Transurethral MR-Thermometry Guided Ultrasound Ablation of the Prostate – The Heidelberg Experience During Phase I of the TULSA-PRO Device Trial

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Background

Prostate cancer (PCa) is the malignancy most commonly diagnosed in men in the western hemisphere. Despite the substantial increase of predominantly low-grade and early stage PCa diagnosed since the appearance of prostate-specific antigen (PSA) screening, PCa remains the second most common cause of cancer-related death in men in the developed world [1], highlighting its aggressive potential and the need for screening and therapy.

The use of prostate-specific antigen (PSA) screening has decreased the average age at diagnosis and increased the proportion of men diagnosed with low-grade, small-volume, localized prostate cancer [2, 3]. Average age at diagnosis is 66 years. While PSA screening is sensitive for prostate cancer, its specificity is low. False positive PSA elevation may be related to benign changes such as prostate hyperplasia (BPH) or prostatitis. Also, PSA and gland size-adjusted parameters such as PSA-density (PSAD) have limited ability to differentiate between BPH and cancer, or between the aggressive life-threatening and low-grade slow-growing forms of the disease [4].

After detection of significant PCa by biopsy, conventional prostate cancer therapy typically consists of either surgical radical prostatectomy or radiation therapy. Due to persistent limitations to predict the aggressiveness of PCa, many patients still receive overtreatment of their disease and are exposed to the associated morbidity with potential long-term erectile dysfunction, urinary incontinence, and bowel complications that may significantly compromise quality of life [5]. It is well-known that low-risk PCa may carry only an insignificant mortality risk compared to men without PCa [6]. Accordingly, the concept of active surveillance (AS) was developed which consists of following patients with low-grade PCa by PSA testing and possibly magnetic resonance imaging (MRI) until significant PCa is detected. Recently, MRI has shown promise to increase detection of PCa compared to standard transrectal ultrasound-guided systematic (TRUS) biopsies [7], with preferential detection of intermediate and higher grade PCa. Negative MRI does currently not exclude significant PCa, although the risk of significant PCa was reported to be lower in patients with negative MRI [8]. The

1 Patient setup in the MRI suite with MR technologist, physicist and anesthesiologist featuring MR-compatible anesthesia machine and monitoring devices needed for general anesthesia on location at the DKFZ Heidelberg, Germany.

continued improvement of MRI detection, localization and grading of PCa and growing data on sensitivity and specificity of MR for PCa detection increase the foundation for evidence-based development of alternative, less invasive treatments of PCa by local therapy. This addresses an important need as intermediate therapeutic approaches between AS and radical therapy which provide good control of local disease are highly sought-after. With such therapies it would be possible, both, to tailor therapy to the intermediate-risk group and reduce permanent adverse side effects while also addressing the needs of the growing number of young men diagnosed with small low- to intermediate grade PCa and those of older patients who are not suitable candidates for surgery.

Minimally invasive ablative therapies have the potential to achieve good oncologic outcomes and low morbidity. Adding MR guidance to ablative therapies offers the advantage of direct monitoring of therapy without the need for intermodality co-registration. Furthermore, MR allows temperature monitoring in the form of MR thermometry which can be used to drive a feedback loop for optimal delivery of thermal energy to the target tissue. At the same time, MR-guidance is based on the principal and currently most promising imaging modality for the visualization of PCa. By combining these properties, a MR

thermometry-guided ultrasound thermal ablation technique appears very promising to achieve precise lesion targeting and local tumor control. This report is based on our institutional experience during the recent prospective, multi-center, Phase I clinical trial of the TULSA-PRO (described below) device. Within this phase I trial, the TULSA-PRO device was used to heat and ablate prostate tissue in 30 men with localized prostate cancer. Of the 30 men included in the trial, 14 were treated at our site in Heidelberg. All procedures were performed within a 3T Siemens MAGNETOM Tim Trio MR system. Twelve-month follow-up results of the phase I trial have been analyzed and published [9]. The objective of the phase I trial was to determine the clinical safety and feasibility of the TULSA-PRO device for whole-gland prostate ablation in the primary treatment setting of patients with localized prostate cancer. As the precision of targeting was being evaluated during the trial, all treatments included a 3-mm safety margin to the prostate capsule with an expected 10% residual viable prostate tissue expected around the ablation margin.

TULSA overview

MRI Guided **T**ransurethral **UL**trasound **A**blation (TULSA) is a novel, minimally invasive technology that ablates the entire prostate gland, via the urethra.

It combines quantitative image-based planning, monitoring, and treatment control with transurethral delivery of therapeutic ultrasound to ablate prostate tissue (both benign and malignant) through thermal coagulation [9, 10].

The procedure is conducted within an MRI scanner (Fig. 1), which provides high-resolution planning images that are registered to real-time quantitative thermometry images acquired during treatment. A closed-loop temperature feedback control algorithm modulates the intensity, frequency, and rotation rate of the ultrasound, shaping the ablation volume with high accuracy to individual prostate anatomy and reducing the risk of possible damage to peri-prostatic structures (rectum, urinary sphincter and neurovascular bundles) [11].

