

**TRANS RECTAL ULTRASOUND GUIDED HIGH
DOSE RATE INTERSTITIAL BRACHYTHERAPY
FOR CARCINOMA PROSTATE**

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& TEAM***

**MANIPAL HOSPITAL
BANGALORE**



CARCINOMA PROSTATE

- Uncommon malignancy
- Implantable cases are rare
 - 22 / 1000 LDR 10 years
 - 21 / 500 HDR 5 years
- Inappropriate training
- TRUS & brachytherapy under one roof
- Dedicated systems are expensive



BRACHYTHERAPY

- Accessibility -- good
- Imaging -- amenable
- Invasiveness -- minimal
- Radiation tolerance -- good
- Dose escalation -- beneficial
- Dispensability -- high
- Critical organs -- close by



INDICATIONS

- Stage T1b to T3b
 - Any Gleason score
 - Any PSA level
 - M0
-
- Low risk -- monotherapy
 - Intermediate / high risk – as boost



CONTRAINDICATIONS

ABSOLUTE

- M1 disease
- Medically unfit for anesthesia
- Life expectancy < 5 years
- Technically not feasible to implant whole gland

RELATIVE

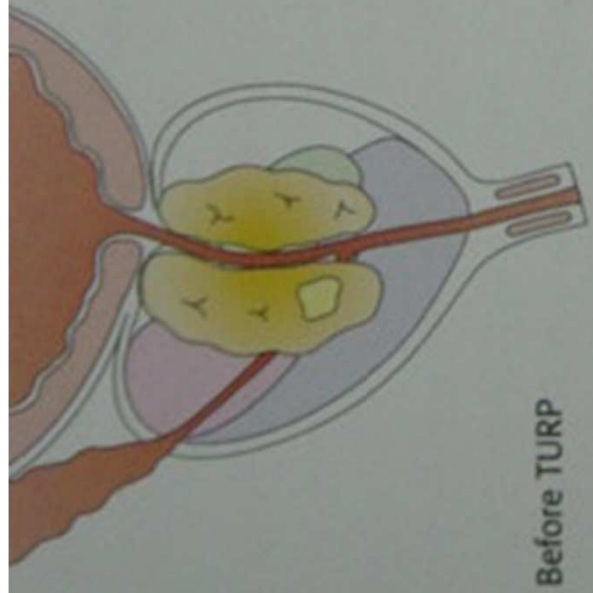
- Gland > 80 cc → Pubic arch interference
- TURP last six months or large TURP defect
- Obstructive urinary symptoms IPSS > 14
- Prior pelvic radiotherapy



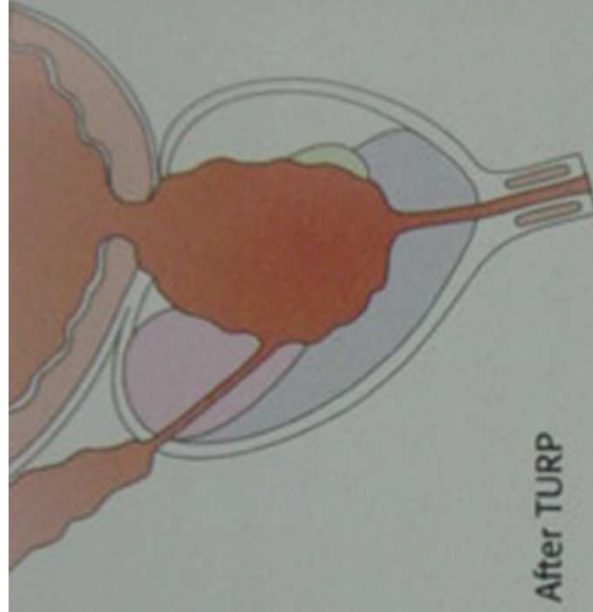
TURP

- Mostly unnecessary
- If IPSS >20 (shows obstruction)
- Complications
- Poor survival
- Delays RT by 3-6 months.
- Excessive urinary morbidity.



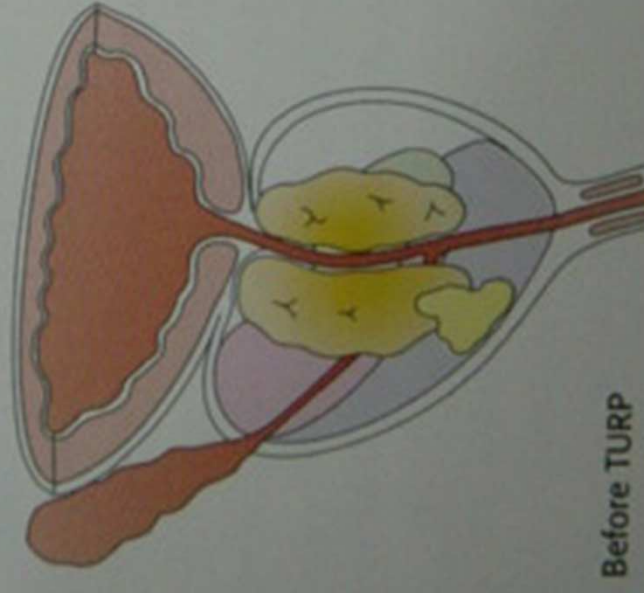


Before TURP

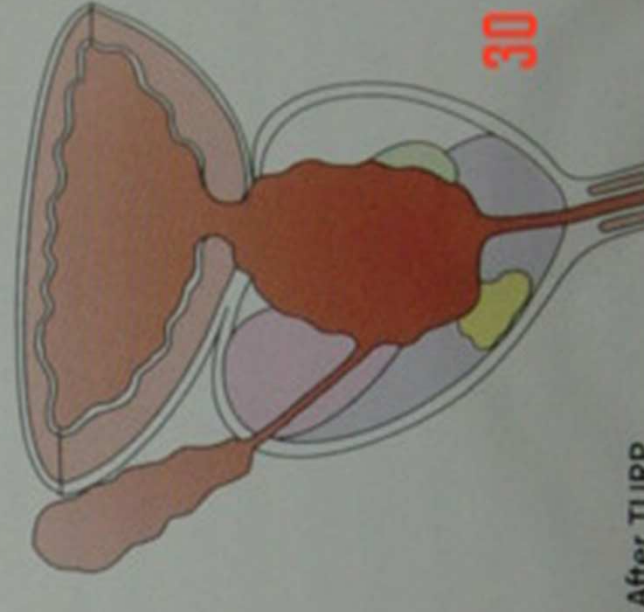


After TURP

T1b



Before TURP



After TURP

30

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BRACHYTHERAPY - TYPES

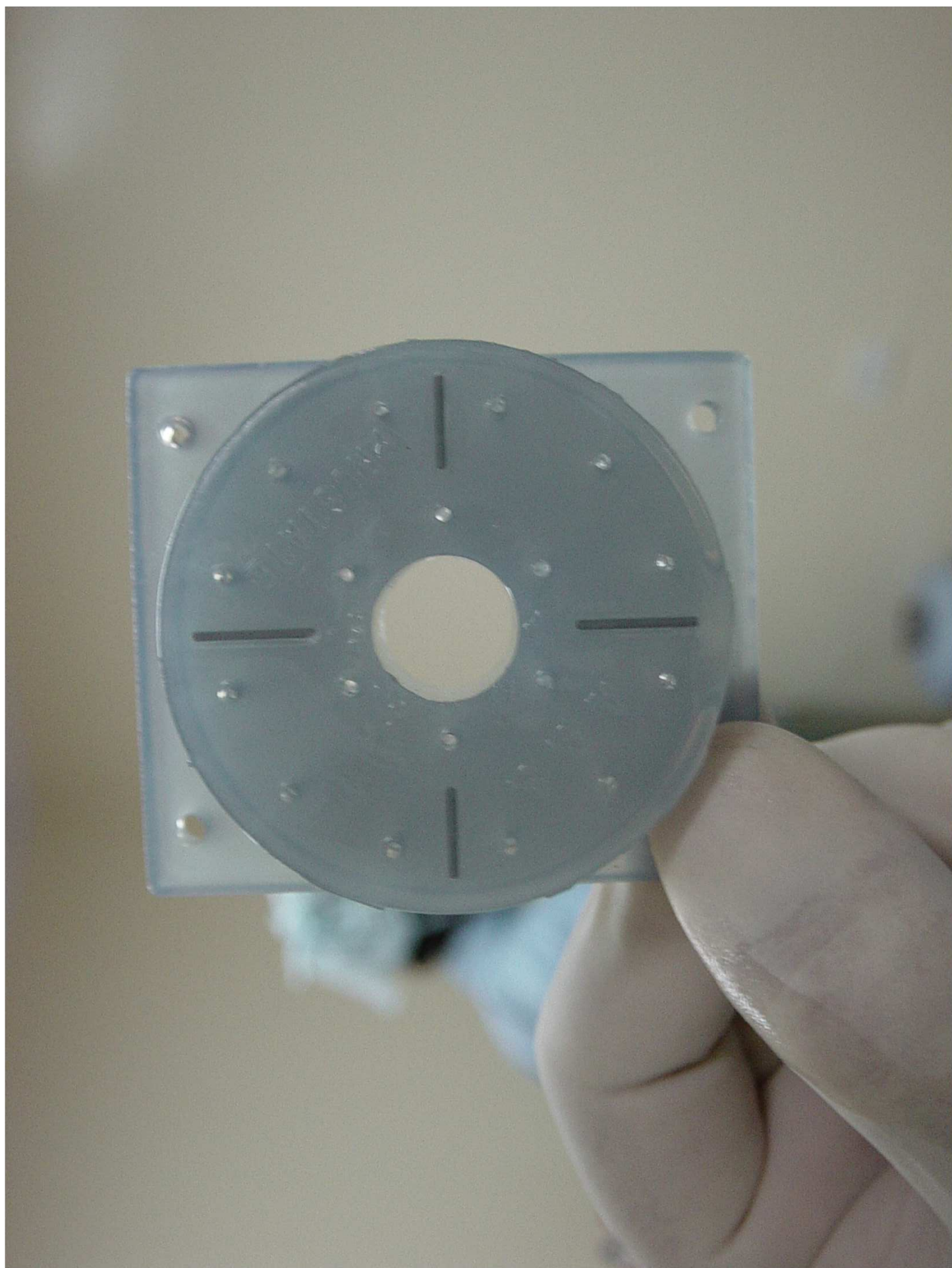
- Permanent seed implants
- Manually afterloaded low dose rate (LDR)
- Remote afterloaded high dose rate (HDR)



SPECIAL CONSIDERATIONS

- Pre op. low residue diet
- Pre op. laxatives / enema
- Liquid diet intra op.
- Flatus tube
- Three way urinary catheter
- Epidural anaesthesia and analgesia

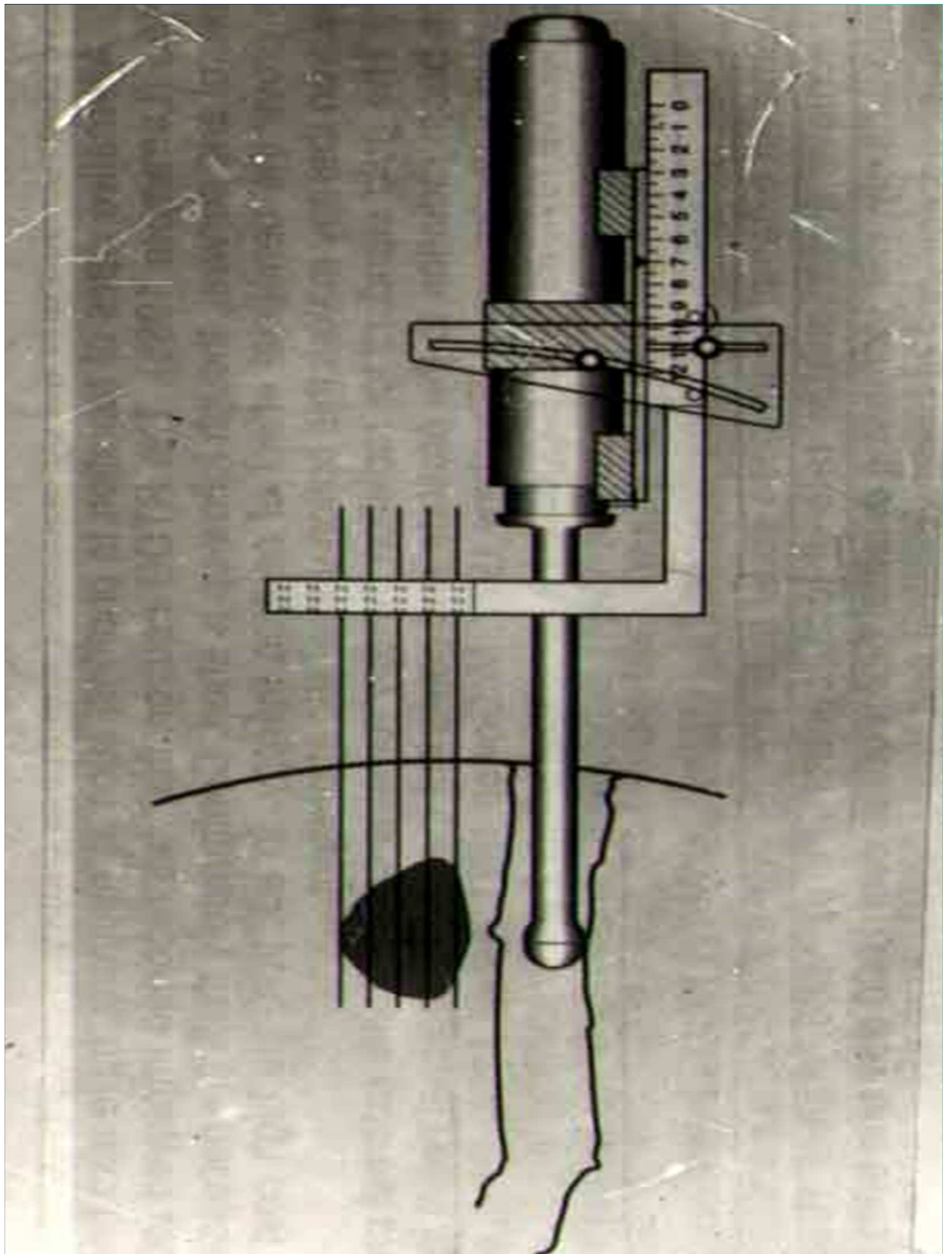




TRUS GUIDED BRACHYTHERAPY

- Allows direct and continuous visualization of the relationship between
 - Rectal wall
 - Urethra
 - Urinary bladder
 - Prostate contour
- Precise dose delivery system
- Very effective treatment



