

# BrachyNext



Working Together to Shape the Future of  
**Brachytherapy**

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**Brachytherapy**

## Modern Interstitial Techniques

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## Disclosure

Umesh Mahantshetty, DMRT, MD, DNB (RT), does not have any financial relationships or products or devices with any commercial interest related to the content of this activity of any amount during the past 12 months.



## Indications for Interstitial Brachytherapy in GYN Cancers



- **Cancer cervix with intact uterus (IB, IIB & above) if:**
  - Distorted anatomy
  - Narrow vagina and obliterated fornices
  - Os /Uterine canal not identifiable
  - Bulky parametrial disease which require boost
- **Post-operative cervical (stump) & endometrial (vault) recurrences**
- **Vaginal cancers:** Extensive para-vaginal (>0.5 cm) or distal vaginal involvement
- **Vulval cancers:** T1-2 N0-1 disease (Radical/Boost)
- **Re-irradiation:** Persistent or post-radiation recurrent cervical/endometrial cancers (highly select patients)

Inadequate geometry with intracavitary brachytherapy

IJROBP 1985, GYNAE ONCOL 1995;

## Interstitial Brachytherapy Techniques

- **Free hand:** Needles/tubes
- **Template-based:** Syed Neblett, MUPIT, Indigenous Templates
- **Intraoperative:** Free hand/template/applicator guided

### Subsite and Selection of Technique

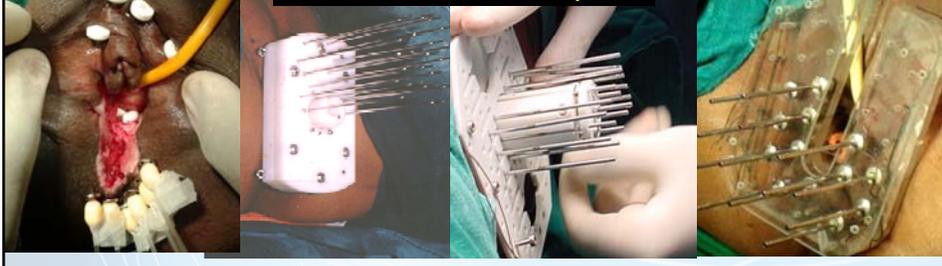
- **Cervix/Endometrial cancers:** Template-based +/- Free hand
- **Vaginal cancers:** Template-based
- **Vulval cancers:** Free hand (predominantly)/Template-based



### Brachytherapy Applicators



### Various BT Techniques



#### Example: Perineal Interstitial HDR Brachytherapy Boost Using Martinez Universal Perineal Interstitial Template (MUPIT)

- EUA: Residual disease, pelvic anatomy, etc. assessed
- 18-G stainless needles: Multiple plane implant (straight +/- divergent planes)
- CT scan images with 3–5-mm slice thickness
- Image acquisition and delineation
- Treatment planning:
  - Catheter reconstruction and Source loading (6–6.5 cm)
  - Basal dose points (Paris Dosimetry system)
  - Dose prescription (HDR): 3.4–4 Gy per fraction @ 2# per day 6 hours apart x 4-5 #
  - Optimization: Geometric +/- graphical
  - Plan evaluation (DVH): Target and OARs



### Procedure Details

### X-Ray/CT-Based Treatment Planning and Evaluation



### Transperineal LDR Interstitial Brachytherapy: TMH Experience n = 65 (1985–1990)

- Retrospective analysis
- Treated EBRT of 50 Gy by Co 60/6MV LA
- Syed-Neblett perineal template
  - Central tandem loaded with 137Cs
  - Parametrial needles with LDR I-192 source
- Median dose delivered 24 Gy (20–32 Gy)
- Follow-up: 53 months

	LCR (%)	DFS (%)	DSS (%)	OS (%)
5 years	71	64	61	44
10 years	71	64	61	40

Two patients had Grade IV rectal complications

Budrukkar AN, et al. Strahl. Onkol. 2002



### Transperineal HDR Interstitial Brachytherapy Tata Memorial Hospital (TMH) Experience

BRACHYTHERAPY

Brachytherapy ■ (2013) ■

Template-based high-dose-rate interstitial brachytherapy in gynecologic cancers: A single institutional experience

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- Study Period: 2000–2008
- No of patients: 113 patients
- Treatment details: External RT: 45–50 Gy @ 1.8–2.0 Gy per fraction followed by brachytherapy
- Brachytherapy Boost: Template-based HDR @3.4-4 Gy per fraction x 4-6 #
- Follow-up period: Median: 43 months (IQR: 19–67 months)



