



Gynecologic Vaginal Brachytherapy (Mostly Post-Op Endometrial)

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BRACHYTHERAPY

American Brachytherapy Society consensus guidelines for adjuvant vaginal cuff brachytherapy after hysterectomy

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Manual Source Loading – Should be Phased Out

Live Sources
Nursing restrictions
Radiation safety

Applicator deficiencies
Poor fixation
Packing compresses



Robotic Brachytherapy



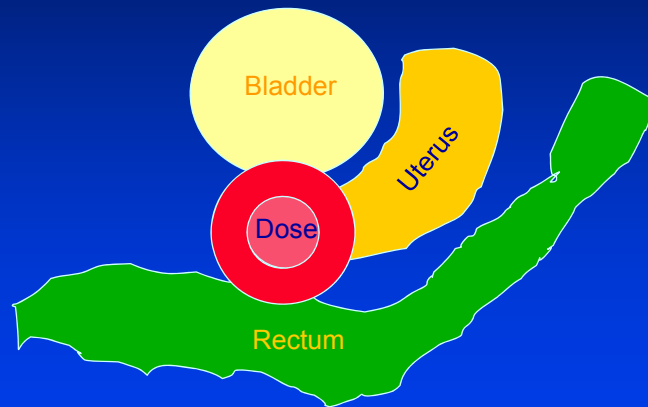
Stage I Endometrial Cancer



Vaginal BT Only
Assumes negative LNs
Avoids SBO and Lymphedema
Risks: vaginal, rectal, bladder



Radiation Sources: must be closer to the target than to adjacent normal organs



Vaginal Brachytherapy

Be sure vagina apex healed **BEFORE** BrachyRx – do a pelvic exam!

2-3 fx per week (not just 1 – unless during EBRT)

Usual target – **4-5 cm upper vagina** (or about $\frac{1}{2}$ way from apex to urethral meatus)



Prescription Dose and Fractionation

VBT only:

Calif. Endocurietherapy 5-6 Gy x 5-6

3 fx (PORTEC 2) 7 Gy x 3

3 fx (PORTEC 4) 3Gy x 3

EBRT only 45-50 Gy

EBRT + VBT 39.6 - 45 central
5-6 Gy x 3

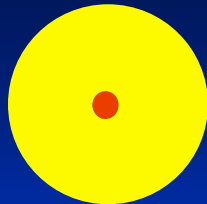
Vaginal Brachytherapy – Equipment



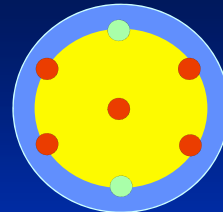


Vaginal Applicators

Single Channel Cylinder



Multi-Channel Cylinder

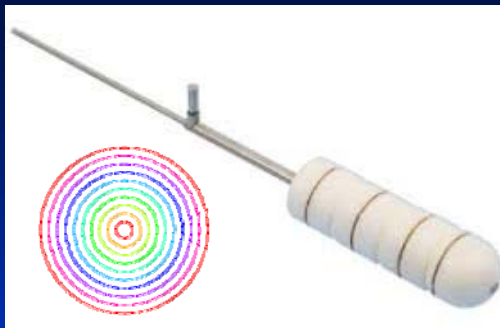


Ovoid and Cylinder

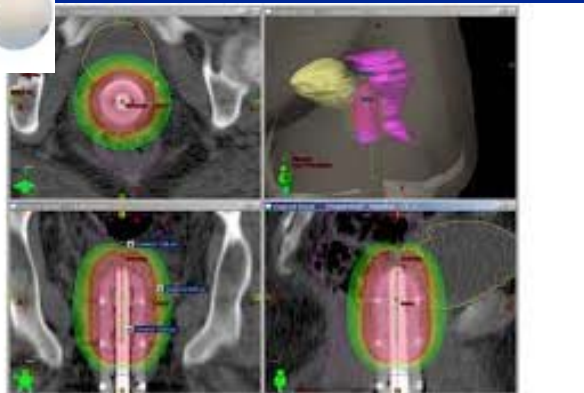
Important considerations:

Cylinder size: Best fit & source to vag surface distance

Distribution of sources: in relation to target and OARs

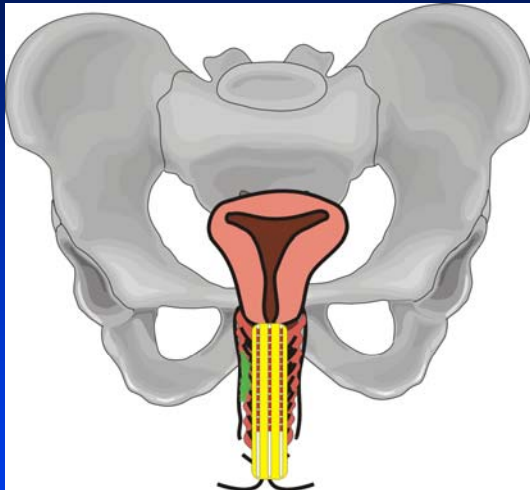


Single-channel applicators =
limited dosimetry control

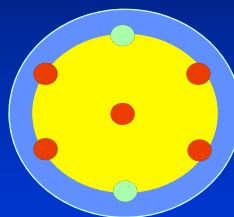




Multi-Channel Applicators

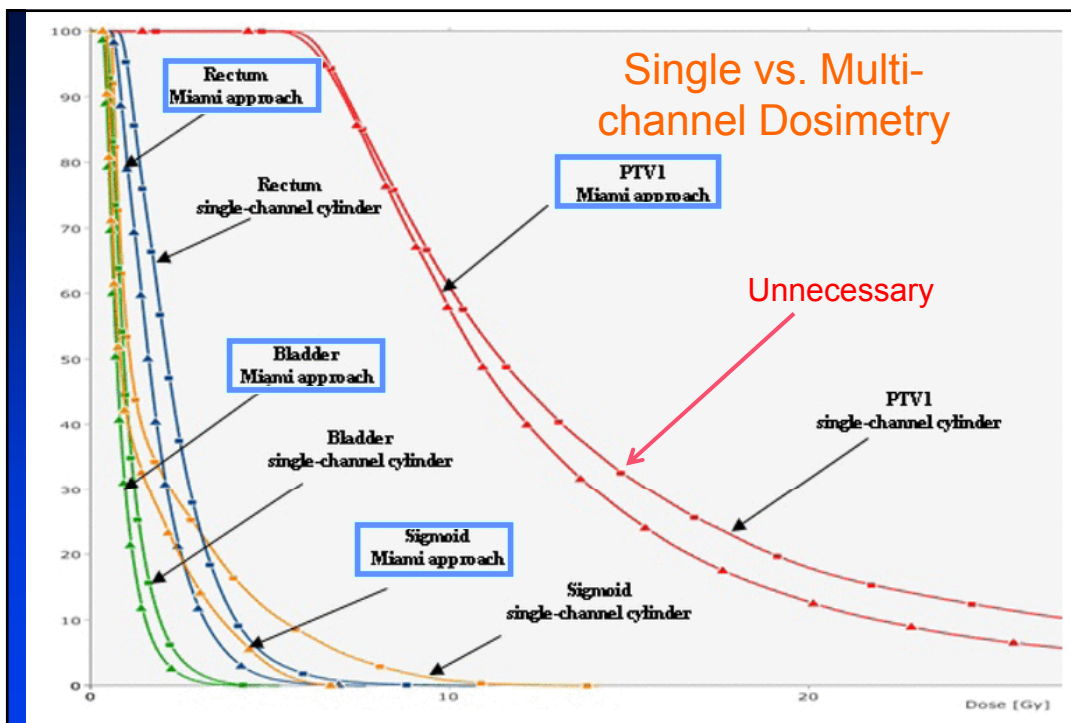


Prescribe Dose 2-5 mm from surface including tip!