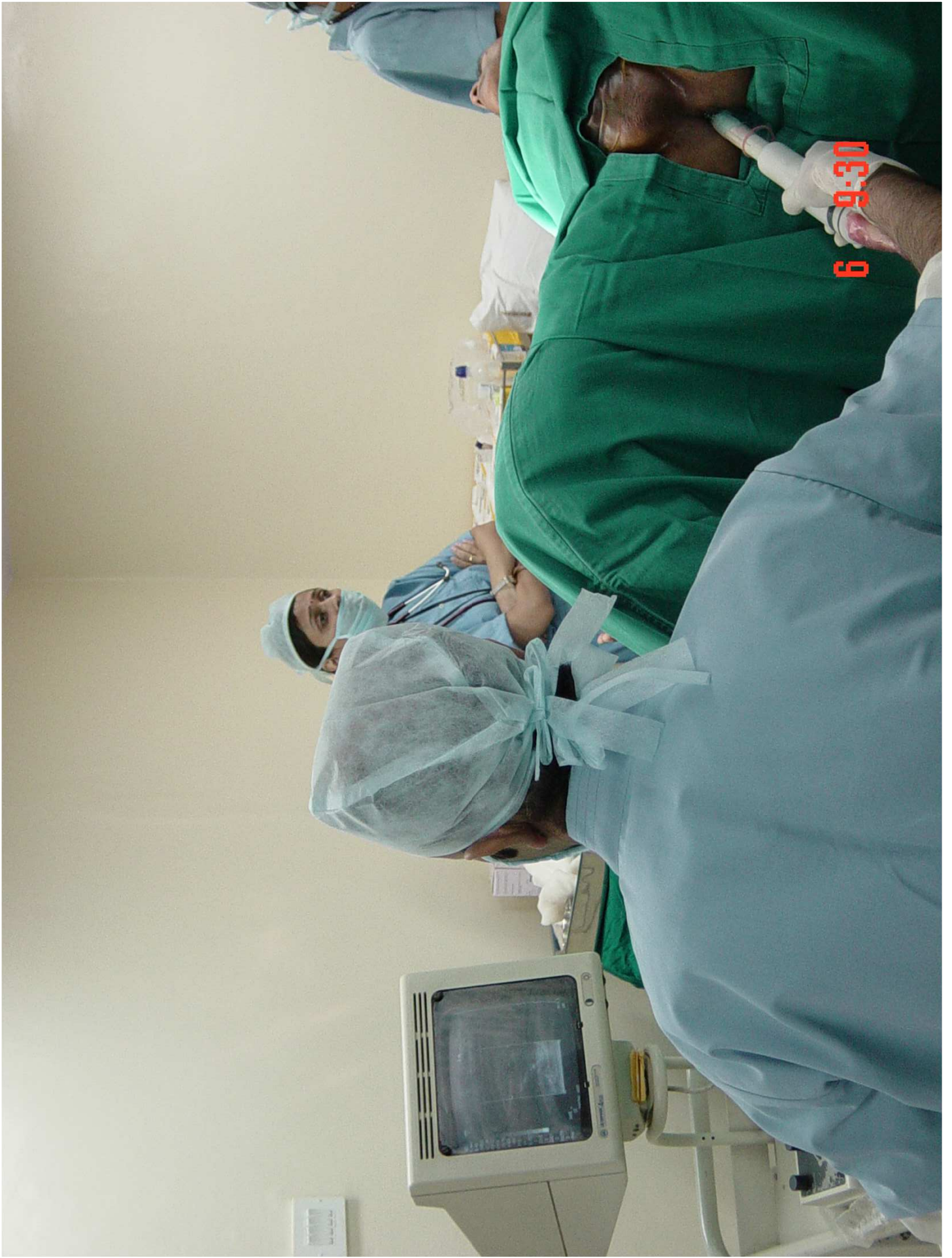




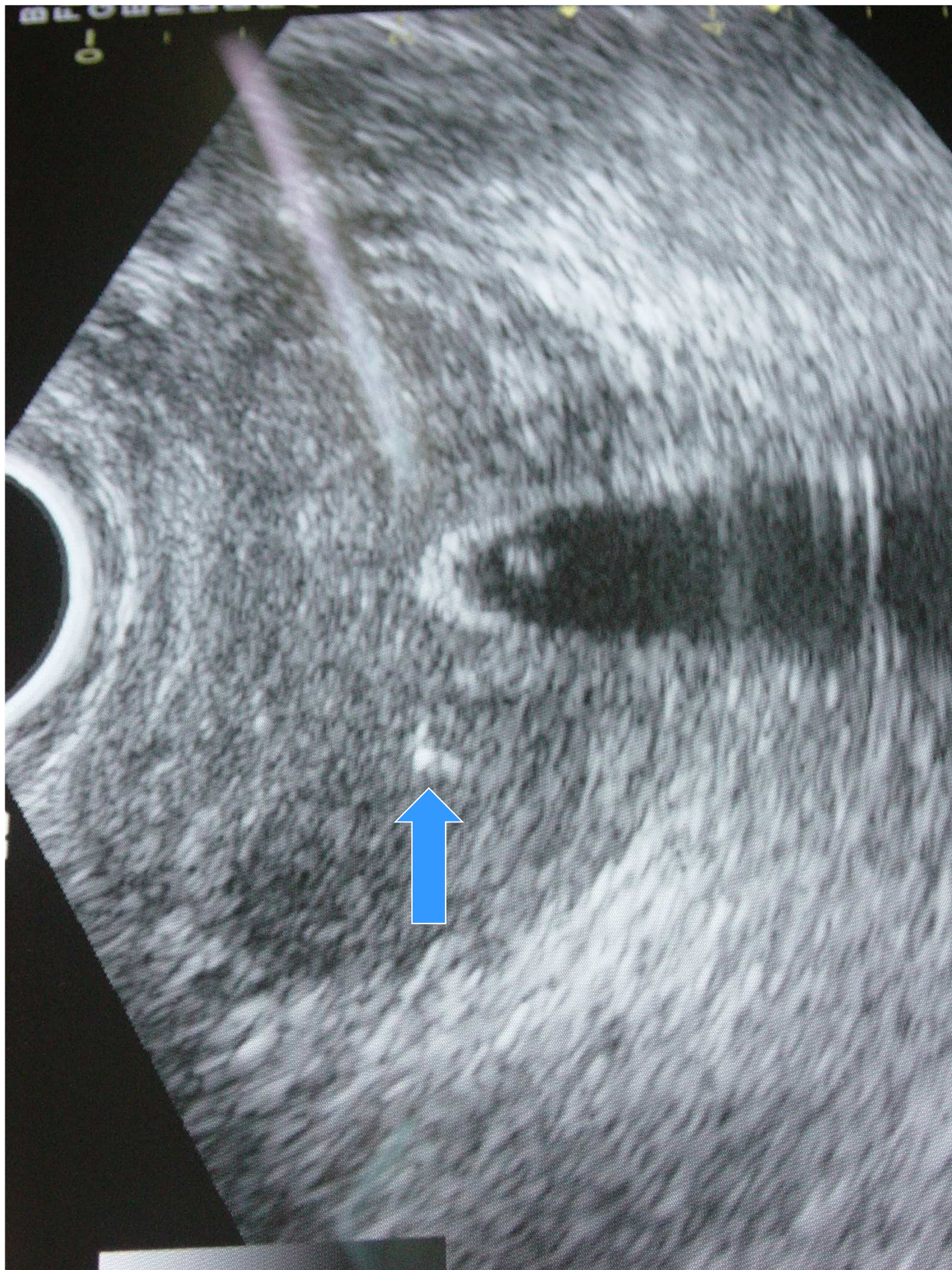


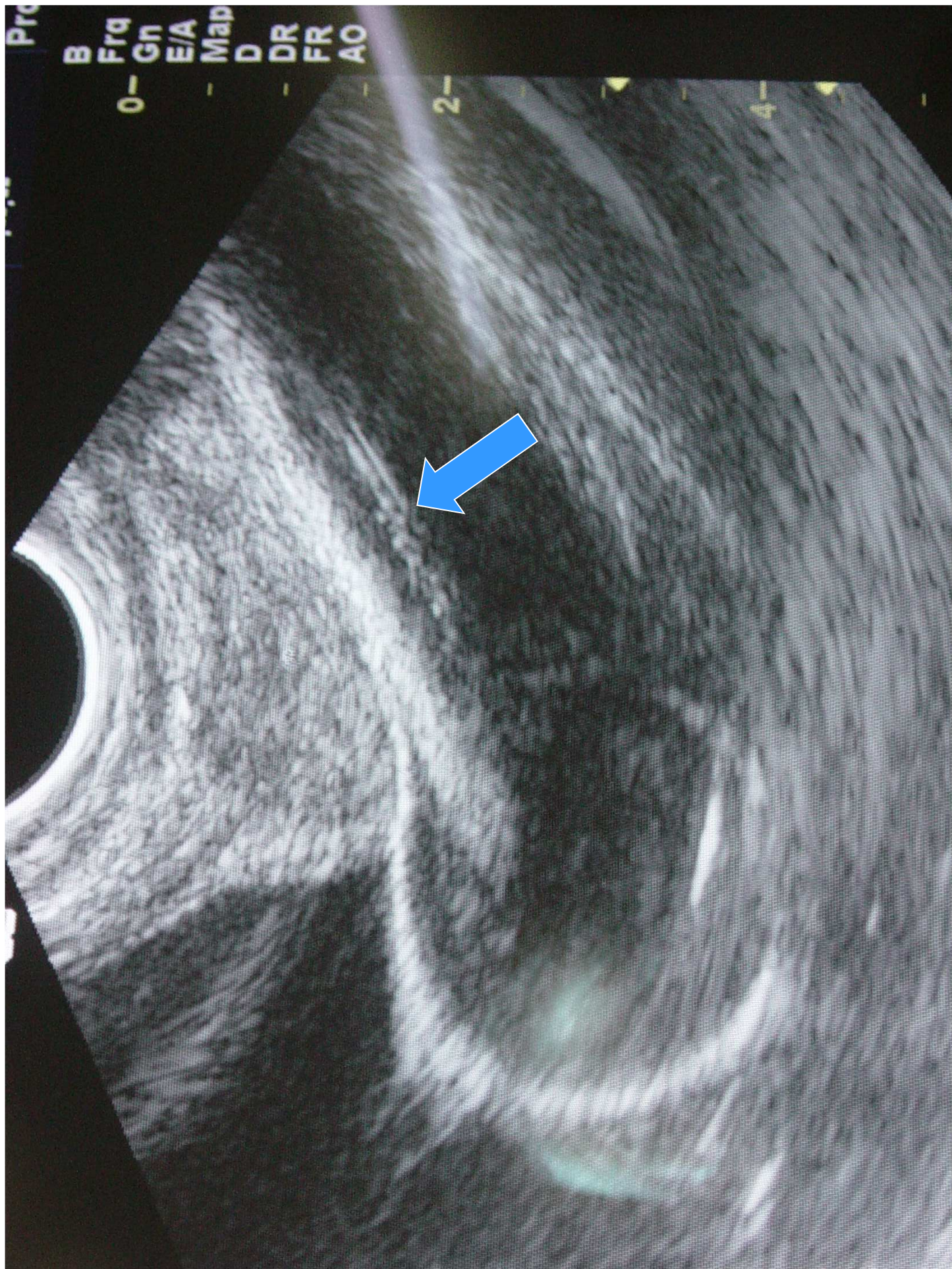
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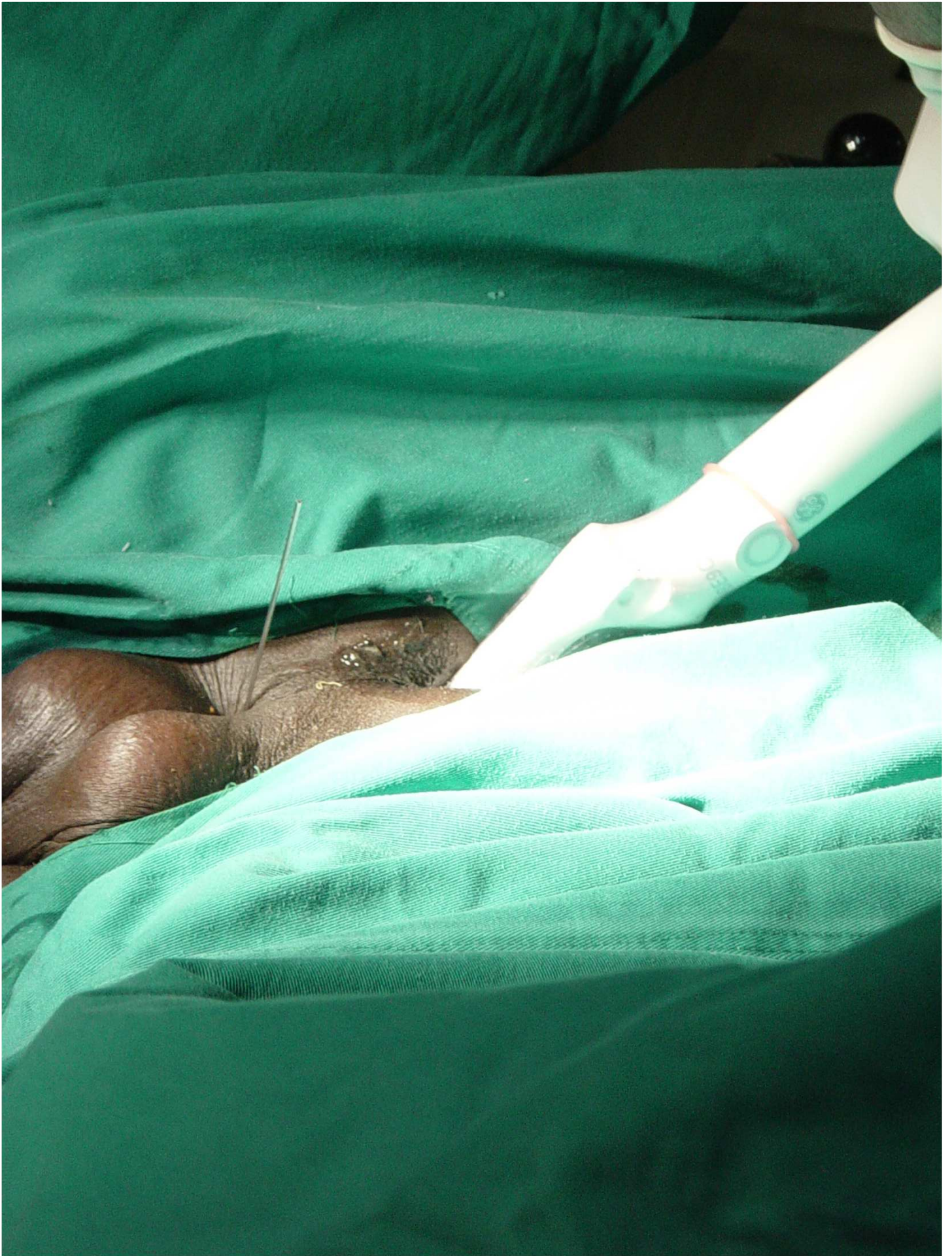












MI 0.27 T1s 0.2 BE9CT

Prostate

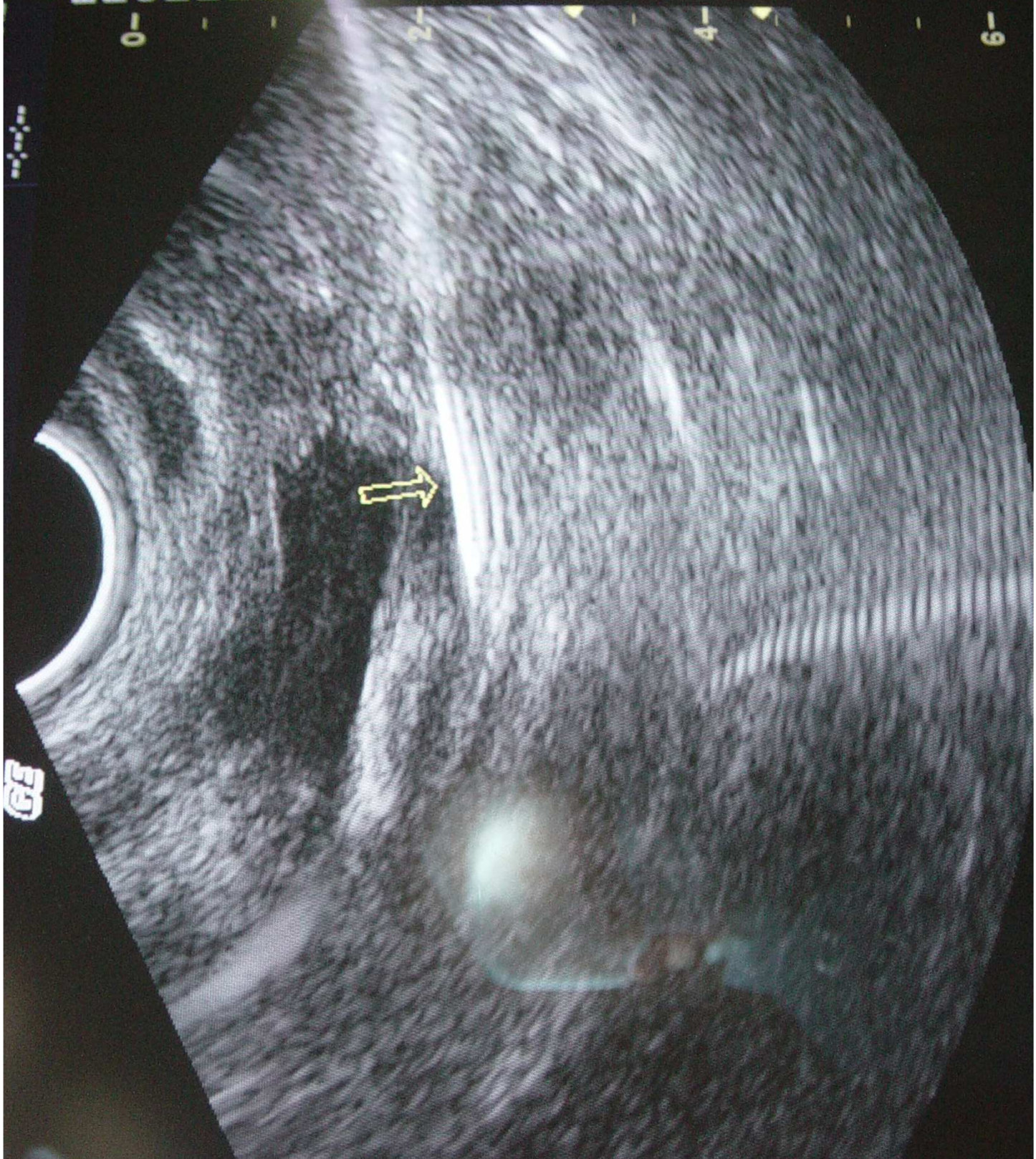
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0-	Gn	80
-	E/A	1/3
-	Map	C10
-	D	6.0 cm
-	DR	72
-	FR	15 Hz
-	AO	100 %