### TMH Experience: HDR Interstitial Patient Characteristics and Treatment Details

	Inadvertent surgery for cervical carcinoma (n = 37)	Vault cancers (n = 57)	Vaginal cancer (n = 19)
<b>Patient details</b>			
Age: mean (y)	48	49	56
Range (y)	34–70	32–70	37–74
<b>Histopathology (%)</b>			
Squamous carcinoma	36 (97)	49 (86)	19 (100)
Adeno carcinoma	1 (3)	8 (14)	0 (0)
<b>Tumor size (%)</b>			
Small (<2 cm)	4 (11)	11 (19)	2 (10)
Medium (2–4 cm)	19 (51)	25 (44)	7 (37)
Large (>4 cm)	14 (38)	21 (37)	10 (53)
<b>Parametrium (%)</b>			
Free	11 (30)	11 (19)	8 (42)
Unilateral	16 (43)	29 (51)	10 (53)
Bilateral	10 (27)	17 (30)	1 (5)
<b>Vaginal involvement (%)</b>			
Free	9 (24)	15 (26)	NA
Upper 1/3rd	19 (51)	31 (54)	10 (53)
Upper 2/3rd	5 (14)	8 (14)	1 (5)
Lower 1/3rd	4 (11)	3 (6)	8 (42)

NA, not applicable.

	Inadvertent surgery for cervical cancer (n = 37)	Vault cancers (n = 57)	Vaginal cancer (n = 19)
<b>External radiotherapy (Gy)</b>			
Mean	49	50	50.5
Median	50	50	50
Range	40–50.4	40–55.4	46–60
<b>Brachytherapy dose (Gy)</b>			
Mean	19	19	18
Median	20	20	20
Range	12–24	12.8–25	12–25
<b>EQD2 (EBRT + BRACHY)</b>			
Mean	71	72	72
Median	73	73.3	73
Range	60–78	60–83	63–83.5
<b>Number of needles</b>			
Mean	18	17	16
Range	12–31	11–28	9–31
<b>Last followup status (%)</b>			
Disease free	23 (62)	32 (56)	13 (68)
Central disease	10 (27)	17 (30)	3 (16)
Local and regional	1 (3)	1 (2)	2 (11)
Local and distant	1 (3)	4 (7)	1 (5)
Distant only	2 (5)	3 (5)	0
<b>Survivals (%)</b>			
3-year DFS	61	61	59
3-year OS	64	64	56

EQD2 = equivalent dose at 2 Gy per fraction; EBRT = external beam radiotherapy; BRACHY = brachytherapy; DFS = disease-free survival; OS = overall survival.

Mahantshetty U, et al. Brachytherapy 2013

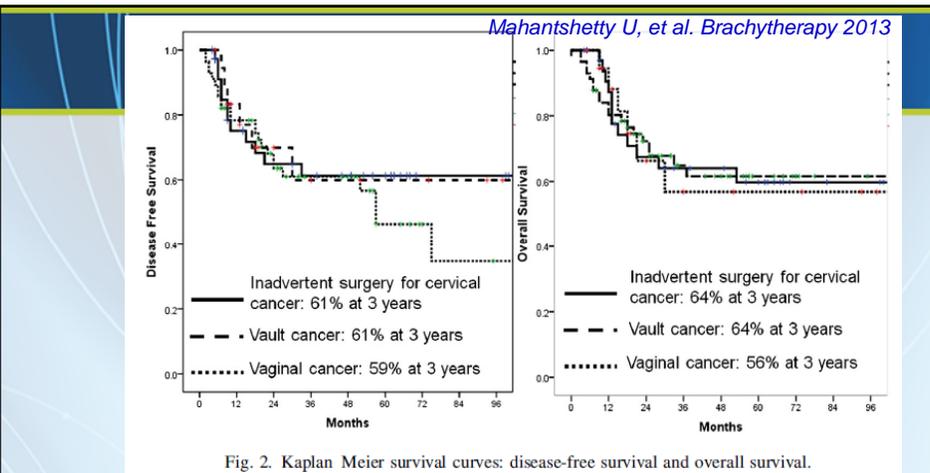


Fig. 2. Kaplan Meier survival curves: disease-free survival and overall survival.