The MRI scanner provides real-time thermal dosimetric monitoring for feedback-controlled ultrasound ablation.

TULSA-PRO™ technical principle

During the phase I clinical trial, we used the TULSA-PRO device developed by Profound Medical Inc. (Toronto, Canada).

The TULSA-PRO System components are depicted in Figure 2. A rigid

Treatment Delivery Console

2 TULSA-PRO System Components. The Ultrasound Applicator, Endorectal Cooling Device and Positioning System are inside the Scanning room on the MRI bed. The Treatment Delivery Console and System Electronics remain outside the Scanning room, in the Console and Equipment room, respectively. *Figure courtesy of Profound Medical Inc.*

Ultrasound Applicator (UA) is inserted into the urethra, making contact with and delivering ultrasound energy directly into the prostate gland. A linear array of 10 independent ultrasound transducer elements emits directional (but unfocused) high-intensity ultrasound energy directly into the adjacent prostate, quickly raising tissue temperatures to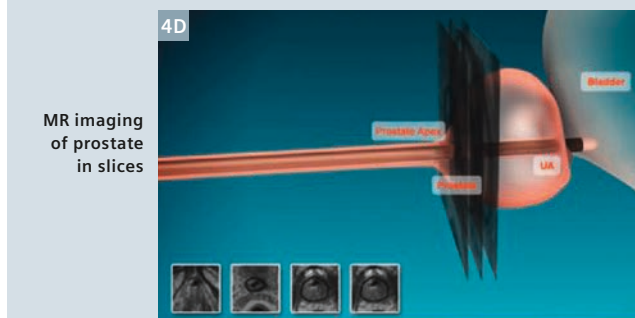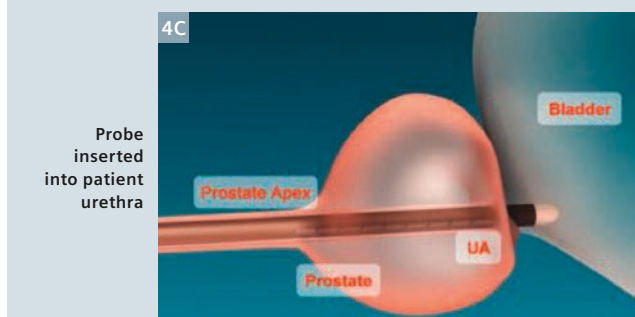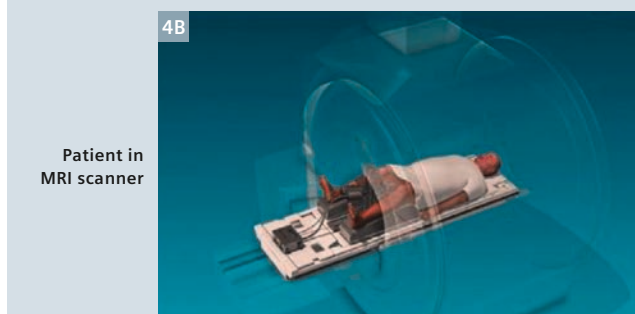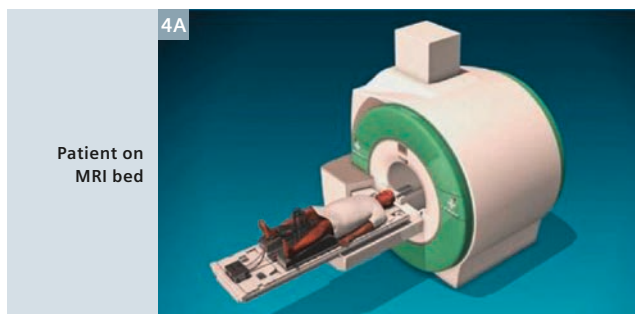 thermal coagulation. The configuration of the ultrasound beams enables treatment of a large volume of prostate tissue, resulting in shorter treatment times of typically less than 40 minutes. Fluid is circulated through the UA, providing 1-2 mm of urethral tissue preservation. A separate circuit flows water through the Endorectal Cooling Device (ECD) to provide thermal protection of rectal tissue during ultrasound ablation delivery. Figure 3 shows a conceptual illustra- tion and a sagittal MR image of the UA and ECD in a patient.