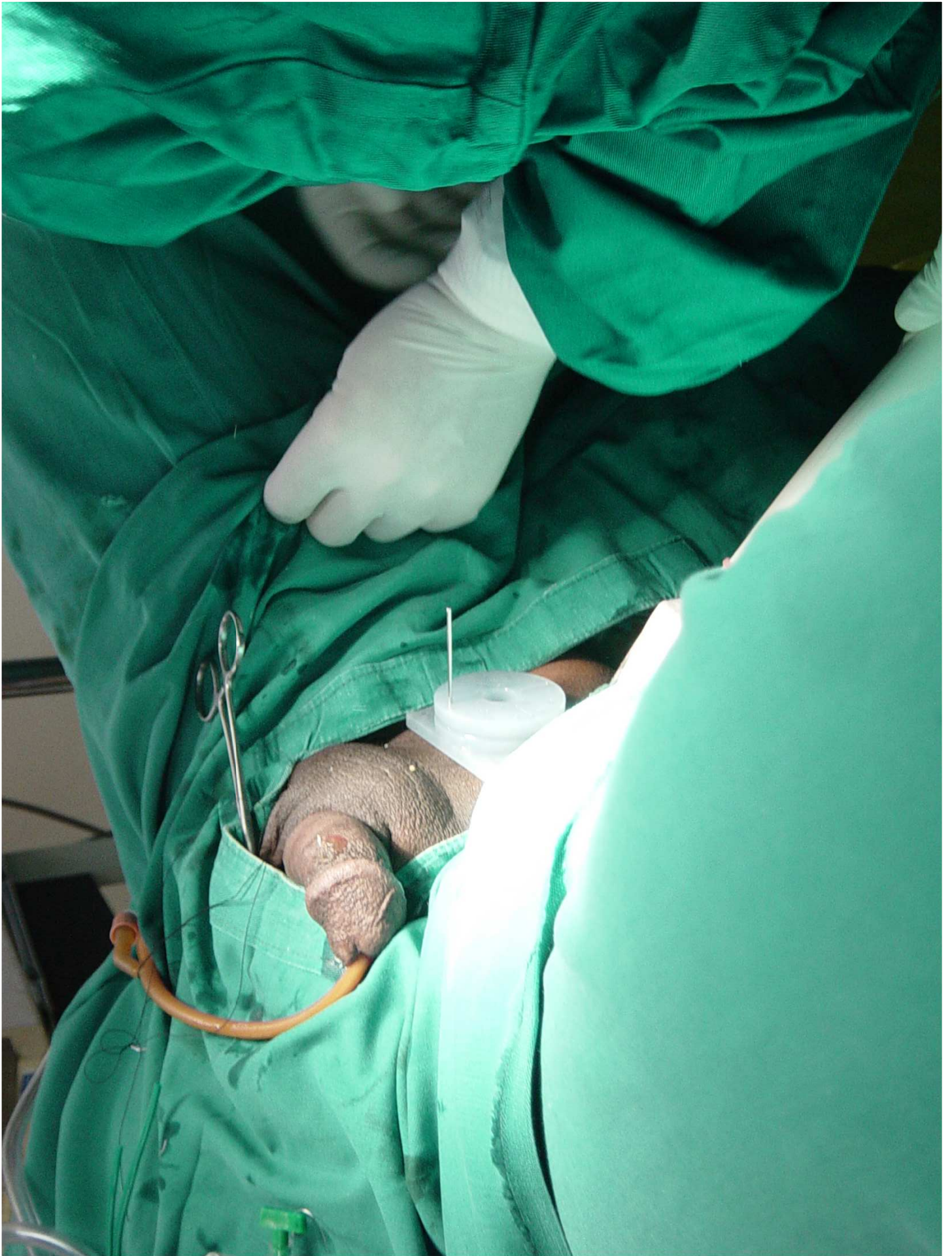
GE

Prostate

B Frq 8.0 MHz
0- Gn 80
E/A 1/3
Map C.0
D 6.0 cm
DR 72
FR 15 Hz
AO 100 %



6-









01/08/06 9:03:03 AM

MI 0.27 TIs 0.2 BEECT
Prostate

B
Fid 9.0 MHz
Gn 80
EIA 1.3
Map C10
D 6.0 cm
DR 72
FR 15 Hz
AO 100 %



Menu
sem Vesicle
Rectum
fibromusc St
Urethra
Base
Sag
Prox
Dist
Left
Lower

Menu
Delete
Active



5 ToolTip Device
Test Overlay
Annot
Scroll

4 Edit Last
Undo

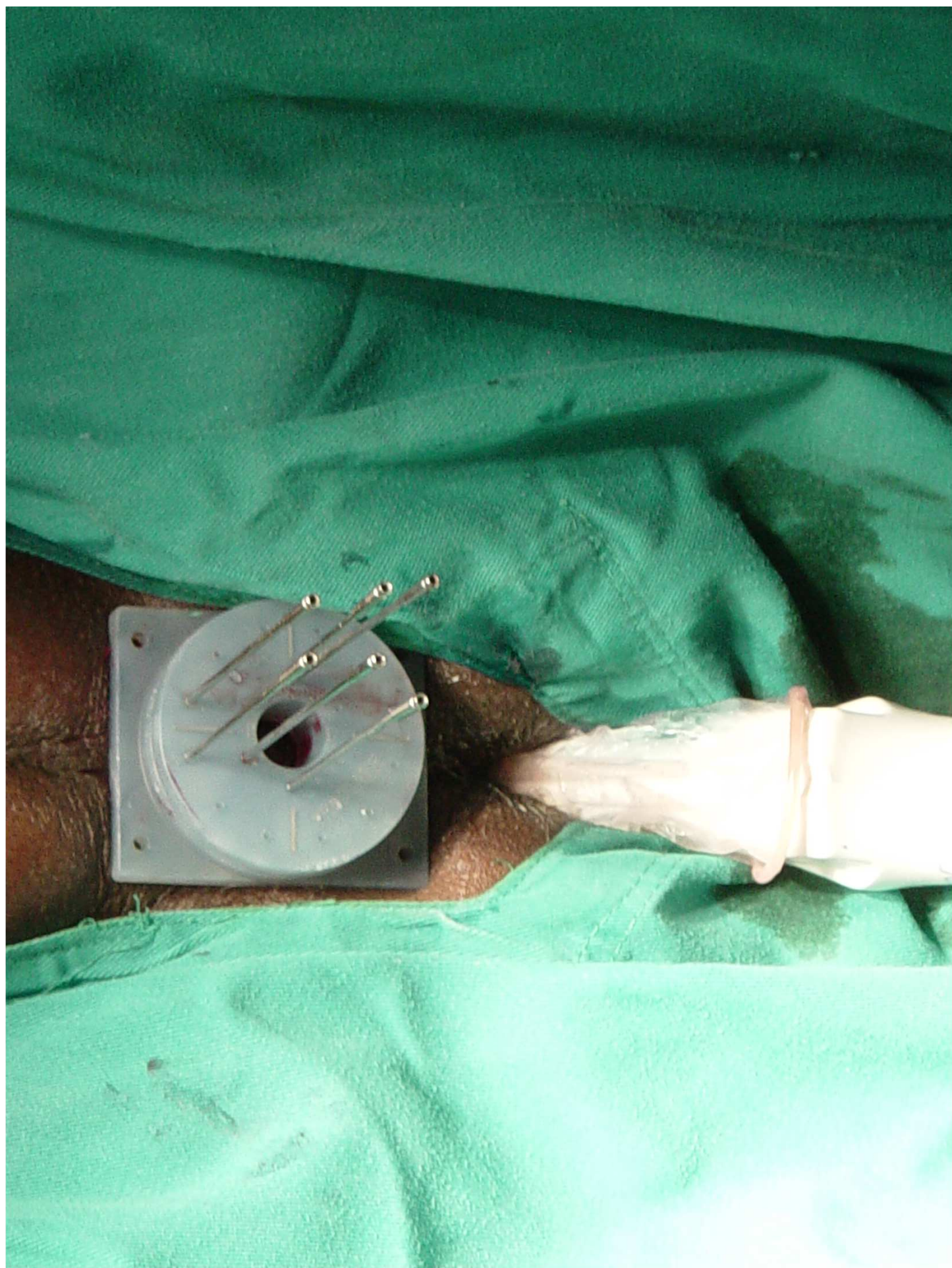
3 Arrow Width
Comment Set

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Delete

1 Right

0- Gn
E/A
Map
D DR
FR
AO





0 1100100 0.00.20 FMI

GE

Prostate

B
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Gn 96
E/A 1/3
Map C.0
D 6.0 cm
DR 72
FR 15 Hz
AO 100 %

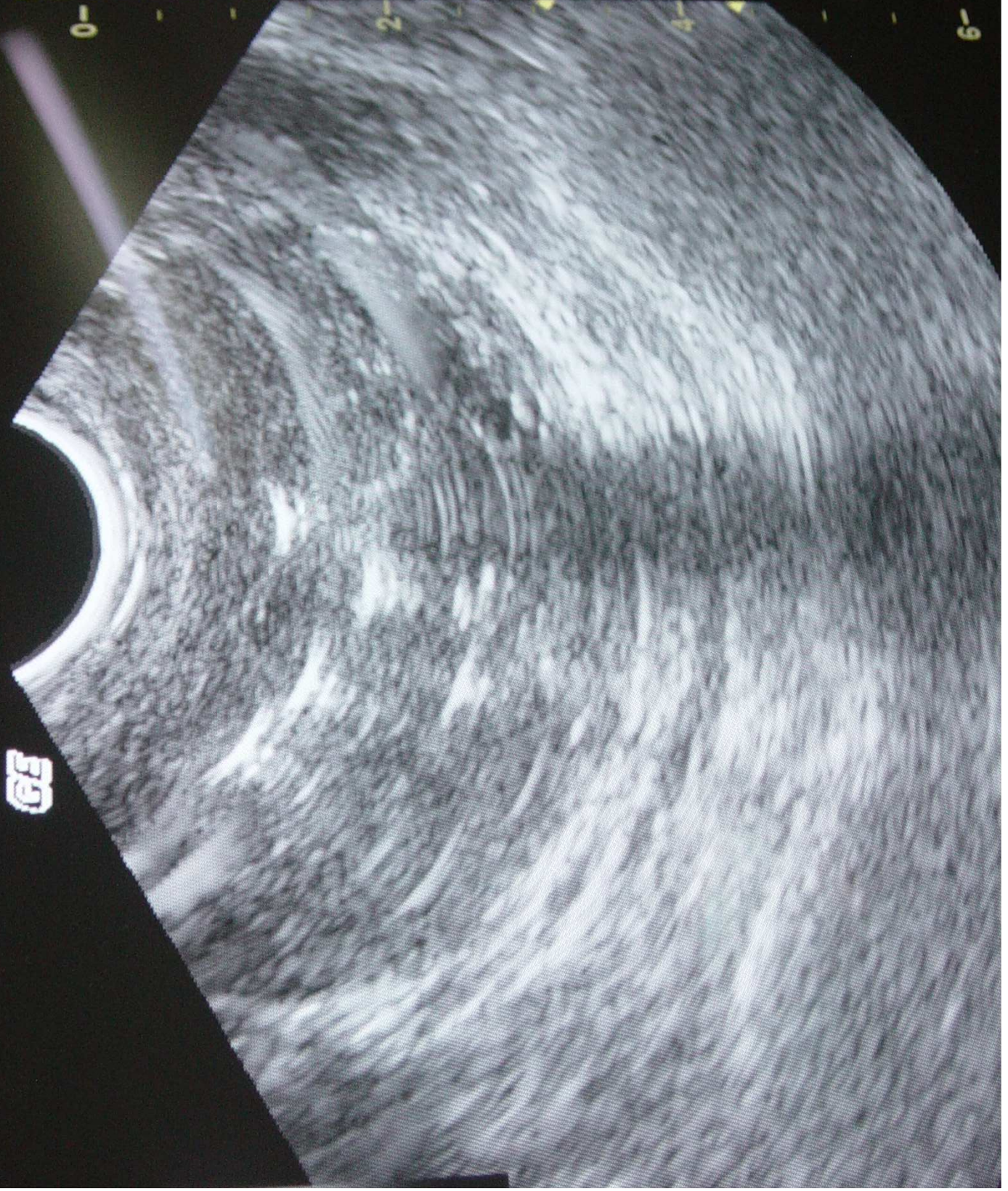
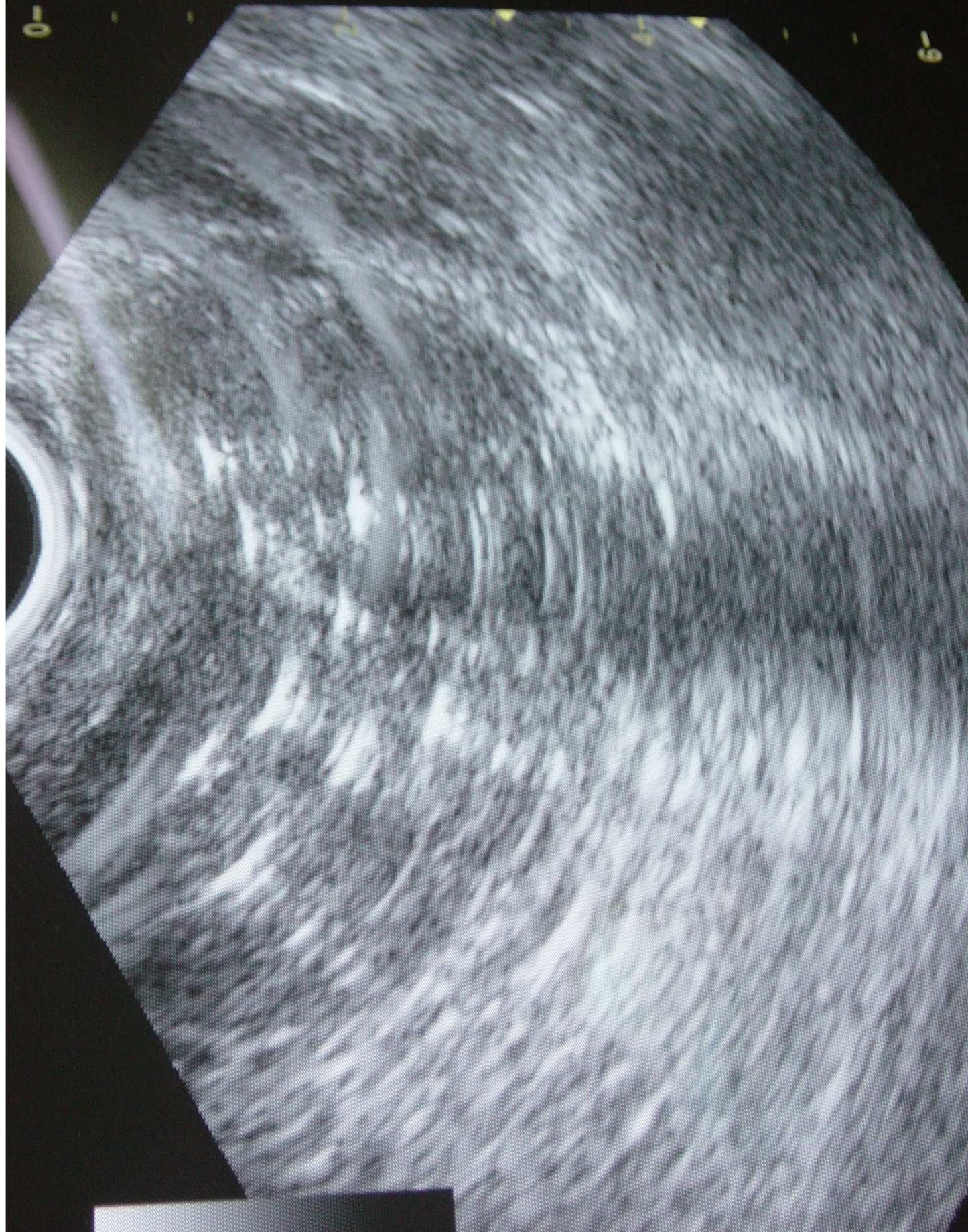
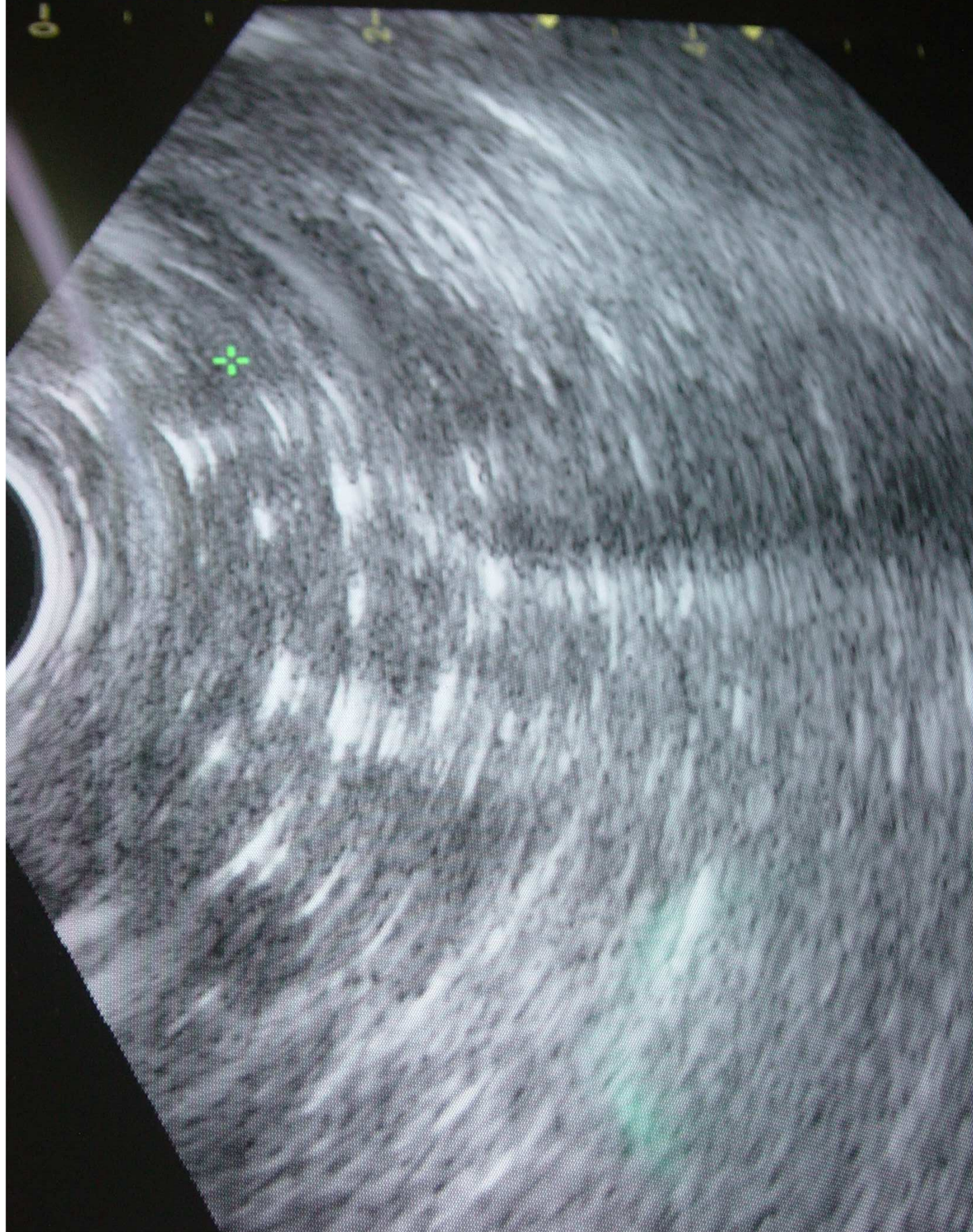


