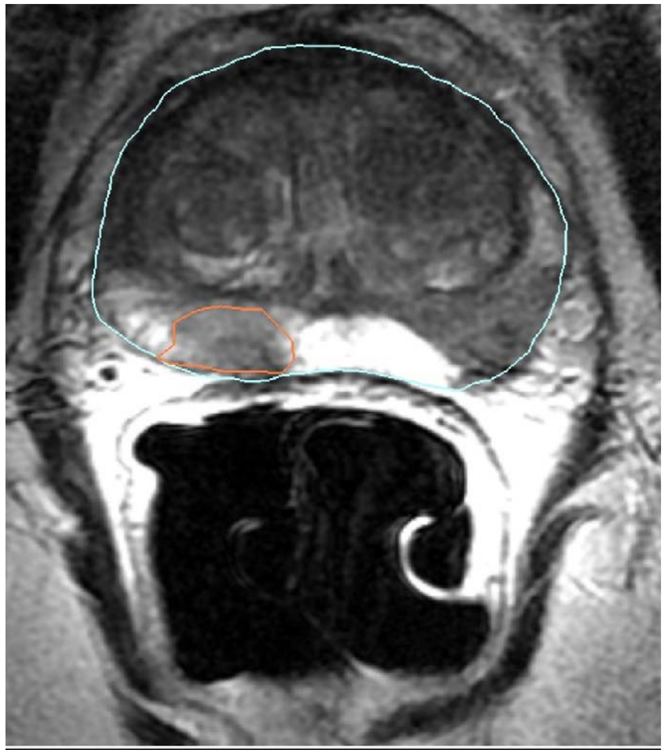

**Fig. 1 – Baseline endorectal axial T2 magnetic resonance (MR) image (axial two-dimensional; 27 slices; 3-mm slice thickness; 2:53 min; field of view: 15 × 15 cm; matrix: 256 × 256; number of excitations: 2; repetition time: 5525 ms; echo time: 98.3 ms; bandwidth: 31.25 kHz; ETL: 16) from patient 1; the prostate (blue line) and tumor (orange line) in the right posterior of the prostate were traced by a radiologist (MAH).**

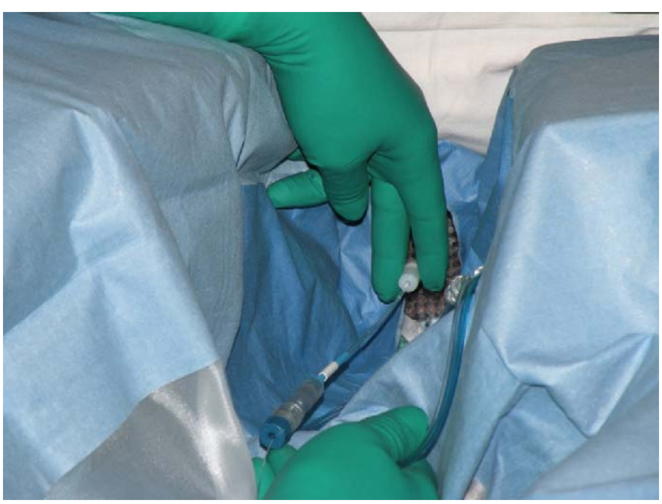

**Fig. 2 – Laser fiber inserted through the selected hole of the template, which was placed against patient's perineum in a sterile field.**

### *1.1. Surgical procedure*

Under general anesthesia with intravenous propofol, fentanyl, and midazolam, the patients were placed in the bore of a 1.5-T GE Excite Twinspeed MR scanner (GE Healthcare, Waukesha, Wisconsin, USA) in semilithotomy position. All MRI was performed with a torso array and endorectal coil (Medrad, Warrendale, PA, USA). An axial T2 fast spin echo scan was combined with preoperative diagnostic MRI with diffusion weighted imaging. Combined T2-weighted and diffusion-weighted MRI for localization of prostate cancer was done for tumor localization (Fig. 1).

A modified MRI-compatible brachytherapy-like template containing saline-filled fiducials was secured against the patient's perineum (Fig. 2). The locations of the magnetic resonance (MR)–visible fiducials in the insertion template were identified in an MR scan (Axial 2D FIESTA [Fast Imaging Employing Steady State Acquisition]; GE Healthcare, Waukesha, Wisconsin, USA), which allowed, using custom planning software, the position and orientation of the template. A virtual representation of the template and the insertion paths was superimposed onto the MR images and an insertion hole was selected based on the overlap of the insertion grid with the tumor (Fig. 3).

An open-ended, 14-gauge, 140-mm-long catheter with an MR-compatible titanium obturator was inserted through the selected hole of the template into the patient's perineum. FIESTA-MRI series were acquired as the catheter was inserted. The images were loaded into in-house planning software as they were acquired (Fig. 4). By monitoring the image slice that was parallel to the catheter insertion path, the insertion depth could be tracked in real time to guide the insertion. Insertion could be performed by reaching into the bore of the magnet by hand (Fig. 4).

Once the catheter reached its target, the metal trocar was replaced by an optical fiber with a 1-cm-long cylindrically

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