The UA is held in situ with a Positioning System (PS) that provides remote robotic linear and rotational motion of the device within the prostate. During treatment, the UA is rotated continuously by the PS, ensuring a continuous pattern of thermal damage and preventing cold spots between ultrasound sonications. The System
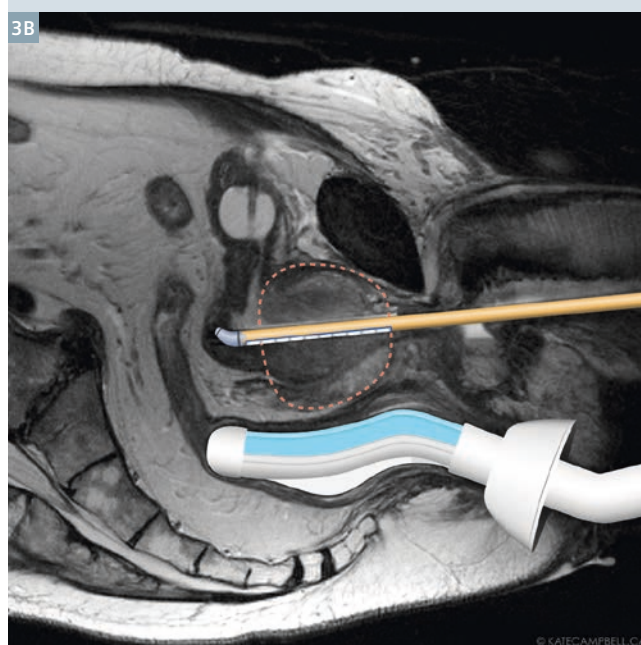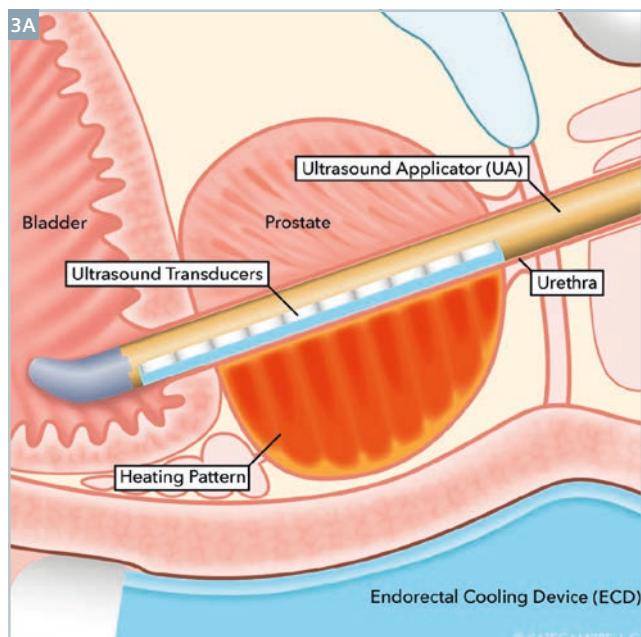
3 Conceptual illustration **(3A)** and sagittal MR image **(3B)** of the UA and ECD in a patient.
Figure courtesy of Profound Medical Inc.

Patient on MRI bed

Patient in MRI scanner

Probe inserted into patient urethra

MR imaging of prostate in slices

4 Conceptual illustration **(3A)** and sagittal MR image **(3B)** of the UA and ECD in a patient.
Figure courtesy of Profound Medical Inc.

Cart (SC) positioned in the MRI equipment room, houses the fluid circuits and the System Electronics (SE), which power the UA transducer elements and PS motors.

The treatment is conducted completely within an MRI, providing real-time temperature images of the heated region to be acquired as the ultrasound treatment is delivered. A custom software interface (Treatment Delivery Console, TDC) communicates with the MR scanner to display high-resolution images for device positioning and treatment planning, and temperature images for treatment monitoring and control. Using MRI thermometry during treatment, dynamic temperature feedback control over the intensity of the ultrasound beams and rotation of the UA can shape the pattern of thermal coagulation accurately and precisely in the prostate gland, thereby reducing the risk of possible damage to important surrounding anatomy, such as, the rectum, urinary sphincters and neurovascular bundles [11].

During the procedure, the software automatically adjusts ultrasound parameters (power, frequency, and device rotation rate) to achieve at least the target temperature ($\geq 55°C$) within the target boundary. Prostate tissue temperature feedback is provided from the MR scanner in real-time during the procedure and is displayed in the form of a temperature map (see Fig. 5).

The procedure

Patients undergo general anesthesia prior to insertion of suprapubic catheter and a transurethral guidewire. The patient is then moved onto the MR bed and the UA is inserted manually over the guidewire, followed by the ECD (Fig. 4A).

Under MR guidance and remote operation of the robotic PS, the UA is positioned precisely within the prostatic urethra (Figs. 4B and 4C). High-resolution prostate MR images are acquired for treatment planning (T2-weighted turbo spin echo, echo/repetition time 52/3000 ms, 26-cm field of view, 1 x 1 x 2.5 mm³ voxels).

Using the TDC, the physician traces the outer prostate boundary on oblique-axial images acquired transverse to the UA and aligned with each transducer element (Fig. 4D).