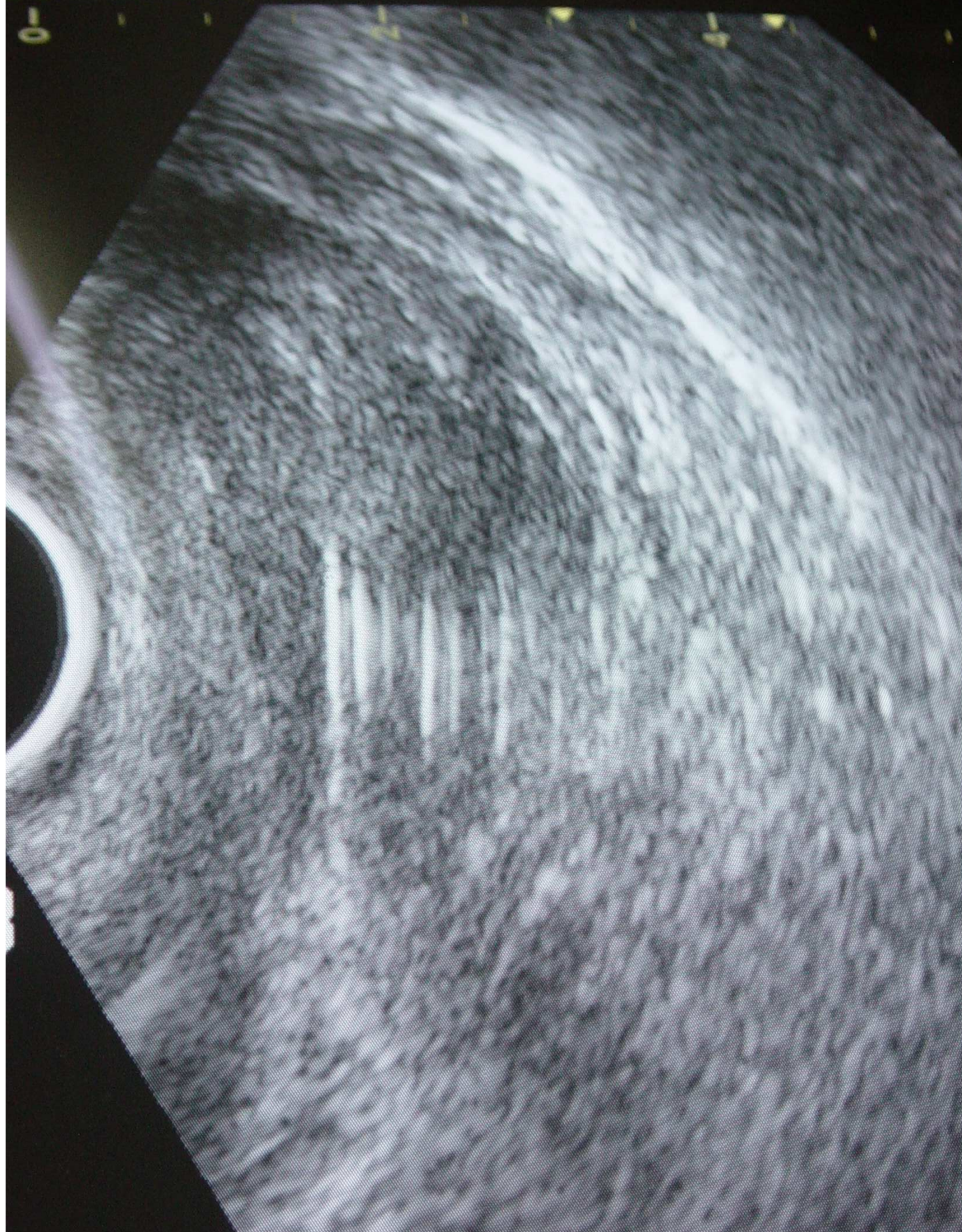
FIG
0- Gn
E/A
Map
D DR
FR
AO



Frq
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0- Gn E/A Ma D DR FR AO



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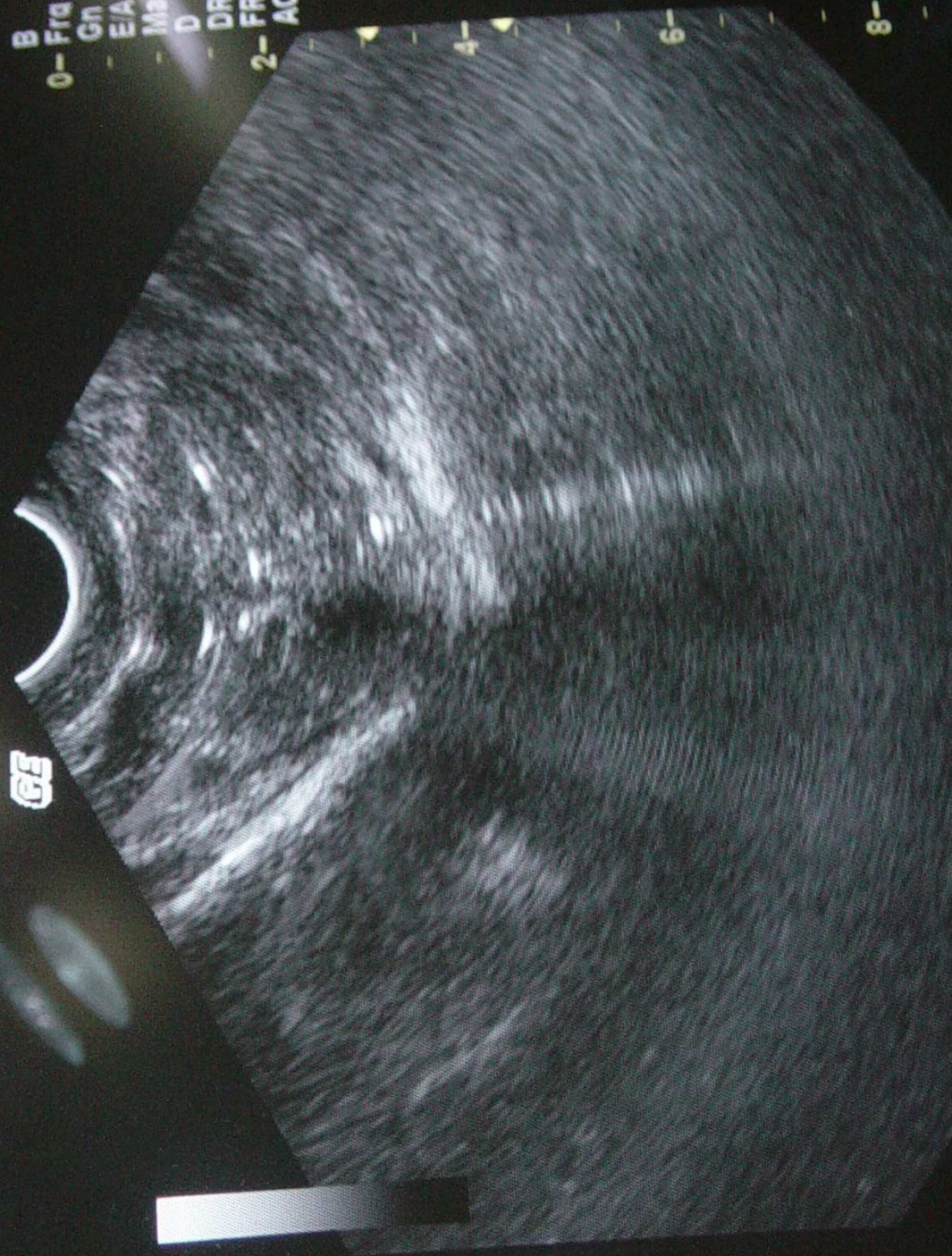


SHABBIR HUSSAIN

MI 0.30 TIs 0.2 BE9CT

Prostate

B 0-Frq 8.0 MHz
Gn 76
E/A 10
Map C0
D 9.0
DR 72
FR 20
2-AO 100



Urology

Urology

Urology

Bladder(0.7)

Prostate

Renal

Bladder

BladderVol(0.7)

Prostate Vol

Renal Vol

Bladder Vol

Worksheet Display



MANIPAL HOSPITAL

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SHABBIR HUSSAIN

MI 0.30 TIs 0.2 BE9CT

Prostate

B
0- Frq 8.0 MHz
Gn 76
E/A 1/3
Map C/D
D 9.0 cm
DR 72
FR 20 Hz
2- AO 100 %



3.73 cm

Menu
Delete

LOGIQ 5 PRO



MANIPAL HOSPITAL

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SHABBIR HUSSAIN

MI 0.30 TIs 0.2 BE9CL
Prostate

B
0- Frq 8.0 MHz
Gn 76
E/A 1/3
Map C.0
D 9.0 cm
DR 72
2- FR 20 Hz
AO 100 %



3:649 (24.1:33.1 s)

Menu

Frq 8.0 MHz
Gn 76
E/A 1/3
Map C/D
D 5.0 cm
DR 72
FR 16 Hz
AO 100 %

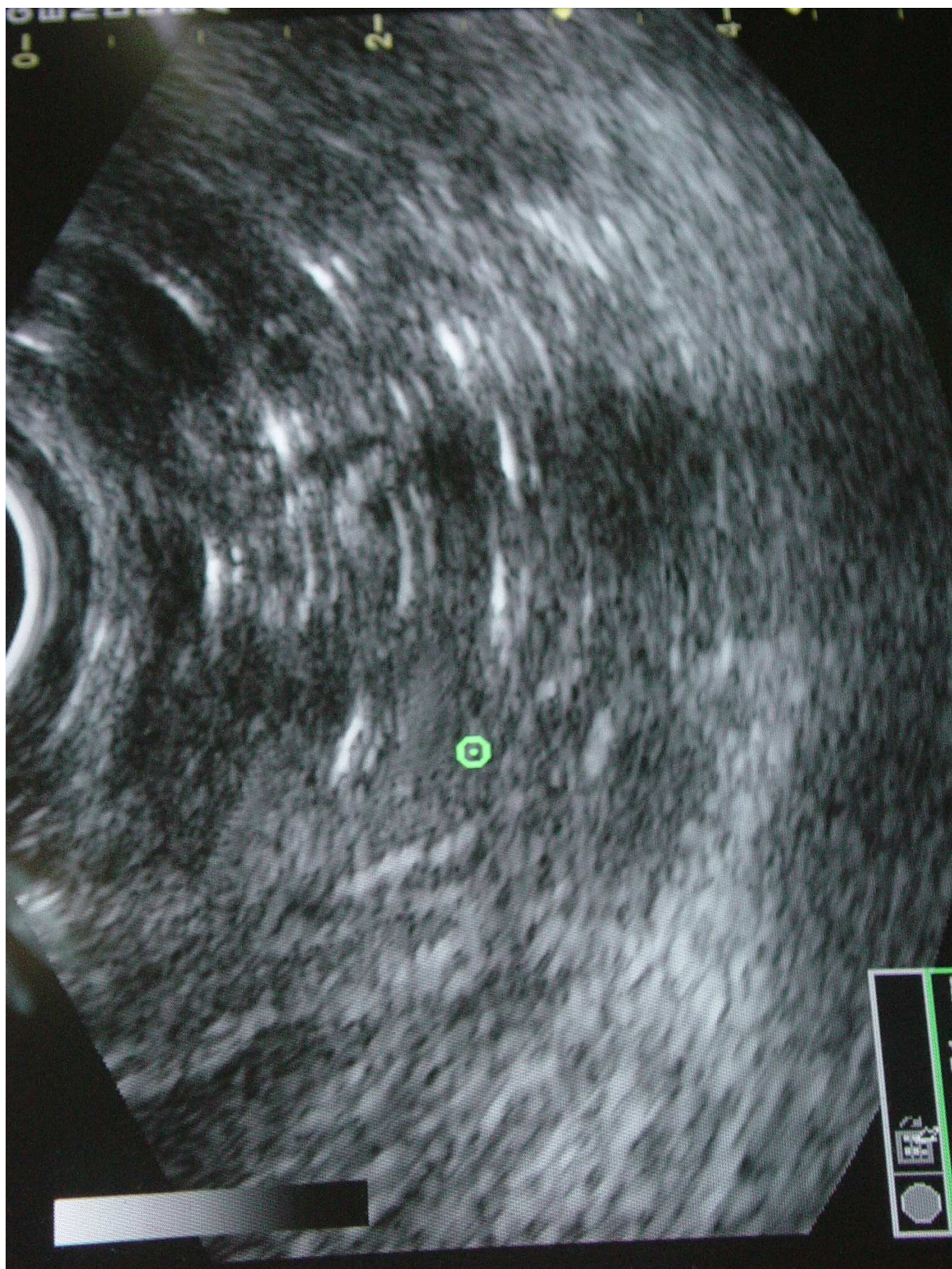
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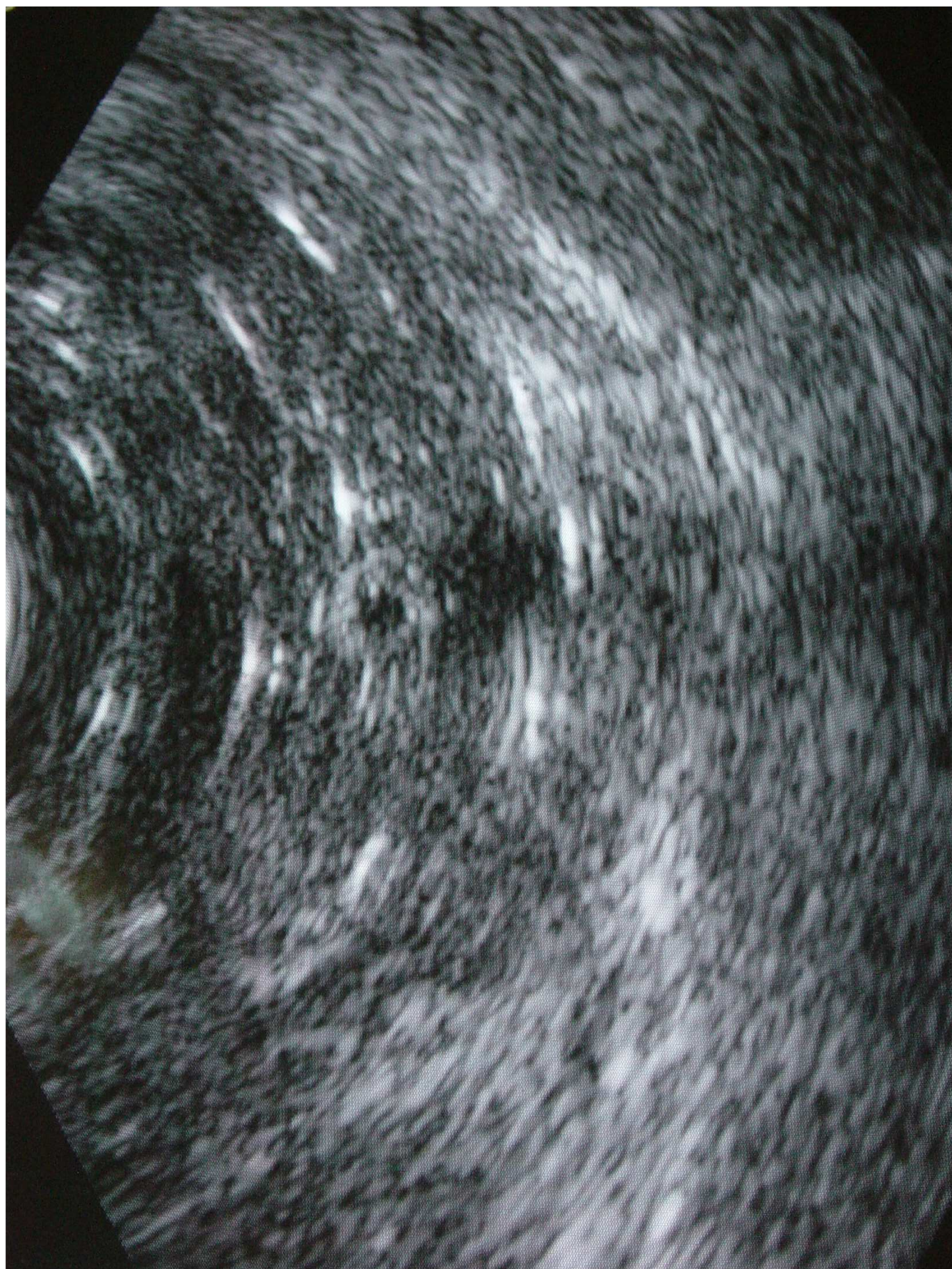
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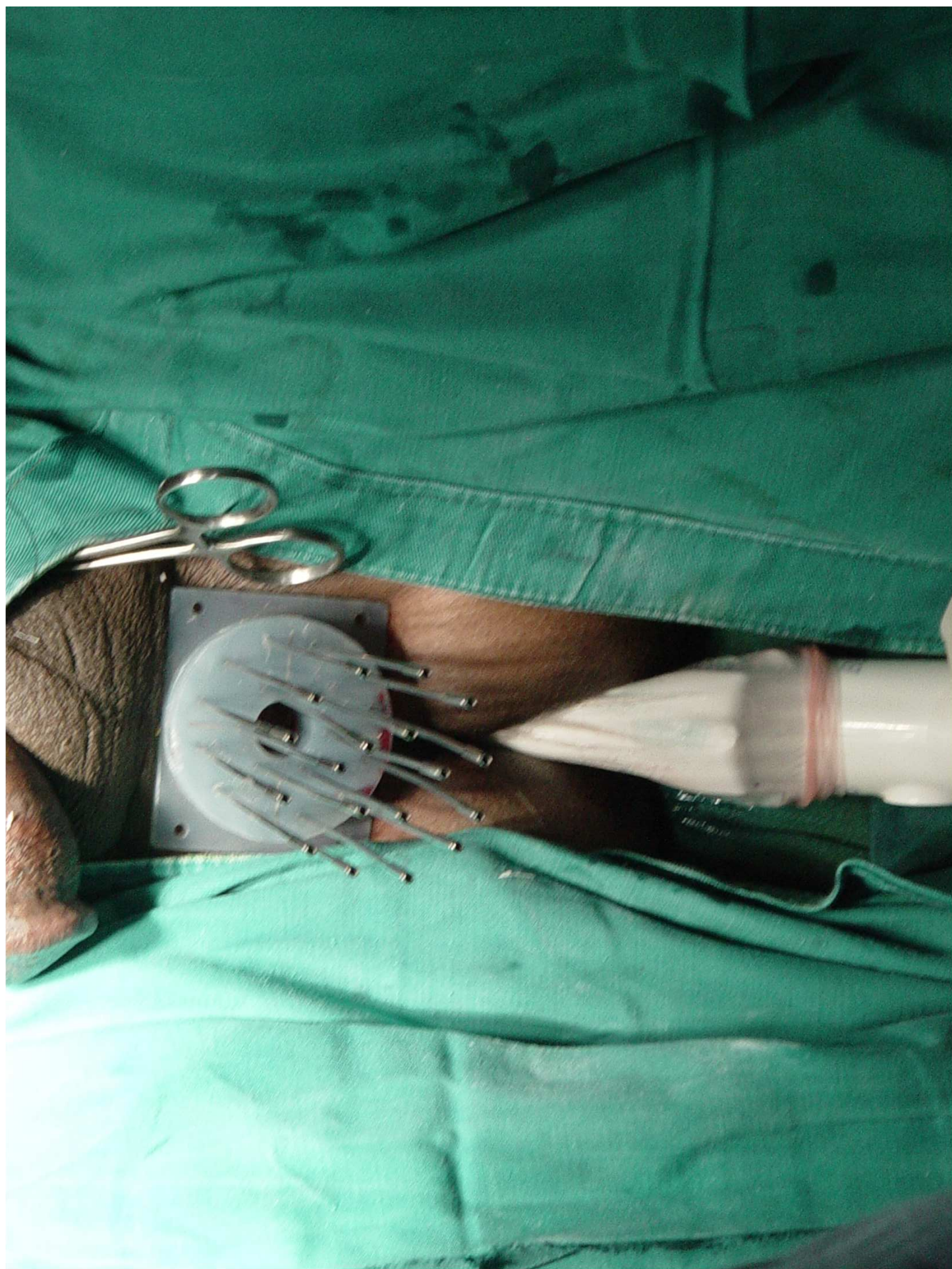
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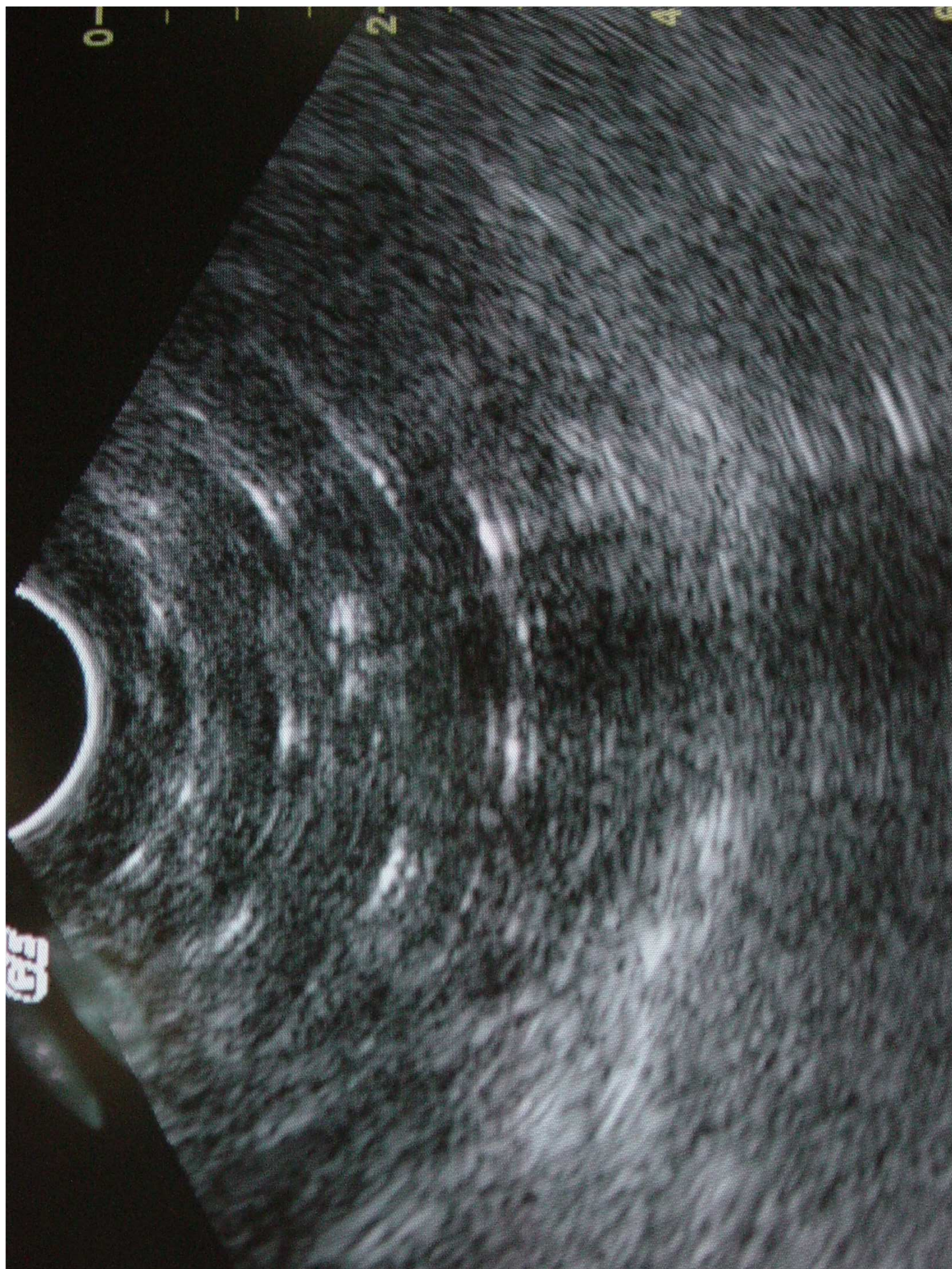
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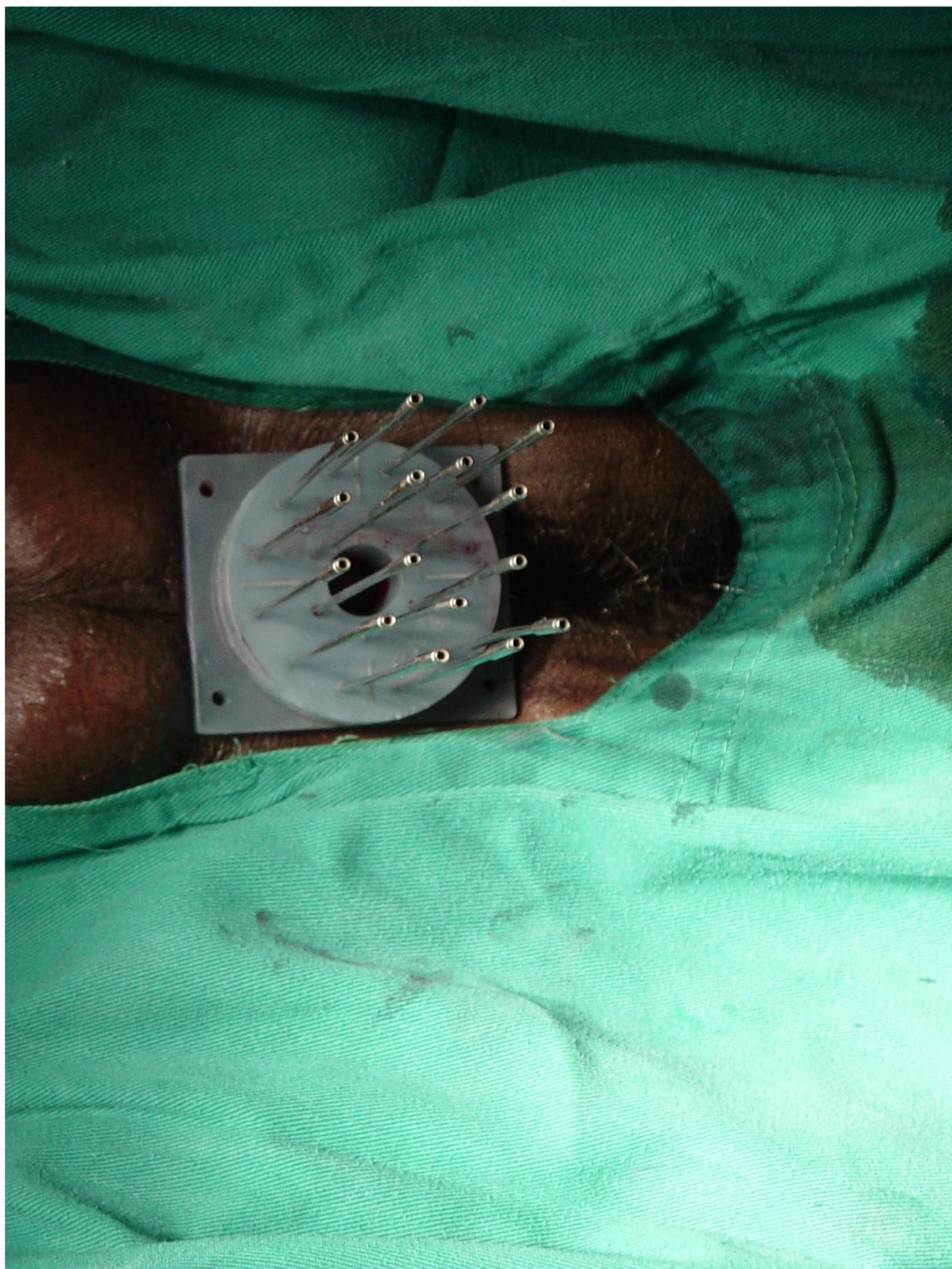