- Late toxicities:
  - Grade III rectal: 10%; grade III bladder: 5%; Small bowel: 6%

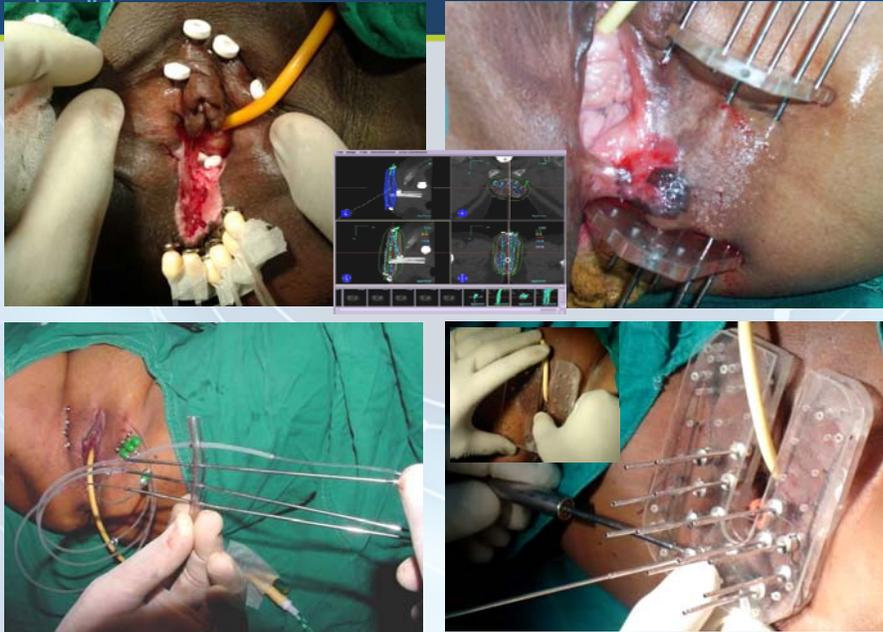
**CONCLUSIONS:** Martinez Universal Perineal Interstitial Template–based high-dose-rate ISBT boost in gynecologic cancer results in a reasonable outcome in terms of survivals with acceptable late toxicities. The use of template-based ISBT is associated with a definite learning curve. © 2013 American Brachytherapy Society. Published by Elsevier Inc. All rights reserved.



## Other Reported Series on Use of Template Interstitial Perineal Brachytherapy

Study	N0: of patients	Type of implant	EBRT dose	Brachy dose	Median FU	Local tumor control	Gr 3-4 late toxicity
Demanes	62	Syed Neblett	36 Gy + 14GyMLB	6Gyx6# HDR	40 mths	94%	6.5%
Gupta	69	MUPIT	39 Gy	32 Gy	30 mths	60%	14%
Nag S	39	Syed Neblett	50 Gy	30 Gy	36 mths	48%	2.5%
Martinez	63	MUPIT	-	-	36 mths	83%	3%
Hughes-Davies	139	MUPIT	42 Gy	30 Gy	57 mths	25%	17%
Monk BJ	70	Syed Neblett	50 Gy	41 Gy	58 mths	32%	21%

## Brachytherapy and Vulval Cancers





## Tata Memorial Hospital Experience Period: 2000–2010

*ESTRO, Barcelona  
Radio. Oncol. 2012*

	Radical Brachy (n = 6)	EBRT + Brachy (n = 11)
Brachy Dose	Median 38 Gy	Median 20 Gy
EBRT dose	NA	Median 50 Gy
HDR Brachy (2#/day)	3.4-4 Gy/# for 8–12 #	3.4-4 Gy/# for 4–5 #
Median OS (months)	62 (12–102 moths)	33 (10–122 moths)

- Median age: 59 years (Range: 33 to 77 )
- Brachytherapy techniques:
  - Needle & plastic tube: 8 patients [Median tubes: 8 (4-12)]
  - Template-based: 7 patients [Median tubes:13 (11-20)]
- 4 Patients received treatment after radical surgery
- Status at last follow up: 2 patients necrotic ulcer at post fourchette (disease)
  - 1 patient expired
  - 3 patients alive with disease (status of others not known)

## NEWER APPROACHES



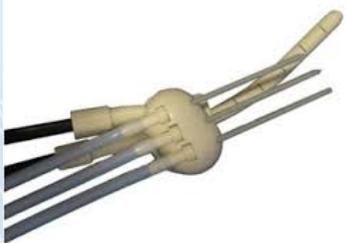
## Applicators for Advanced Disease

- Combined Intracavitary and interstitial (IC + IS)