The target prostate volume is defined from the outer prostate boundary drawn by the physicians, and heated to $\geq 55°C$, the temperature critical to achieve acute thermal coagulation (Fig. 5). Treatment begins with high-intensity ultrasound energy delivered to the prostate in one complete rotation of the UA under active MRI thermometry feedback control (proton resonance frequency shift method, echo planar imaging, oblique-axial aligned with planning images, echo/repetition time 8/350 ms, 26-cm field of view, 2 x 2 x 4 mm³ voxels, 0.8°C average precision *in vivo* human prostate). Real-time MRI thermometry images are acquired every 5.9 s, providing continuous assessment of a three-dimensional temperature volume during treatment. After treatment, contrast-enhanced (CE) MRI may be acquired to confirm non-perfused tissue volume.
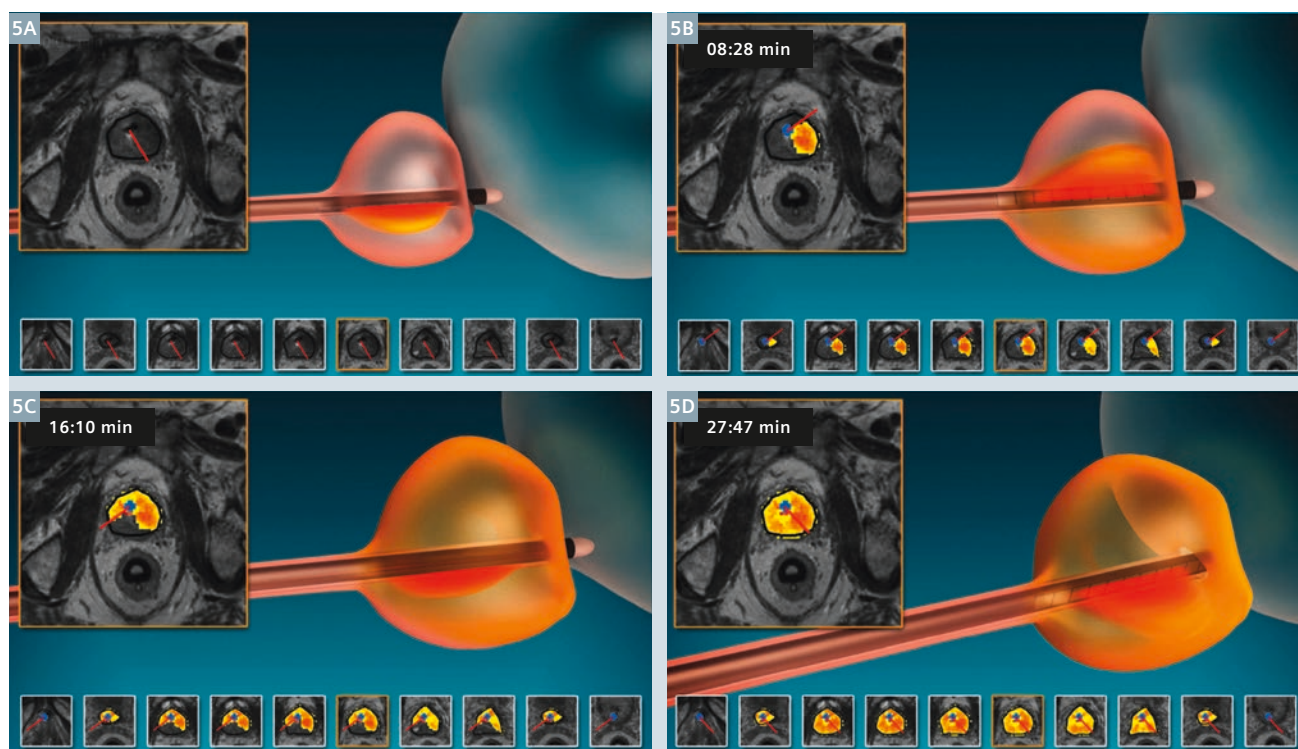
5 Temporal evolution of a MRI-guided TULSA treatment, completed in one full rotation of the UA.
*Figure courtesy of Profound Medical Inc.*

Case 1

A 70-year-old patient in good health, initially managed on active surveillance, was enrolled in the Phase I study and treated with the TULSA-PRO. In 2012, the patient presented with a PSA of 6.3 ng/ml, clinical stage T1c and initial biopsy showing 1/12 positive cores with Gleason Score 3+3. In 2013, the patient's PSA increased to 7.5 ng/ml and he subsequently underwent a second biopsy, this time with 6/26 positive cores with Gleason Score 3+3. The patient then enrolled in the TULSA-PRO study and was treated in October 2013.

The prostate volume was 33 cc, and the duration of the ultrasound treatment was 25 min. Figure 6A shows an example mid-gland MR thermometry image demon-strating the millimeter accuracy and precision of prostate ablation. Thermometry findings are confirmed on post-treatment CE-MRI with the hypointense region of non-perfused tissue concordant with the region of cytoablative thermal treatment (Fig. 6B). Figures 6C and D illustrate the prostate anatomical changes at 12 months, demonstrating an 85% decrease in gland volume.