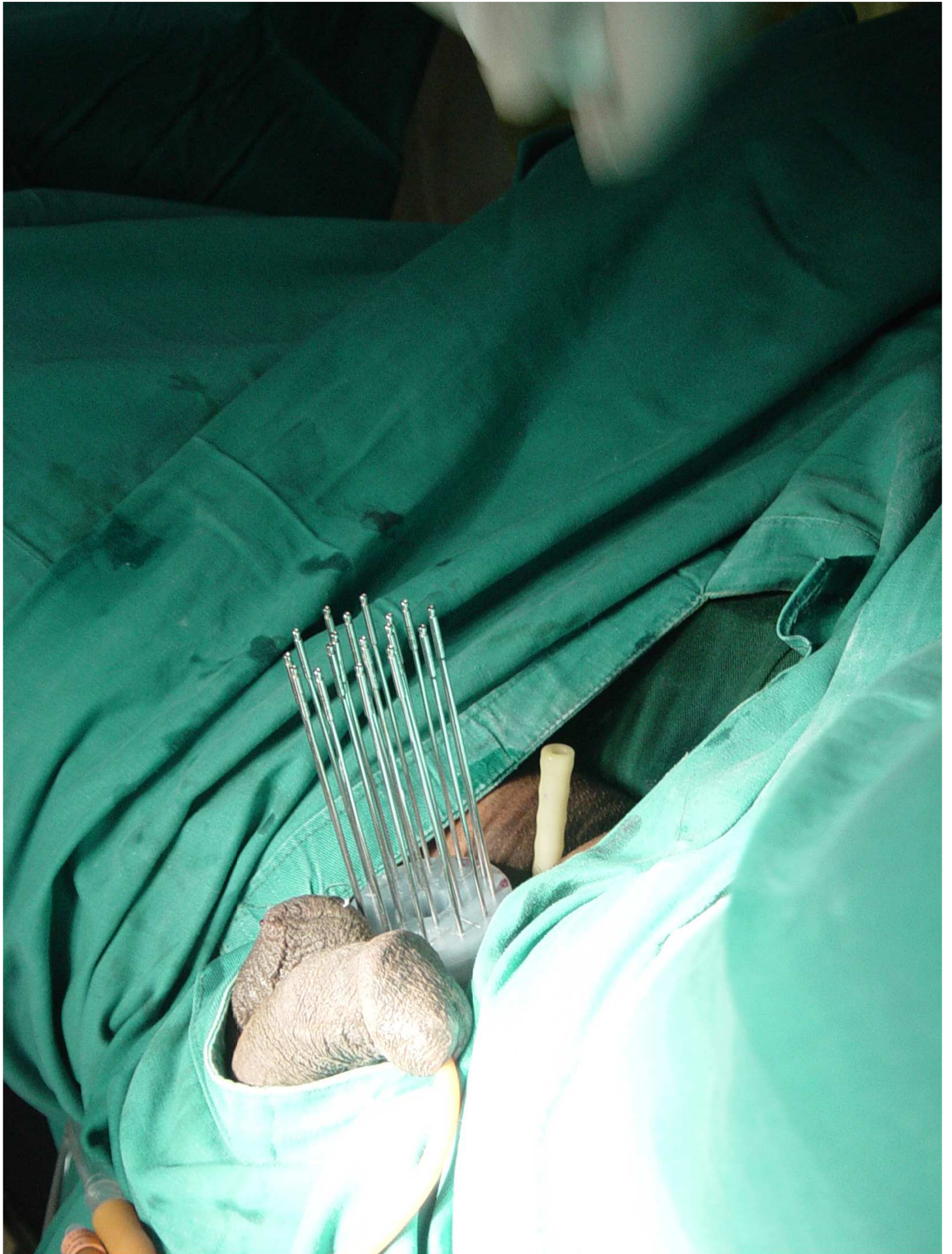


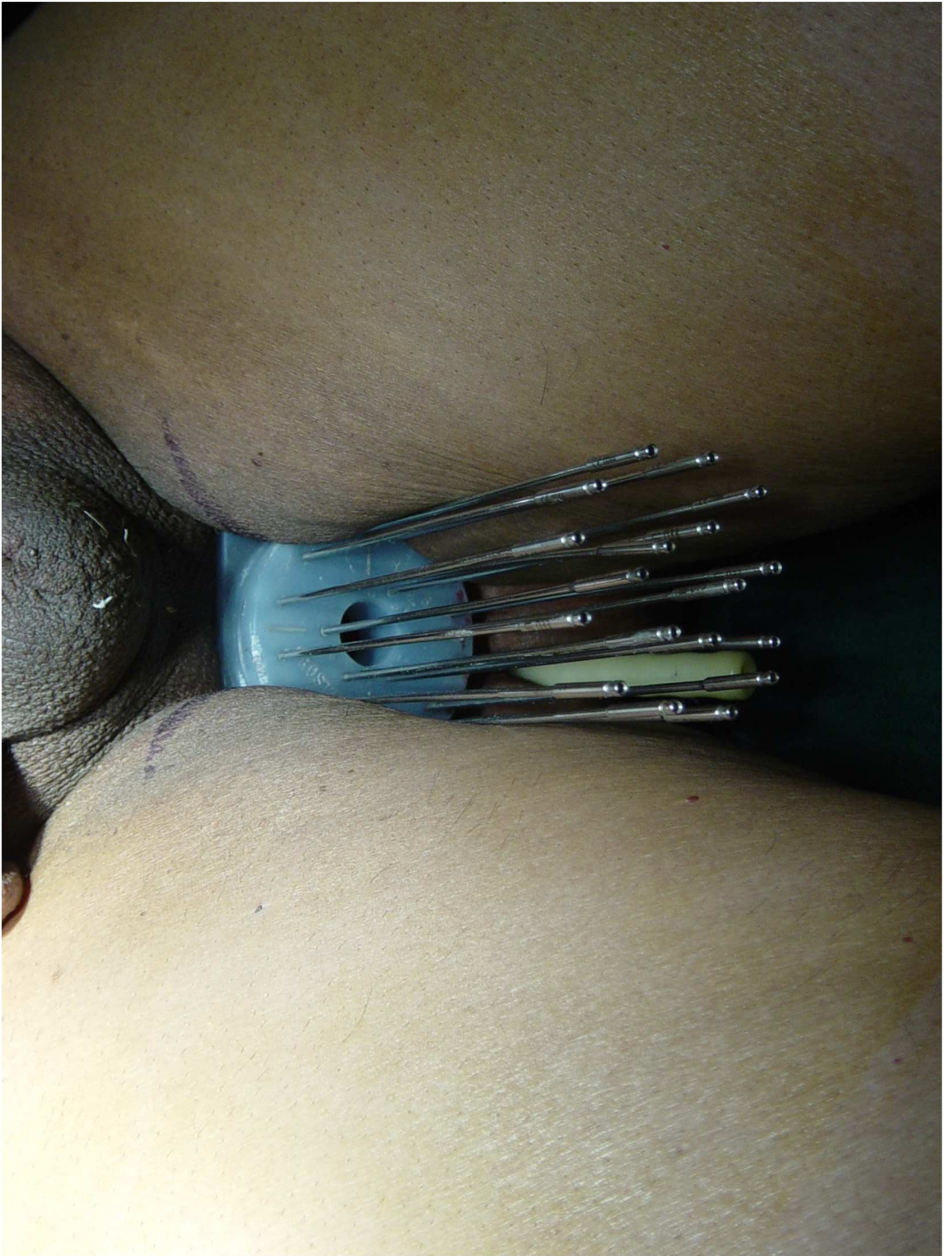




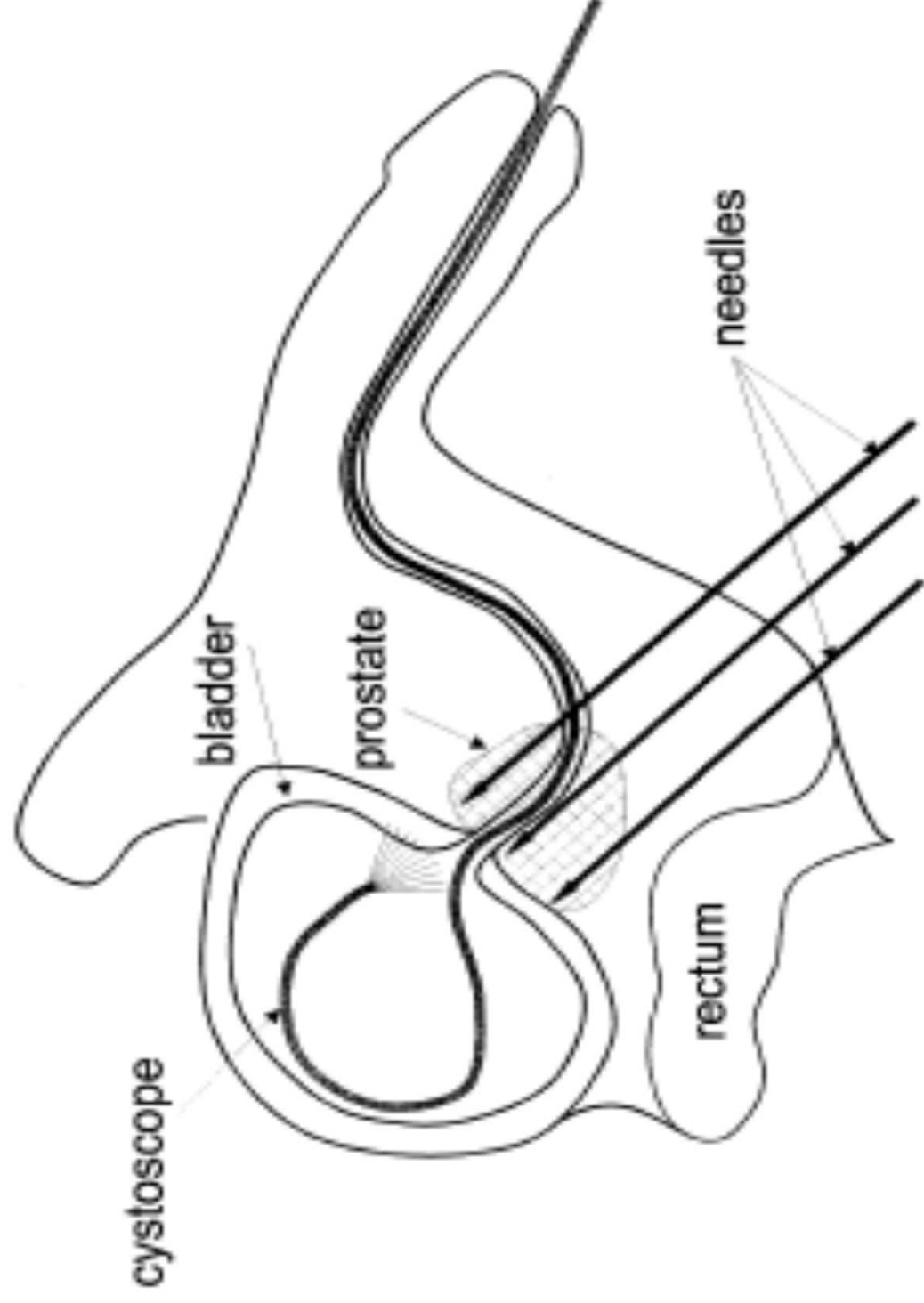


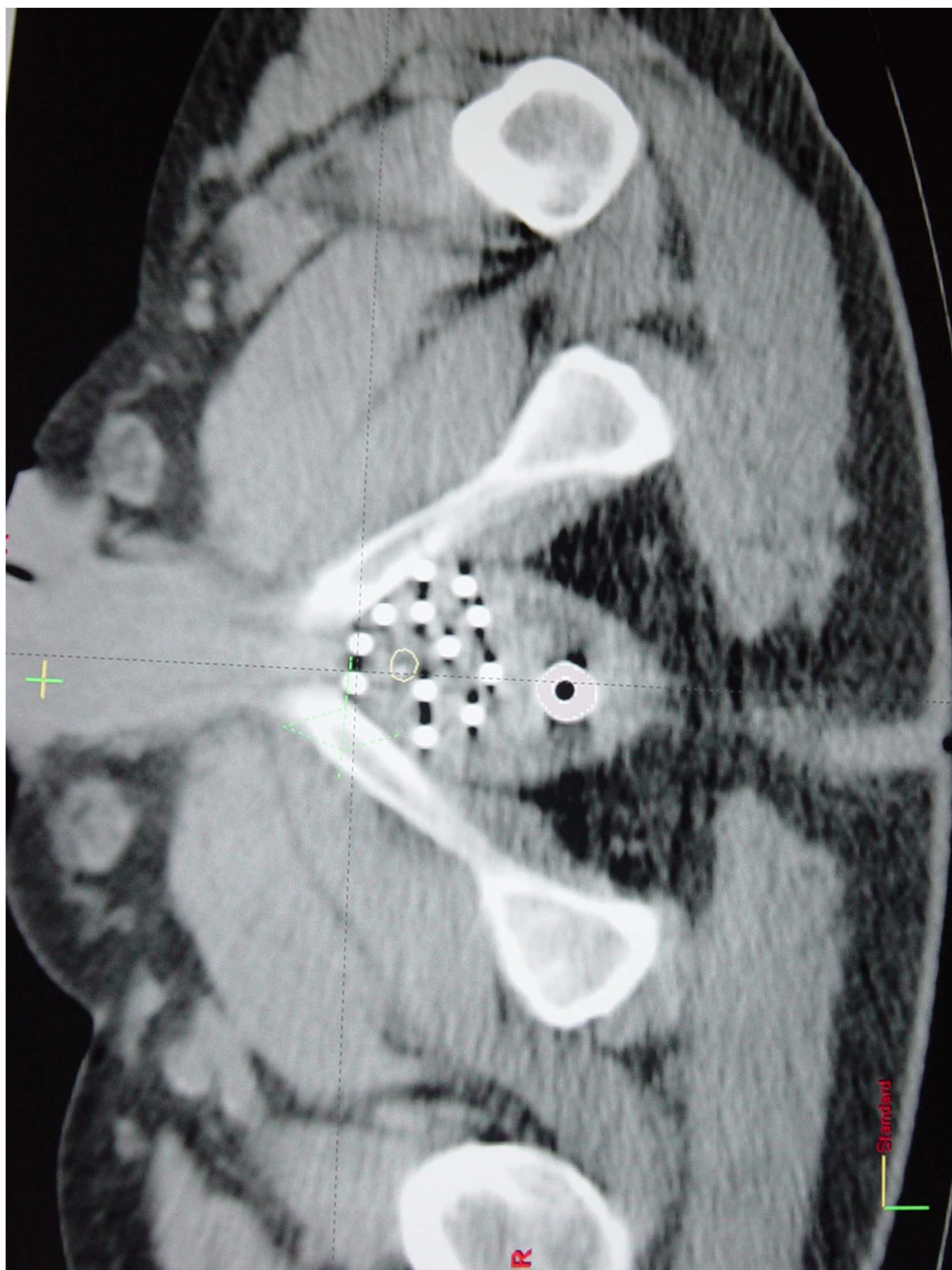


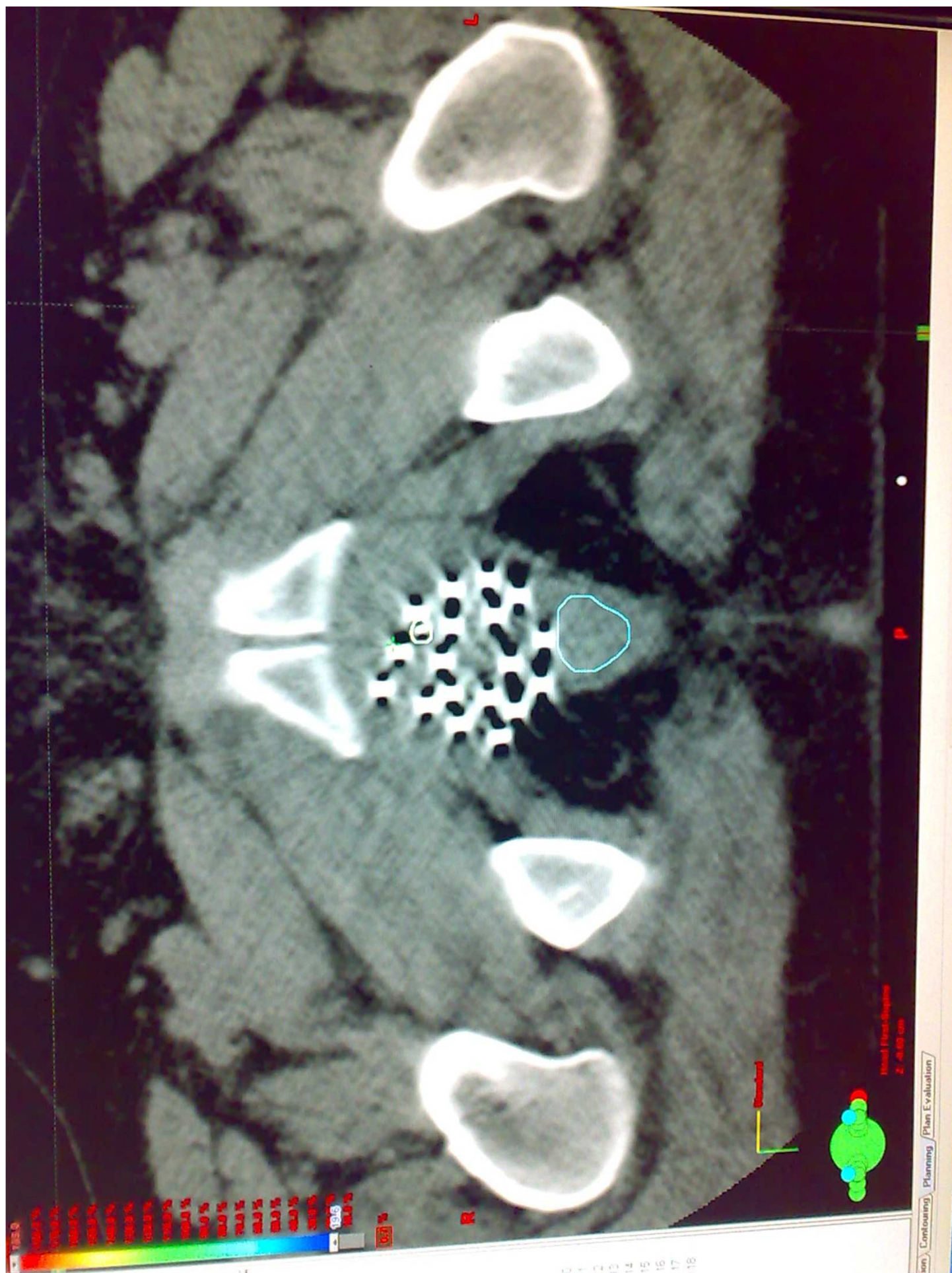




Post-Implant Cystoscopy



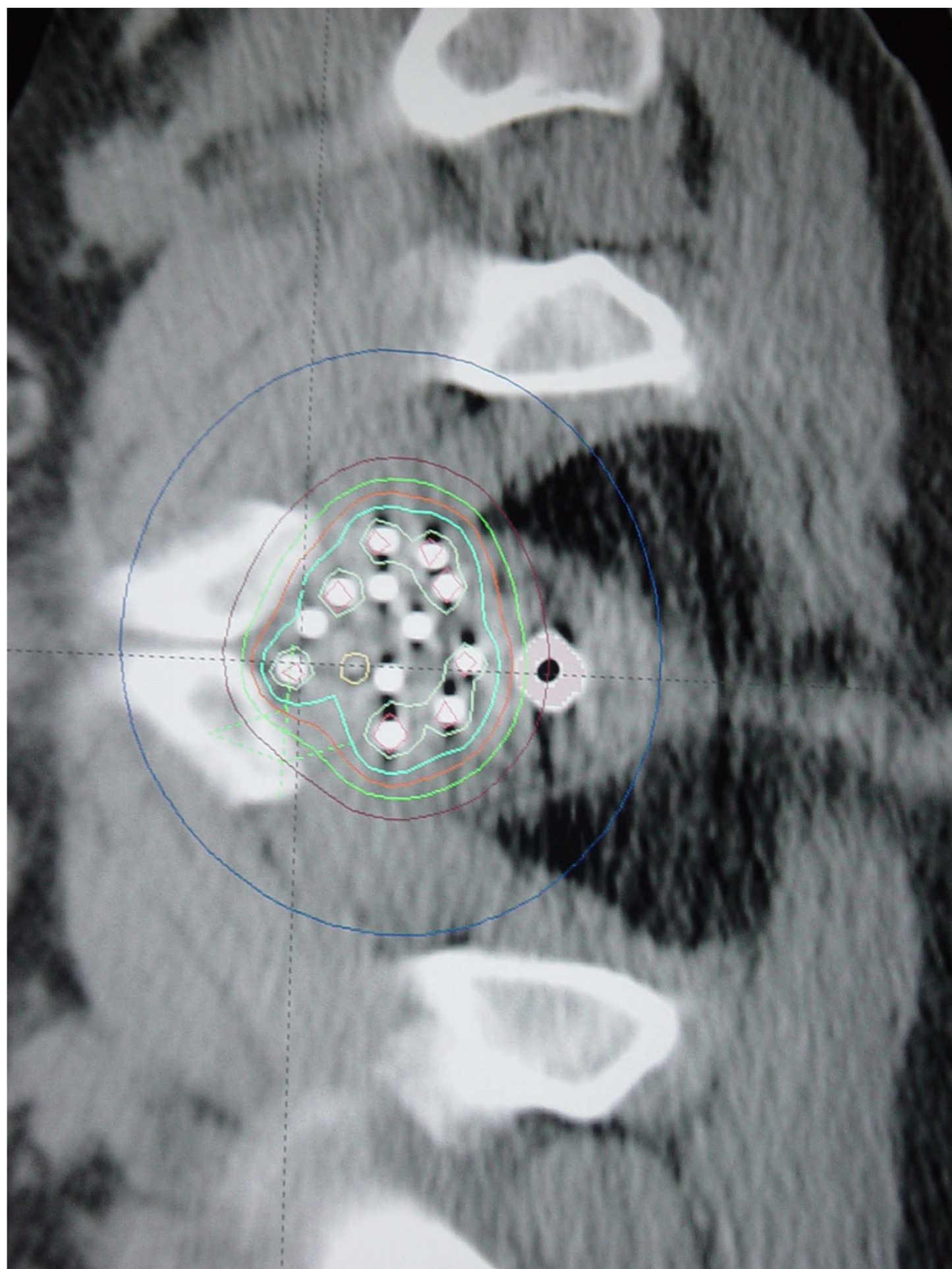


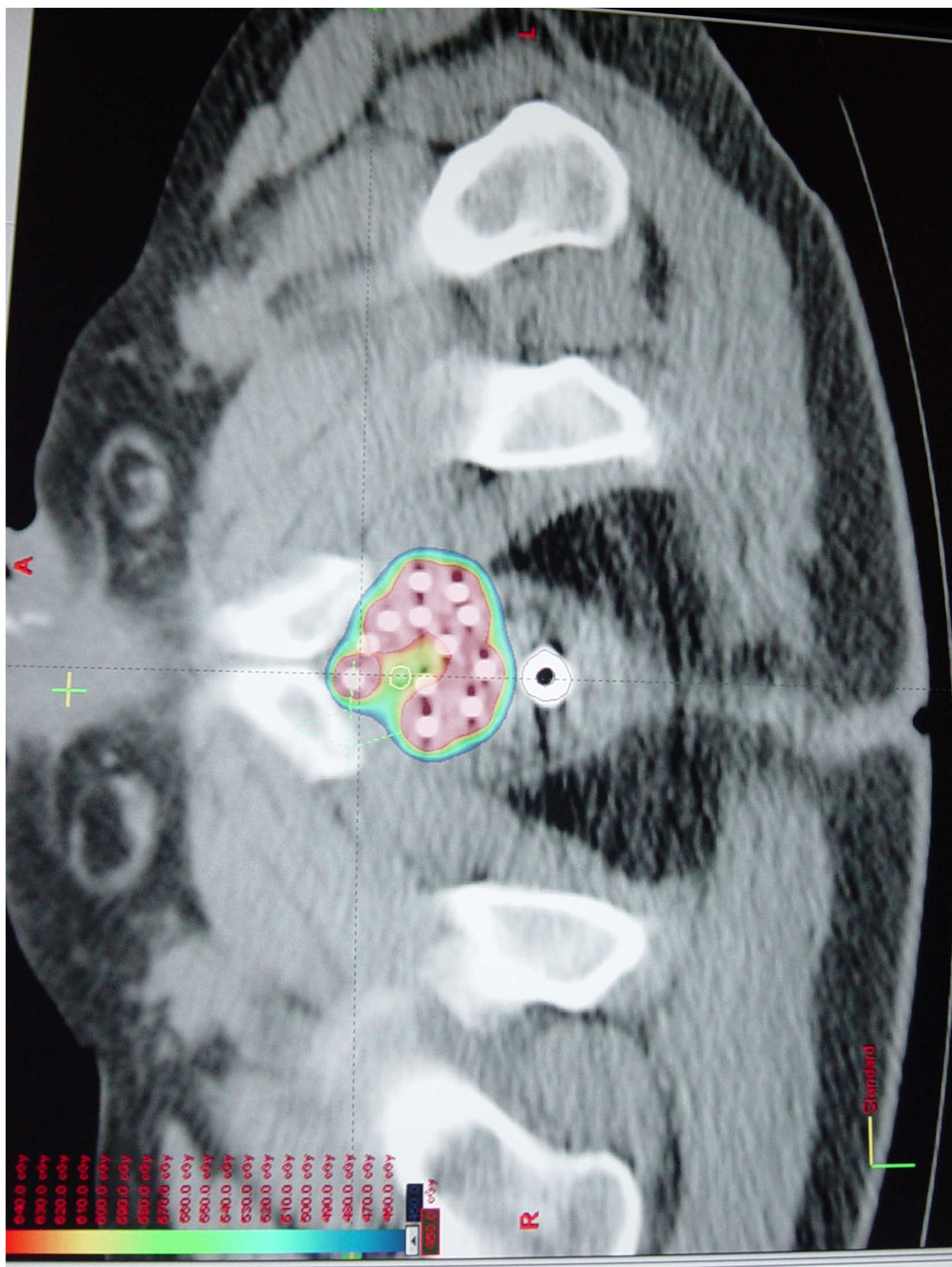


OPTIMIZATION CONSTRAINTS

- Max. urethral dose $\leq 125\%$ MPD
- MPD allowed to indent few mm. anteriorly but still covered by 80% isodose
- Higher doses to posterolateral portions (anatomic rationale) 150-200%