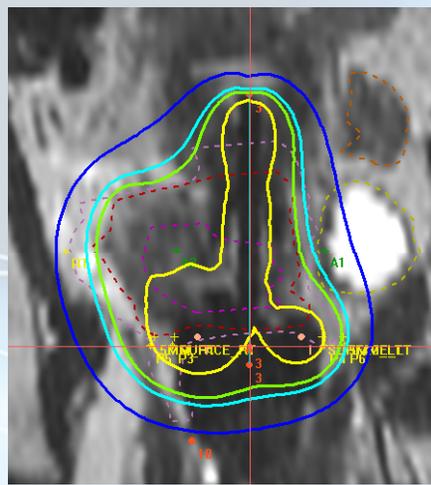
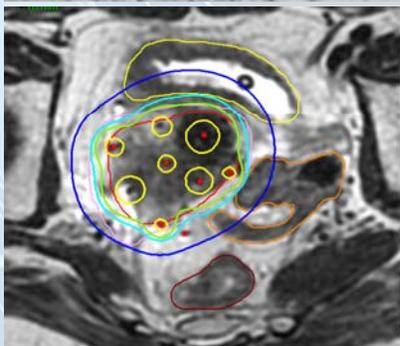
- Vienna Applicator, Utrecht applicator, etc.

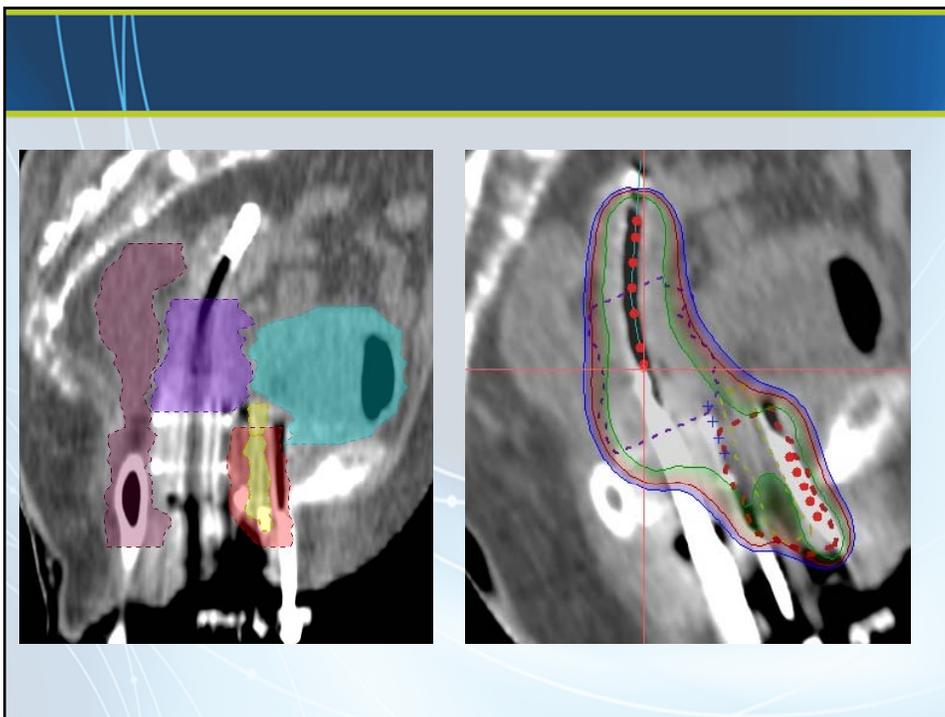


Vienna + Template



## Plan Optimization for Advanced Disease





## *Is there a role for image-guided adaptive brachytherapy In locally advanced or recurrent gynaecological malignancies?*

### Brachytherapy

Image and laparoscopic guided interstitial brachytherapy for locally advanced primary or recurrent gynaecological cancer using the adaptive GEC ESTRO target concept

Lars Fokdal<sup>a,\*</sup>, Kari Tanderup<sup>a,b</sup>, Søren Kynde Nielsen<sup>c</sup>, Henrik Kidmose Christensen<sup>d</sup>, Lisbeth Røhl<sup>e</sup>, Erik Morre Pedersen<sup>e</sup>, Niels Kim Schönemann<sup>f</sup>, Jacob Christian Lindegaard<sup>a</sup>

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### CLINICAL INVESTIGATION

#### TREATMENT OF LOCALLY ADVANCED VAGINAL CANCER WITH RADIOCHEMOTHERAPY AND MAGNETIC RESONANCE IMAGE-GUIDED ADAPTIVE BRACHYTHERAPY: DOSE-VOLUME PARAMETERS AND FIRST CLINICAL RESULTS

JOHANNES C. A. DIMOPOULOS, M.D.,\* MAXIMILIAN P. SCHMID, M.D.,† ELENA FIDAROVA, M.D.,†  
DANIEL BERGER, PH.D.,† CHRISTIAN KIRISITS, D.Sc.,† AND RICHARD PÖTTER, M.D.†