Figure 7 illustrates the changes in PSA and patient quality of life following treatment with the TULSA-PRO. PSA reached a nadir of <0.10 ng/ml at 1 month and remained stable to 0.25 ng/ml at 24 months. The International Prostate Symptom Score (IPSS, range from 0 "no symptoms" to 35 "severe symptoms") initially increased at 1 month and returned to baseline at 3 months after treatment with the TULSA-PRO, further decreasing at 24 months. Internal Index of Erectile Function (IIEF) Item 2 (erection firmness sufficient for penetration, range from 0 "never or almost never" to 5 "always or almost always") remained unchanged after treatment with the TULSA-PRO through 24 months of follow-up. This patient presented with a total of one adverse event attributable to treatment with the TULSA-PRO, which was an asymptomatic urinary tract infection that was resolved with oral antibiotics. At 12 months, the patient's 12-core transrectal follow-up biopsy was negative for adenocarcinoma.

Maximum temperature (°C)

- Acute cell kill
- Late cell kill
- Sublethal
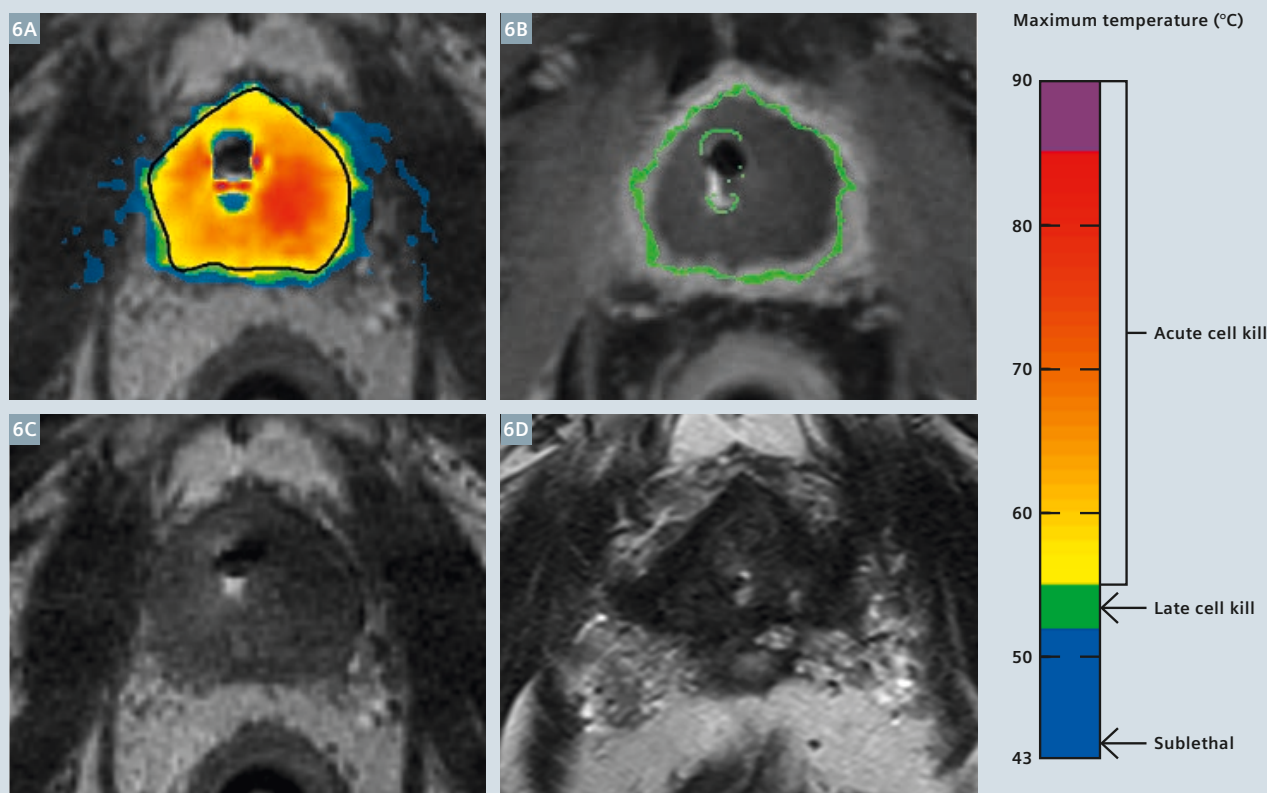
6 MRI findings of case study patient, with example images through the mid-gland. **6A** shows the maximum temperature reached in the prostate measured using real-time MR thermometry; the acute cell kill target temperature ≥ 55°C was shaped accurately and precisely to the treatment plan (black contour). **6B** shows the CE-MRI acquired immediately after treatment, demonstrating the hypointense region of non-perfused prostate tissue concordant with the ablative temperatures on MR thermometry. **6C** shows the corresponding treatment planning image (Day 0), which is compared to **6D** showing the same location at 12-month follow-up.