- Rectal dose $\leq 75\%$



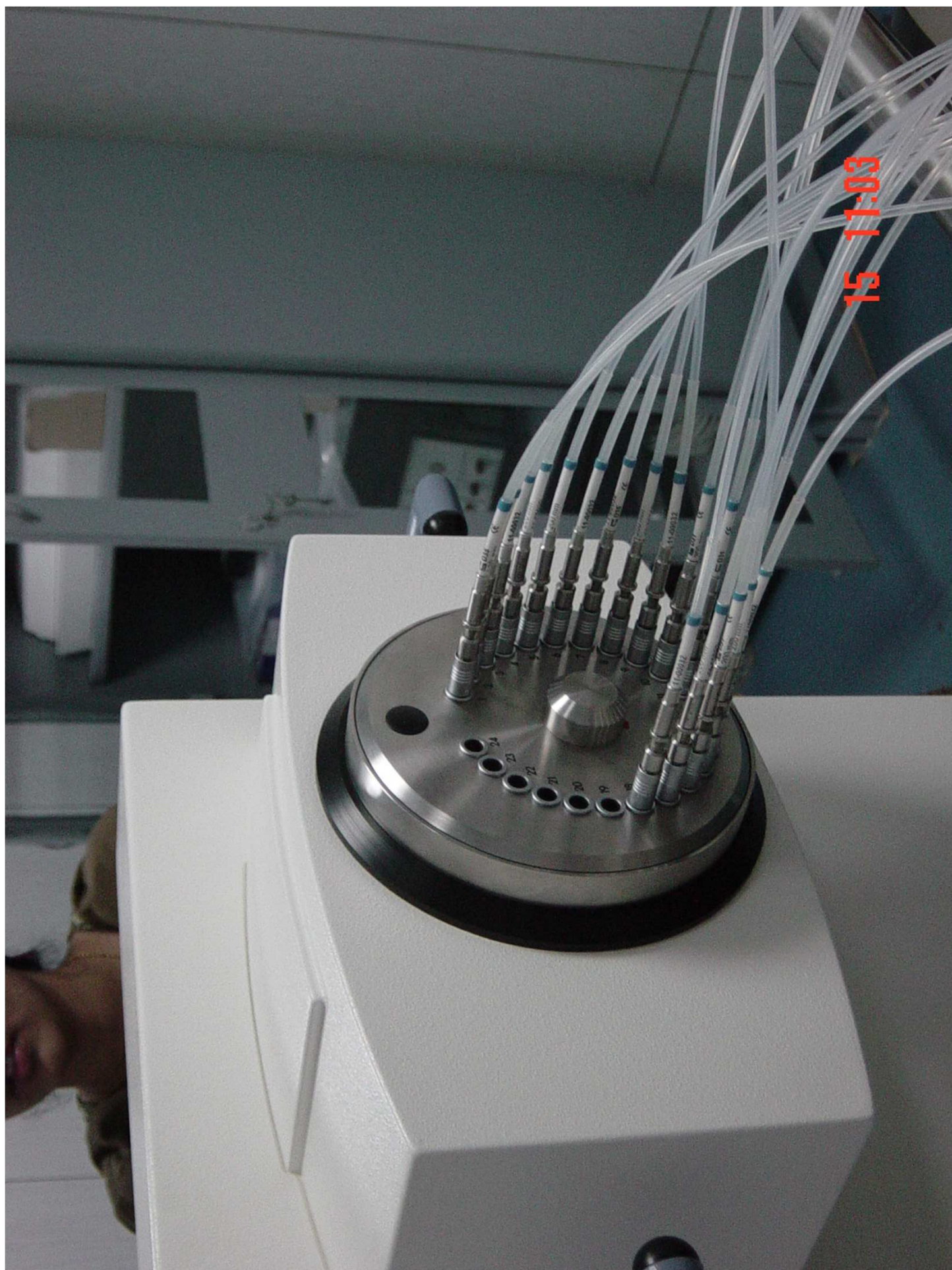








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HDR EXPERIENCE

- August 2003 – May 2008 – 22 cases
 - 1 -- Low risk
 - 10 -- Intermediate risk
 - 11 -- High risk
- T2b – T3b Gl. 6- 8 PSA .13 – 191
- XRT 50.4 Gy 3DCRT / 54Gy by IMRT
- ISBT minimum peripheral dose (MPD)
 - 5.5Gy x 3 -- 5
 - 5.5 Gy x 4 -- 5
 - 7.5 Gy x 2 -- 7
 - 8.5 Gy X 2 -- 4
 - 8.5 Gy x 4 -- 1
- Follow up 5 – 51 m. LC – 100% One dead lung mets.
- No significant morbidity