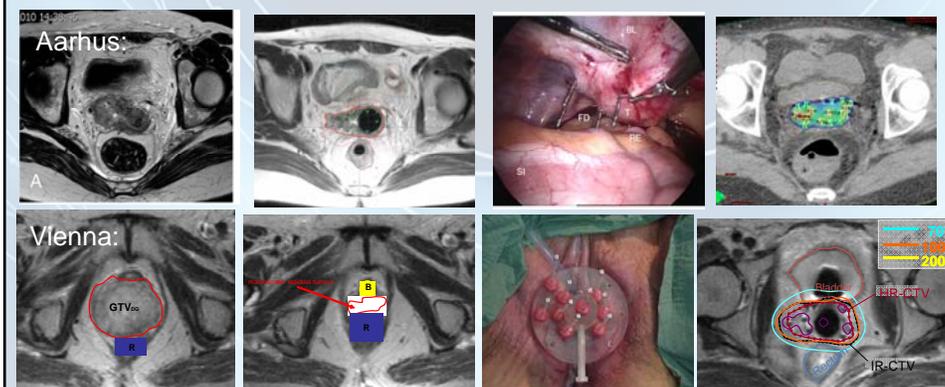
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**Courtesy: Max, AKH Vienna**



## Brachytherapy

- PDR schedule
- MR image-guided treatment planning
- Target concept derived from the GEC-ESTRO recommendations
- Treatment aim D90 >80-85 Gy for HR CTV



## Outcome and DVH Parameters

		Aarhus	Vienna
Number of pts.		28	13
Follow-up (months)		18 (6-61)	43 (19-87)
3 months CR (%)		92	100
LC (%)		92 (2Y)	92 (3Y)
OS (%)		74 (2Y)	85 (3Y)
Morbidity G3+ (%)		4	~*
HRCTV	D100 (Gy)	69 (61-80)	71 (55-88)
	D90 (Gy)	82 (77-88)	86 (64-110)
D2cc	Bladder (Gy)	65 (47-81)	80 (55-129)
	Rectum (Gy)	71 (50-77)	70 (46-81)
	Sigmoid (Gy)	52 (44-68)	60 (53-70)

Brachy 2011; IJROBP 2011



Egger SpringerPlus 2013, 2:395  
http://www.springerplus.com/content/2/1/395

**SpringerPlus**  
a SpringerOpen Journal

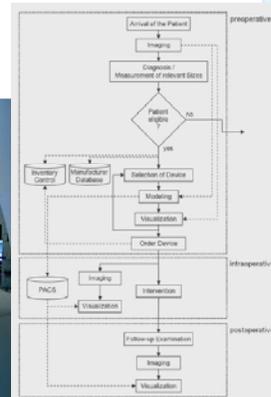
**RESEARCH**

**Open Access**

## Image-guided therapy system for interstitial gynecologic brachytherapy in a multimodality operating suite

Jan Egger

AMIGO Suite



## Novel Use of Hydrogel Spacer Permits Re-irradiation in Otherwise Incurable Recurrent GYN Cancers

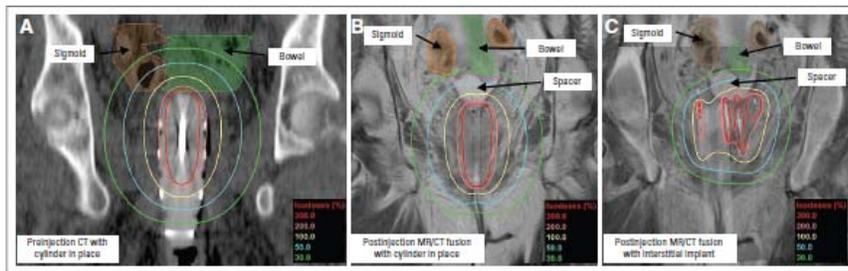


Fig 1.

- Hydrogel safely separates normal tissues, including the rectum and small bowel, from the tumor
- Significantly lower radiation doses to previously irradiated normal tissue
- Novel brachytherapy approach to treat recurrent gynecologic malignancies in re-irradiation settings
- Gel spacers insertion into para-vaginal tissue with ultrasound guidance. Use of a hydrogel spacer may sufficiently protect the surrounding tissues to permit re-irradiation to curative doses in patients who previously would not have been considered for treatment

Viswanathan et al; JCO, 31 (34) Dec. 2013



## Summary and Conclusions

- Interstitial brachytherapy in GYN cancers: Skill oriented
- Interstitial brachytherapy application and workflow: Learning Curve
- Training and quality assurance: Vital
- Clinical outcome: Promising
- Newer approaches like use of hydrogel, laparoscopy, etc.: Promising
- Further research to reduce the toxicities