7A PSA (ng/ml) — Time (months)

7B IPSS/ IIEF Q2 Score — Time (months)
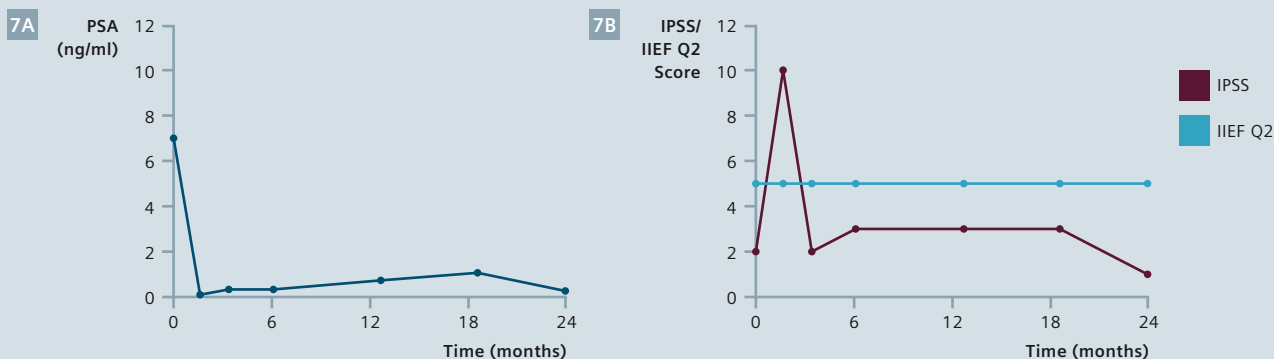
- IPSS
- IIEF Q2

7 PSA and Quality of Life outcomes for case study patient (TULSA-PRO treatment at time 0). **7A** shows the PSA decreasing to <0.10 ng/ml at 1 month after treatment with the TULSA-PRO, and stable to 0.25 ng/ml at 24 months. **7B** shows the IPSS score [range 0 (no symptoms) to 35 (severe symptoms)] increase at 1 month and return to baseline at 3 months after treatment with the TULSA-PRO, further decreasing at 24 months. IIEF Q2 score (erection firmness sufficient for penetration) [range 0 (never or almost never) to 5 (always or almost always)] remains unchanged after treatment with the TULSA-PRO through 24 months of follow-up.

Case 2

A 68-year-old patient with an initial PSA of 9.1 ng/ml and a Gleason Score of 3+3 was treated with TULSA-PRO in March 2014. Prostate volume was 58 cc requiring a longer than average ultrasound treatment time of 58 min. Prior to treatment, the patient had IPSS of 20 (severe symptoms), which decreased to 11 and 9 (both moderately symptomatic) at 3 and 24 months, respectively. Baseline IIEF item 2 score was 2, and remained stable to 2 and 3, at 3 and 24 months, respectively. Side effects associated with the procedure were urinary tract infection, resolved with oral antibiotics, and obstructive micturition, requiring prolonged post-treatment catheterization from 2 weeks (per-protocol) to 5 weeks.

Following treatment the PSA value decreased to 1.0 ng/ml at 1 month, 0.9 ng/ml at 3 months, 0.7 ng/ml at 6 months, and remaining stable at 0.55 ng/ml at 24 months. Biopsy at 12 months was negative. Figure 8 shows this patient's treatment day and 12 months' mid-gland MR images.
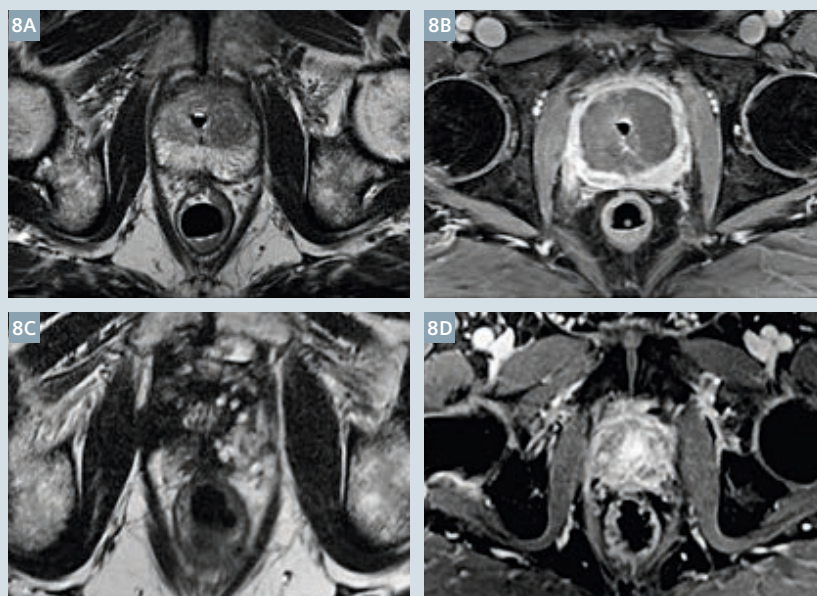
8 MRI findings of case study II patient. Example images through the mid-gland on treatment day **(8A, B)** and at 12 months **(8C, D)**. **8A** shows the axial T2-weighted treatment planning image, used to define the target boundaries for the real-time MR thermometry algorithm. **8B** shows the T1-weighted fatsat contrast-enhanced image acquired immediately following treatment. It demonstrates accurate ablation with the hypointense region of non-perfused prostate tissue and demonstrates the peripheral security margin of 3 mm used in the phase I trial, which will be reduced in the upcoming Pivotal trial. **8C** shows the axial T2-weighted image of the prostate gland at 12 months. Prostate volume is significantly reduced and T2 hypointense scarring is seen. **8D** demonstrates the low post-treatment prostate volume at the 12 month follow-up on a T1-weighted fatsat contrast-enhanced image with enhancement corresponding to a mixture of fibrotic tissue and remaining peripheral prostate tissue.