MORBIDITY

LDR

HDR

ACUTE

Haematuria

22/22

3/22

Retention

0/22

2/22

GU gr. III

2/22

0/22

CHRONIC

Proctitis

1/22

0/22

Stricture

0/22

0/22



HIGH DOSE RATE BRACHYTHERAPY

- **No organ motion concerns**
- **Optimization allows IMRT**
- **High dose / fraction suits radiobiology of prostate cancer**
- Short treatment time
- Minimum isolation → Better nursing care
- Minimal hospitalization → Better patient compliance
- Significantly reduced cost
- No second malignancy concerns



HIGH DOSE RATE BRACHYTHERAPY

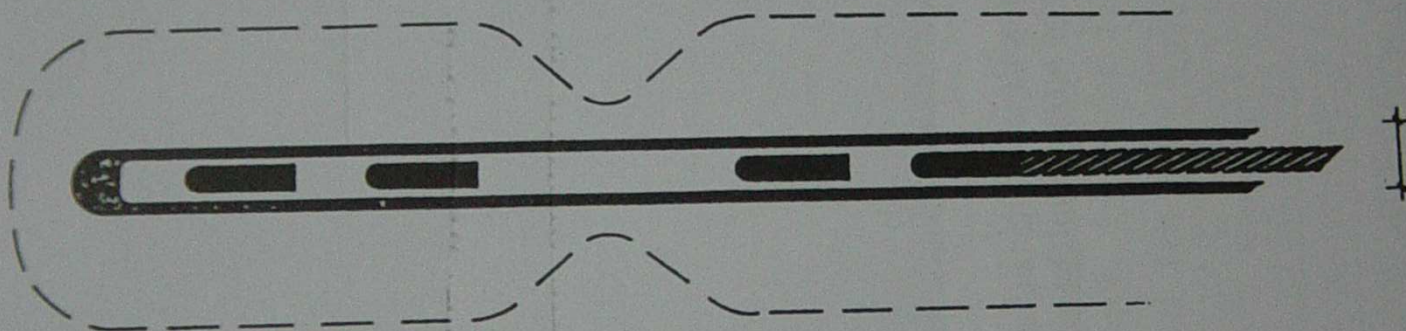
- Infinite optimization possibilities due to more number of channels, dwell positions and dwell times

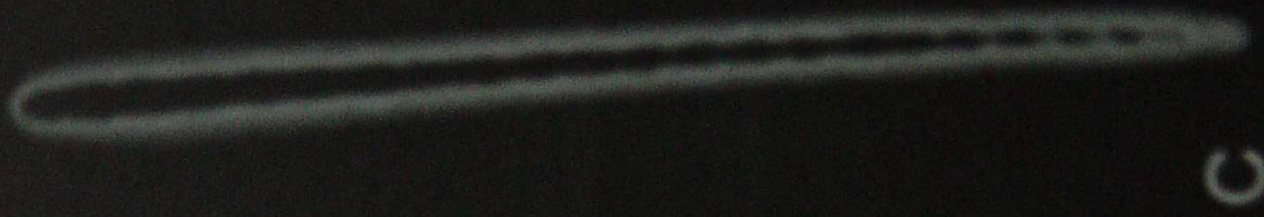
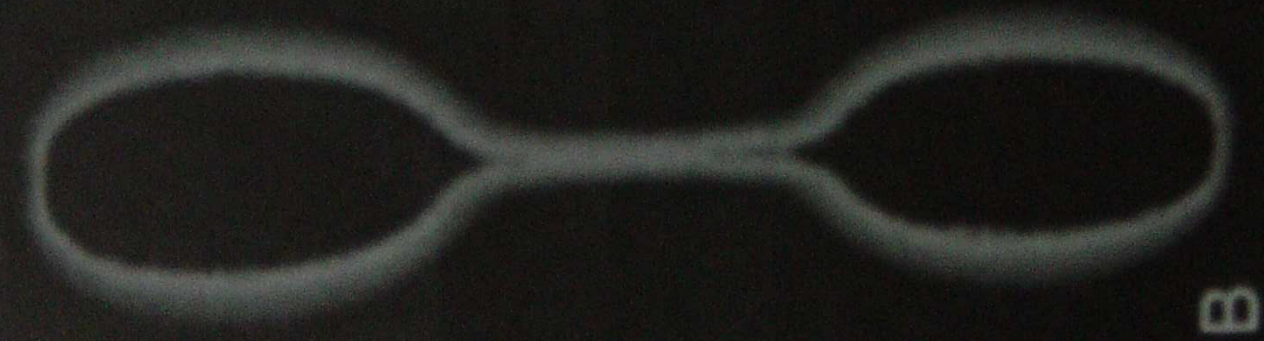
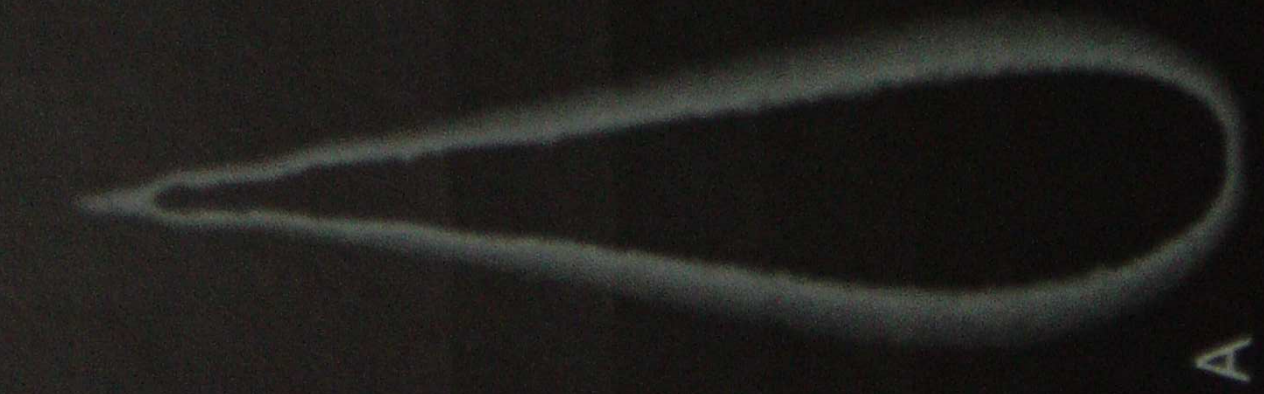
ALLOWS INTENSITY MODULATION WITHIN AND IMMEDIATELY AROUND PROSTATE

- Better integration of XRT and BT may yield better cure rates



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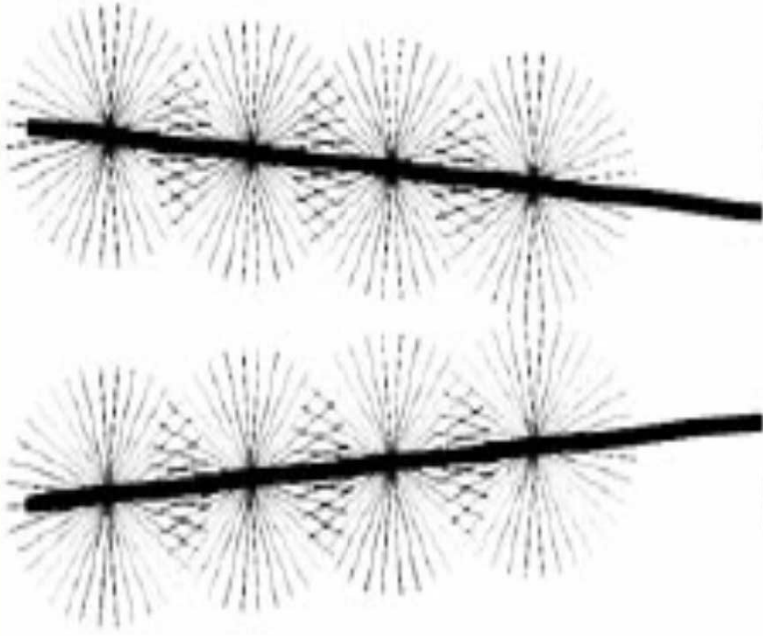


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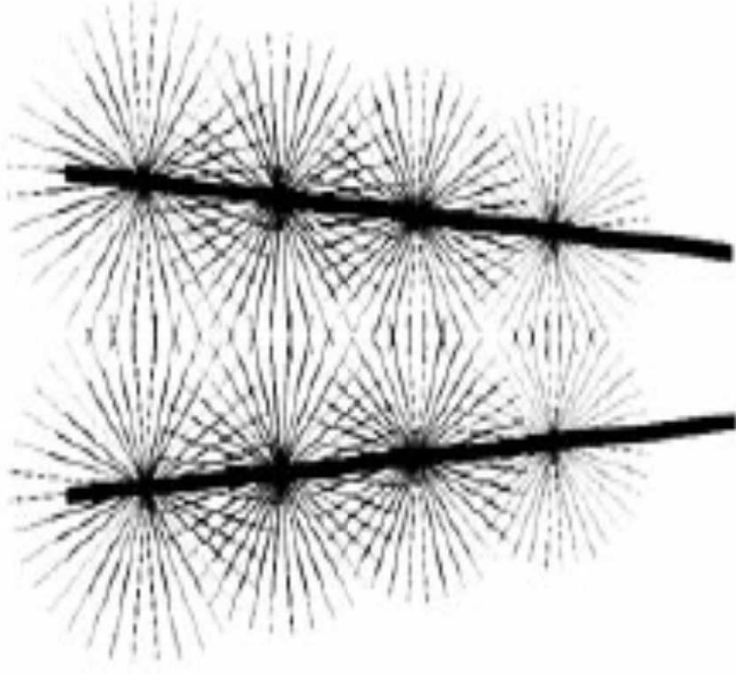
INTENSITY MODULATION USING HDR

- Correction of suboptimal needle placement makes it a forgiving type of procedure
- Possible to treat bigger size prostates with lesser needles by increasing dwell times in lateral or anterior needles
- Boost to areas of known gross disease
- Lesser dose to rectum by decreasing dwell times in posterior needles