Parameter (n=30)		Average	Std Deviation	Median	IQR
Patient Age (years)		69.0	3.7	69	67-71
Prostate Volume (cc)		47.6	17.2	44	38-48
Ultrasound Treatment Time (min)		35.8	10.4	36	26-44
Thermal Ablation Accuracy (mm)		0.1	0.4	0.1	−0.3-0.4
Thermal Ablation Precision (mm)		1.3	0.4	1.3	1.0-1.5
Median Value (IQR)	**Baseline**	**1 month**	**3 months**	**6 months**	**12 months**
IPSS	8 (5-13)	14 (11-19)	6 (4-10)	5 (3-8)	5 (4-7)
IIEF item 2	13 (6-28)	7 (2-12)	11 (4-18)	11 (4-19)	13 (5-25)
Bowel Habits	100 (90-100)	100 (80-100)	100 (89-100)	100 (89-100)	100 (100-100)
PSA (ng/ml)	5.8 (3.8-8.0)	0.8 (0.5-1.1)	0.9 (0.4-1.7)	0.8 (0.4-1.1)	0.8 (0.6-1.1)

Table 1: Results summary of the prospective 12-month Phase I follow-up data.

Results summary of the TULSA-PRO prospective phase I study

An analysis of the prospective 12-month Phase I follow-up data showed that the TULSA-PRO is spatially accurate and precise to ablate prostate tissue, both malignant and benign, to millimeter accuracy, while providing a favourable safely profile and a low rate of erectile dysfunction [9].

Of the 30 study subjects, median (IQR) age was 69 (67-71) years, with 24 (80%) low-risk and 6 (20%) intermediate-risk cancers (D'Amico criteria). As summarized in Table 1, ultrasound treatment time was 36 (26–44) min and prostate volume 44 (38–48) cc. Spatial control of ablation was 0.1 ± 1.3 mm (spatial accuracy of 0.1 mm, precision of ± 1.3 mm). Adverse events (CTCAE v4) included haematuria Grade 1 (asymptomatic) in 13 patients (43%), and Grade 2 (symptomatic) in 2 patients (6.7%); urinary tract infections Grade 2 in 10 patients (33%); acute urinary retention Grade 1 (blocked suprapubic catheter) in 3 patients (10%), and Grade 2 (prolonged catheterization) in 5 patients (17%); and epididymitis Grade 3 (resolved with IV antibiotics) in 1 patient (3.3%). There were no rectal injuries or intraoperative complications.

Baseline IPSS of 8 (5-13) recovered to 6 (4-10) at 3 months, stable to 5 (4-7) at 12 months (n=29). The proportion of patients with erections sufficient for penetration (IIEF item 2 ≥ 2) remained unchanged from 21/30 (70%) at baseline to 20/29 (69%) at 12 months. Median PSA decreased 87% at 1 month, stable to 0.8 (0.6-1.1) ng/ml at 12 months (n=30). Positive biopsies at 12 months show 61% reduction in total cancer length, clinically significant disease in 9/29 patients (31%), and any disease in 16/29 patients (55%).

Conclusion

Here we report our initial experience with the TULSA-PRO device during a recently completed comprehensive prospective Phase I study, with Heidelberg being the center that has enrolled most of the patients into the trial. The TULSA-PRO device offers a novel, MRI-guided, minimally-invasive method to safely ablate target benign and malignant prostate tissue with millimeter accuracy and precision. Real-time MR thermometry performed during transurethral ultrasound delivery enables active feedback control of the thermal volume, with high success in the ablation of the target tissue. Furthermore, MRI-guidance allows acquisition of high-resolution images of the prostate for accurate treatment planning without the need for fusion algorithms. The TULSA-PRO device demonstrated conformal thermal ablation of target prostate volumes with a favorable side-effect profile and minor or no impact on urinary, erectile and bowel function, while maintaining a security margin of 3 mm to the prostate capsule during the phase I trial. In the upcoming Pivotal trial, and after assessment of millimeter accuracy during phase I, the security margin will be reduced further to allow treatment of the most peripheral portions of prostatic tissue.

TULSA-PRO has the potential to be an effective therapy option for clinicians and their patients diagnosed with localized prostate disease. The effectiveness of the device continues to be evaluated through the upcoming prospective pivotal study, with a 110-patient trial being established in over 10 institutions across Europe (Germany, The Netherlands, Spain), Canada and the United States.

References

1   Carlsson S and Vickers A, "Spotlight on prostate cancer: the latest evidence and current controversies," BMC Medicine 13:60 (2015).
2   Cooperberg M, Broering J, Kantoff P and Carroll P, "Contemporary trends in low risk prostate cancer: risk assessment and treatment," The Journal of Urology 178(3 Pt 2): S14-9 (2007).
3   Neutel C, Gao R, Blood P and Gaudette L, "The changing age distribution of prostate cancer in Canada," Canadian Journal of Public Health 98(1): 60-4 (2007).
4   Hammerer P, Kattan M, Mottet N and Prayer-Galetti T, "Using prostate-specific antigen screening and nomograms to assess risk and predict outcomes in the

management of prostate cancer," BJU International 98(1): 11-9 (2002).

5 Thompson I, Thrasher JB, Aus G, Burnett AL, Canby-Hagino ED, Cookson MS, D'Amico AV, Dmochowski RR, Eton DT, Forman JD, Goldenberg SL, Hernandez J, Higano CS, Kraus SR, Moul JW, Tangen CM; AUA Prostate Cancer Clinical Guideline Update Panel, "Guideline for the management of clinically localized prostate cancer: 2007 update," The Journal of Urology 177(6): 2106-31 (2007).

6 Rider JR, Sandin F, Andrén O, Wiklund P, Hugosson J, Stattin P. Long-term outcomes among noncuratively treated men according to prostate cancer risk category in a nationwide, population-based study. Eur Urol. 2013 Jan;63(1):88-96. doi: 10.1016/j.eururo.2012.08.001. Epub 2012 Aug 10. PMID: 22902040

7 Siddiqui MM, Rais-Bahrami S, Truong H, Stamatakis L, Vourganti S, Nix J, Hoang AN, Walton-Diaz A, Shuch B, Weintraub M, Kruecker J, Amalou H, Turkbey B, Merino MJ, Choyke PL, Wood BJ, Pinto PA. Magnetic resonance imaging/ultrasound-fusion biopsy significantly upgrades prostate cancer versus systematic 12-core transrectal ultrasound biopsy. Eur Urol. 2013 Nov;64(5):713-9. doi: 10.1016/j.eururo.2013.05.059. Epub 2013 Jun 12.

8 Dianat SS, Carter HB, Pienta KJ, Schaeffer EM, Landis PK, Epstein JI, Trock BJ, Macura KJ. Magnetic resonance-invisible versus magnetic resonance-visible prostate cancer in active surveillance: a preliminary report on disease outcomes. Urology. 2015 Jan;85(1):147-53. doi: 10.1016/j.urology.2014.06.085. Epub 2014 Oct 16.

9 Chin JL1, Billia M2, Relle J3, Roethke MC4, Popeneciu IV5, Kuru TH5, Hatiboglu G5, Mueller-Wolf MB4, Motsch J5, Romagnoli C2, Kassam Z2, Harle CC2, Hafron J3, Nandalur KR3, Chronik BA2, Burtnyk M6, Schlemmer HP4, Pahernik S5. Magnetic Resonance Imaging-Guided Transurethral Ultrasound Ablation of Prostate Tissue in Patients with Localized Prostate Cancer: A Prospective Phase 1 Clinical Trial. Eur Urol. 2016 Jan 6. pii: S0302-2838(15)01238-5. doi: 10.1016/j.eururo.2015.12.029. [Epub ahead of print]

10 Chopra R, Colquhoun A, Burtnyk M, N'djin WA, Kobelevskiy I, Boyes A, Siddiqui K, Foster H, Sugar L, Haider MA, Bronskill M and Klotz L, "MR imaging-controlled transurethral ultrasound therapy for conformal treatment of prostate tissue: initial feasibility in humans," Radiology 265(1): 303-13 (2012).

11 Burtnyk M, Chopra R and Bronskill M, "Simulation study on the heating of the surrounding anatomy during transurethral ultrasound prostate therapy: A 3D theoretical analysis of patient safety," Medical Physics 37(6): 2862-75 (2010).

12 Fütterer JJ, Briganti A, De Visschere P, Emberton M, Giannarini G, Kirkham A, Taneja SS, Thoeny H, Villeirs G and Villers A, "Can clinically significant prostate cancer be detected with multiparametric magnetic resonance imaging? A systematic review of the literature," European Urology 68(6): 1045-53 (2015).

13 American Cancer Society, http://www.cancer.org/cancer/prostatecancer

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