Seeds



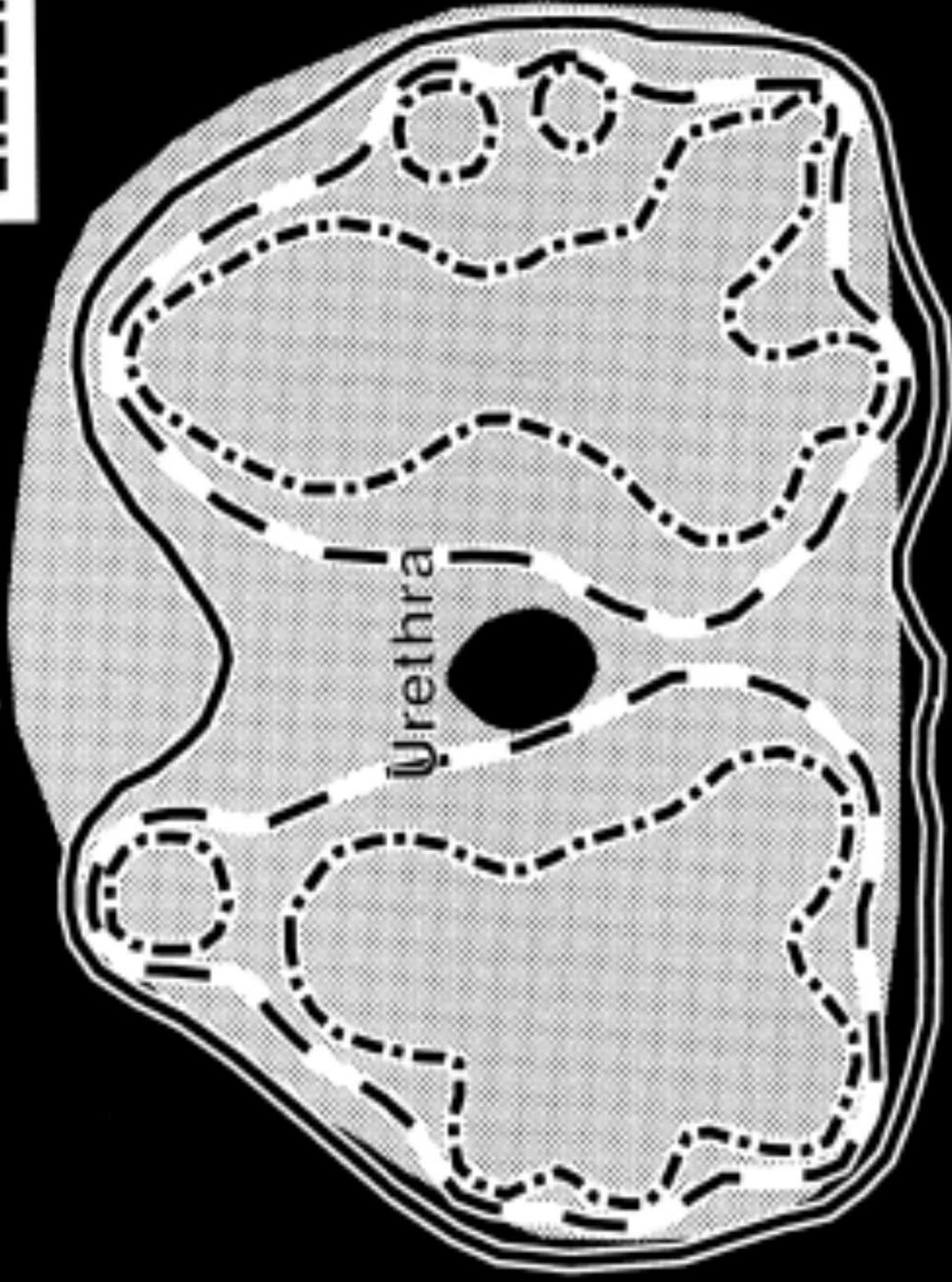
HDR

Resulting Dose Distributions

Prostatic Capsule



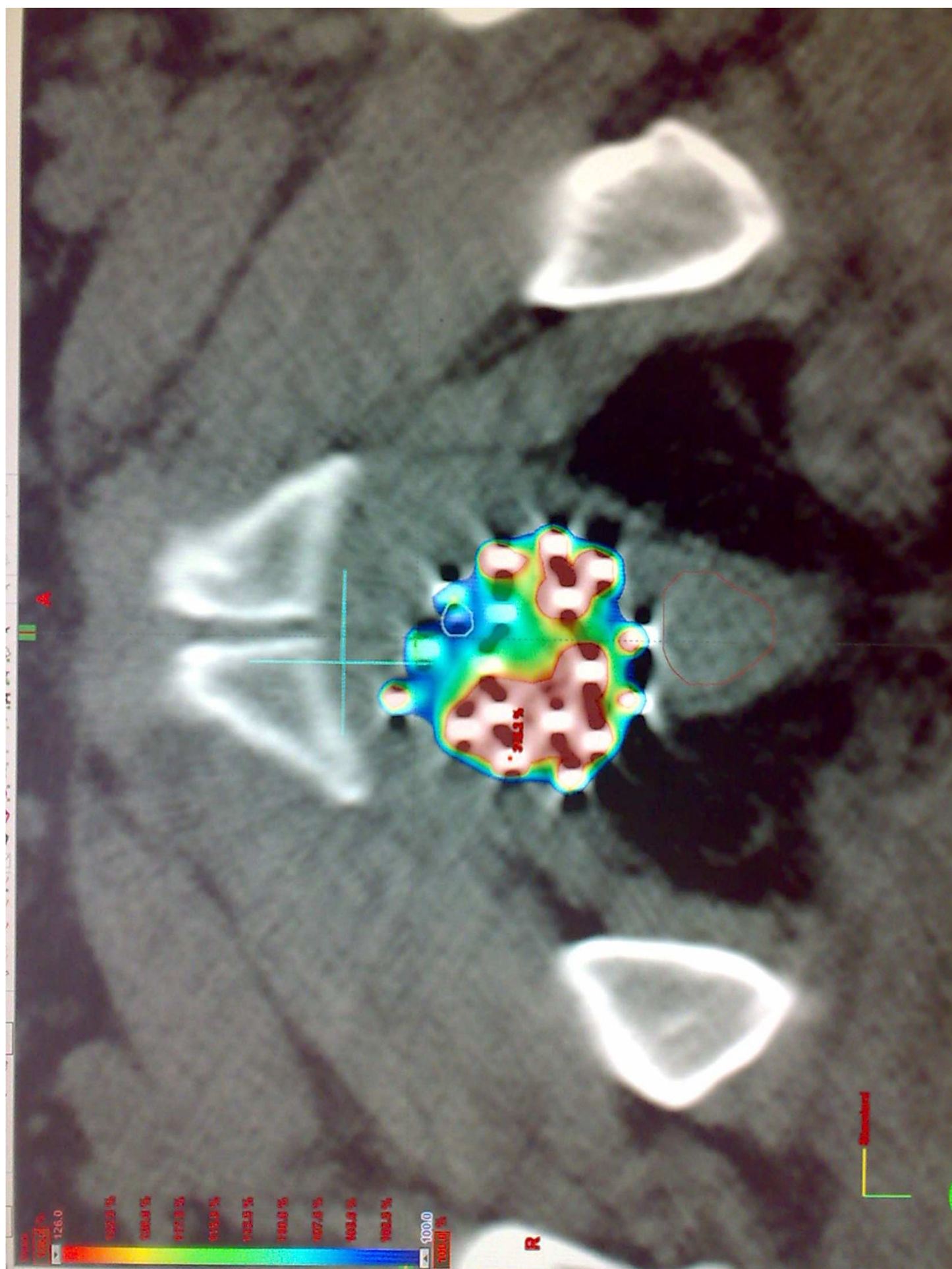
— 100%
- - 125%
- · - 150%



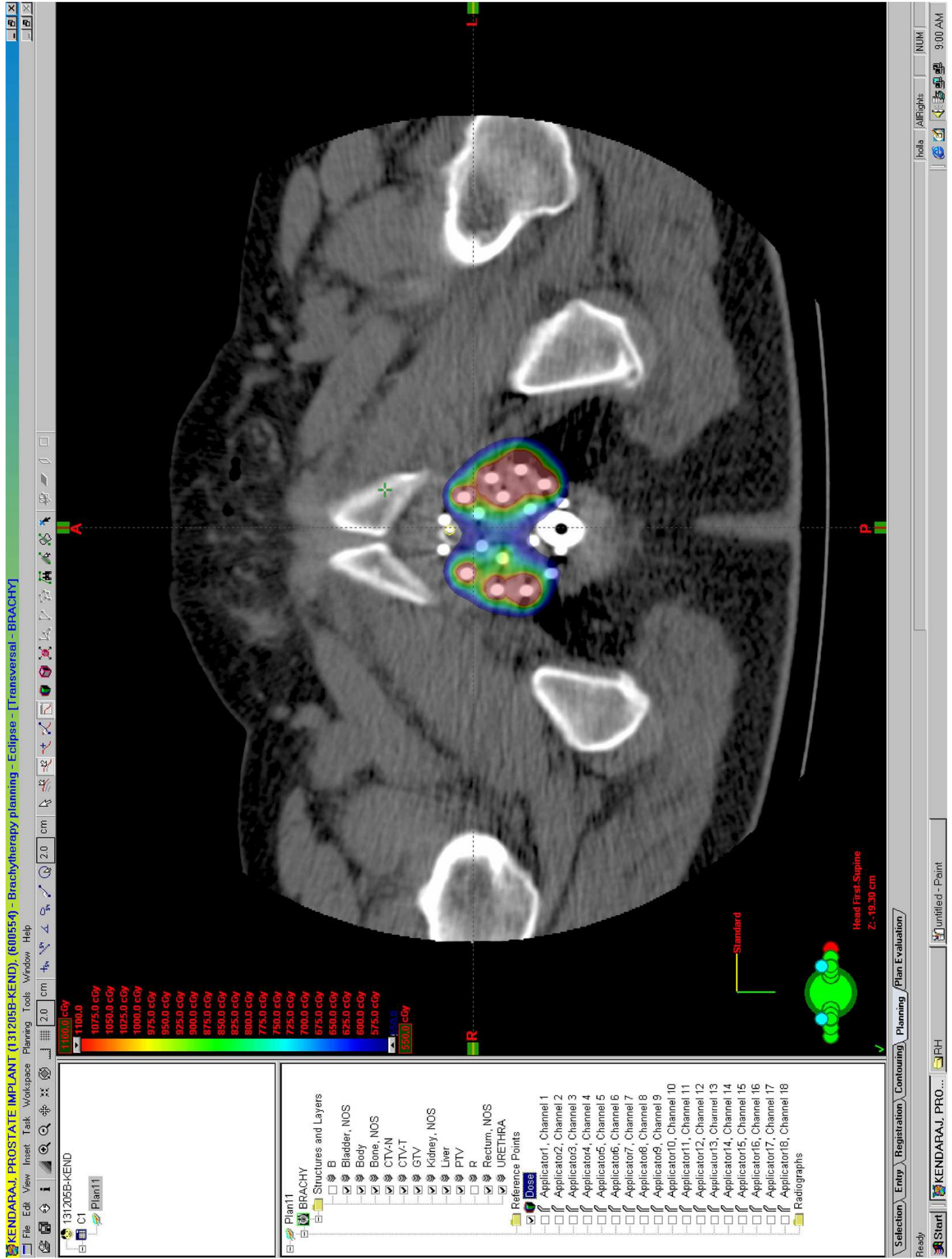
INTENSITY MODULATION UNIQUE TO HDR

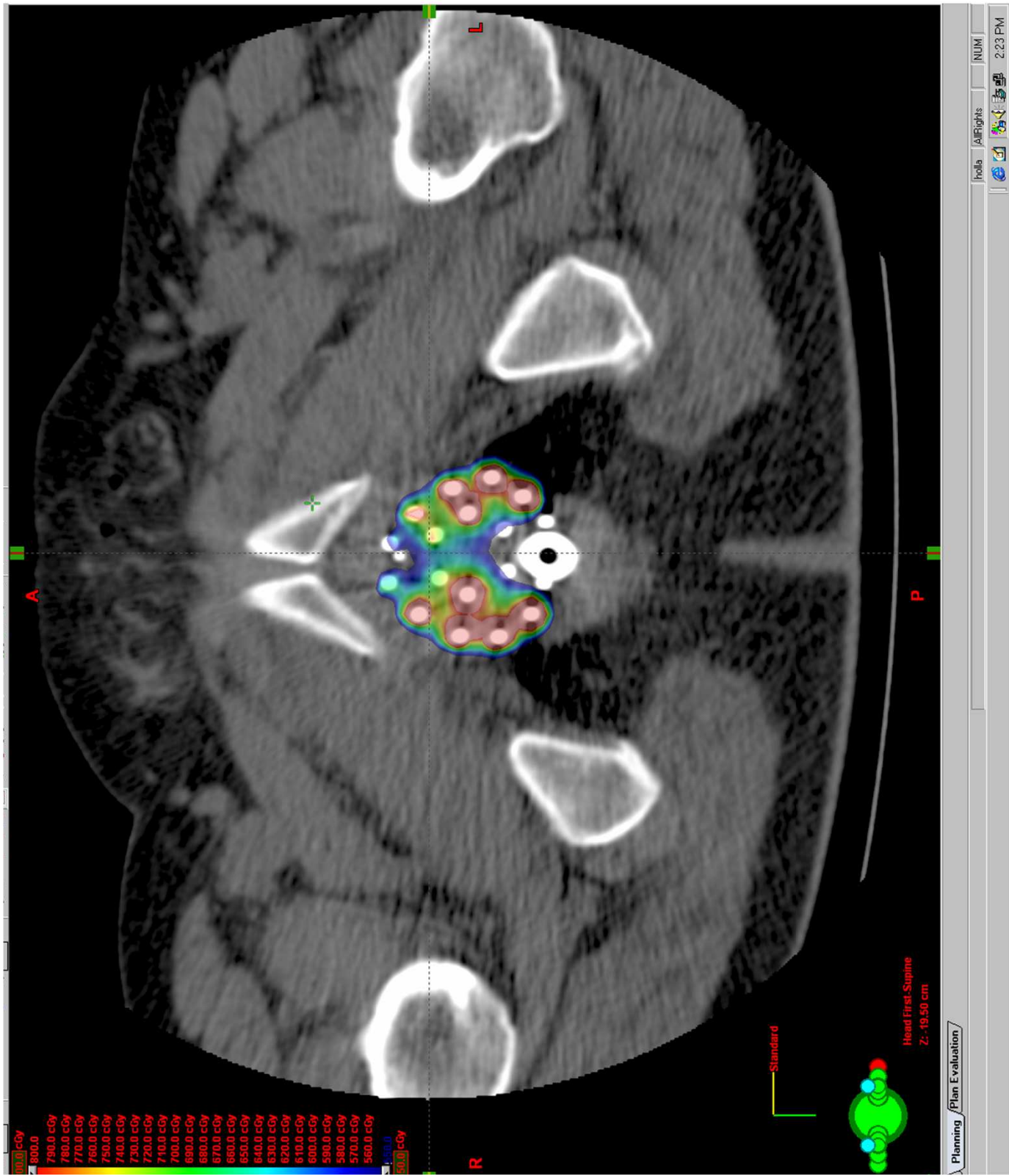
- Decreased dose to urethra
- Major limitation of IMRT is inability to do this (No significant reduction of urinary morbidity)

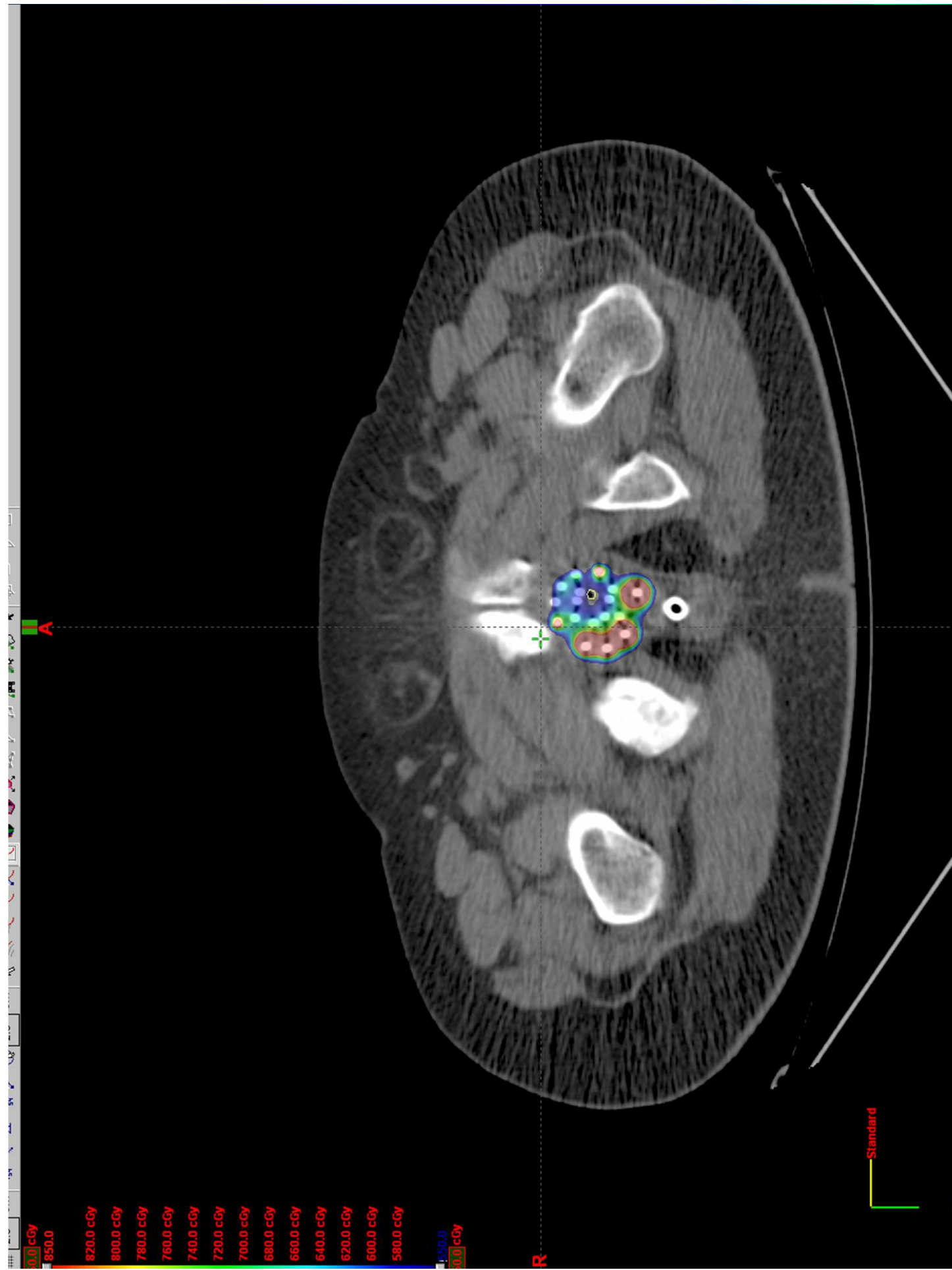












BC STRATIFIED BY RISK FACTOR GROUPS

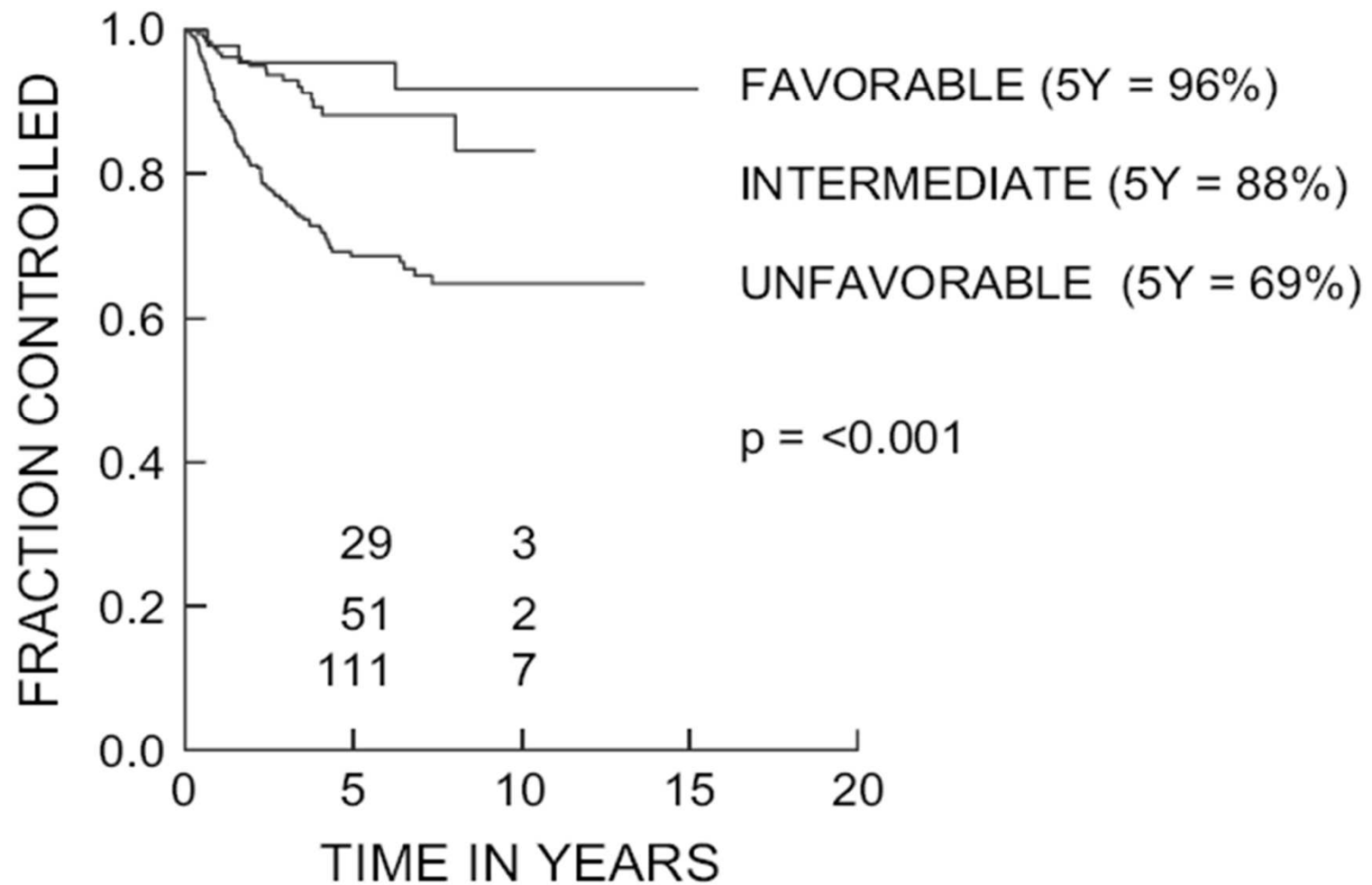


Fig. 2. Biochemical control (BC) stratified by risk factor groups.

BRACHYTHERAPY VERSUS 3D-CRT

5 YEAR BRFS (%)

	FR	IR	HR
3DCRT	90	70	47
SEEDS	94	82	65
SEED + XRT	85	77	45
HDR + XRT	96	87	69

Table 1. Equivalent dose per brachytherapy dose level

Dose level	Brachytherapy dose	BED* (Gy)		
		$\alpha/\beta = 10$	$\alpha/\beta = 5$	$\alpha/\beta = 1.2^\dagger$
Low dose	5.50 Gy \times 3	67.1	70.7	80.2
	6.00 Gy \times 3	70.0	74.3	86.1
	6.50 Gy \times 3	72.6	78.1	92.5
High dose	8.25 Gy \times 2	72.0	78.8	94.2
	8.75 Gy \times 2	74.2	82.1	99.9
	9.50 Gy \times 2	78.0	87.1	108.9
	10.50 Gy \times 2	82.9	94.4	122.0
	11.50 Gy \times 2	87.0	99.8	136.3

Abbreviation: BED = biologically equivalent dose.

* To 2 Gy per fraction, 70 Gy total external beam dose.

[†] α/β ratio of 1.2 derived from our clinical trial (39).

HDR AS MONOTHERAPY

- Favorable risk patients
- 5 year BRFS 98%

GRILLS et al, J. Urol., 2004

- Longer follow up needed



HDR AS MONOTHERAPY

- 297 patients
- 8.5Gy x 4 in one implant Eq. 75.6 Gy in 1.8 Gy/ fr
7 Gy x 6 in two implants Eq. 76 Gy in 2.0 Gy Gy/ fr
- 5 year results
 - OAS – 94.5% DM – 0%
 - CSS – 100% BRFS – 91% (Phoenix)
 - LC – 98.9% GU toxicity -- < 1%

Martinez et al, Brachytherapy, 7(2), 2008



Table 1

HDR monotherapy vs. ¹⁰³Pd monotherapy

Toxicities	HDR (%)	¹⁰³ Pd (%)	
Acute dysuria (Grades 1–3)	36	67	<i>p</i> <0.001
Acute urinary frequency/urgency	54	92	<i>p</i> <0.001
Urethral stricture			
Chronic urinary frequency/urgency	32	56	<i>p</i> <0.001
Urethral stricture	8	3	
Three-year impotency rate	16	45	

Most of above toxicities were Grade 1.

No difference in chronic dysuria, incontinence retention, and hematuria.

BRACHYTHERAPY

- Highly conformal dose to prostate (viz. 7 field 3D-CRT/ IMRT)
- Radiobiologically appropriate
- Better normal tissue sparing
- No set up / organ motion and localization errors
- Convenient
- Quick



ADVANTAGES OF BRACHYTHERAPY OVER IMRT

- Significantly less investment
- Negligible recurring costs
- Cheap therapy
- Even best form of IMRT is still an XRT only.
- Radiobiologically superior
- Clinically and financially more relevant to Indian conditions



IMAGE BASED OPTIMIZED HIGH
DOSE RATE CONFORMAL
BRACHYTHERAPY IS THE BEST
FORM OF IMRT



THANK

YOU