Multichannel: bladder and rectal dose reduction approx. 15%

Demanes et al IJROBP 1999 v44 n1 p211

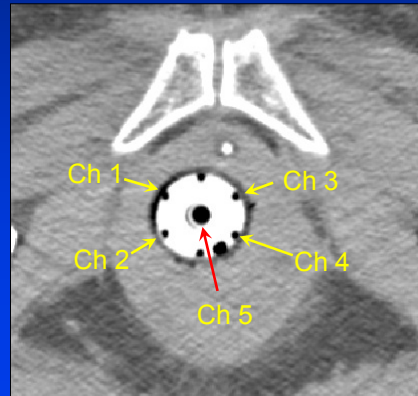
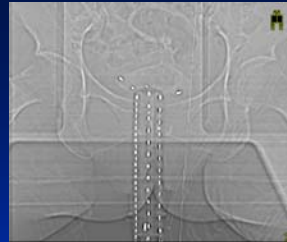




Multi-channel Cylinders

Diameter: 2.6 cm

Length: 10 cm



CET Multichannel Cylinder Dosimetry

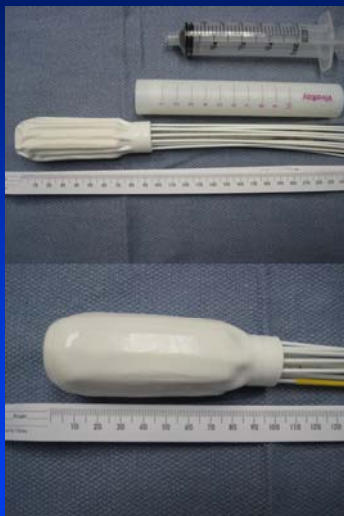




Nucletron multi-channel VC – with curved tip channels

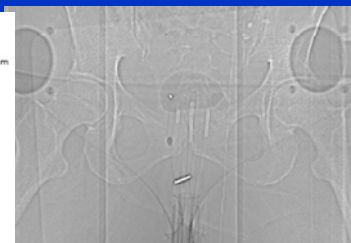
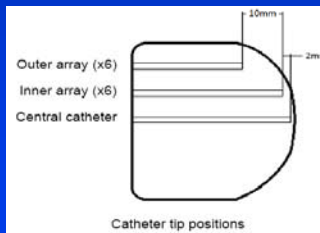
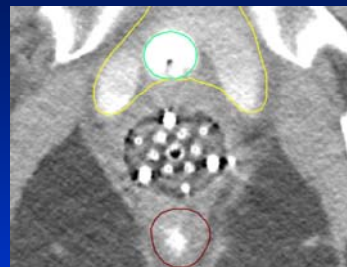


Capri Multi-Channel Inflatable VC Applicator



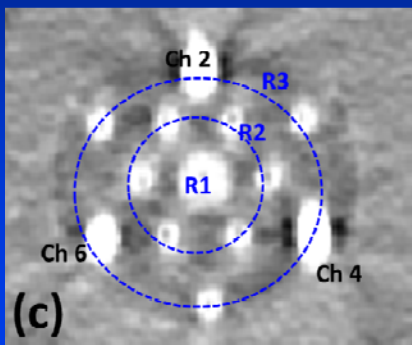
Diameter:
3.4 – 4.3 cm

Length: 10
cm





Target Dose	V_{100} , V_{150} , D_{90} , D_{mean}	Why?
5mm	No diff with various channel permutations	Dose normalized to 5mm
Surface	All different except V_{150}	V_{150} is within cylinder vol



OARs	R23 = R123	R1
$D_{0.1cc}$ D_{1cc} D_{2cc} D_{mean}		
5mm	lowest	highest
Surface	lowest	highest

R1 not needed when using R23
R2 not optimally distributed for independent use

Park et al IJRPB 2013 v87n4p840

Where to Calculate the Dose?

Radial and Tip:

Single Channel: 0-5mm from applicator surface

Multi-Channel: 2 - 4mm from surface

Longitudinal

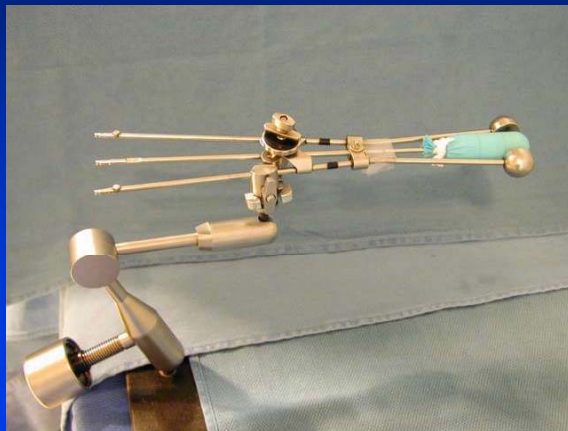
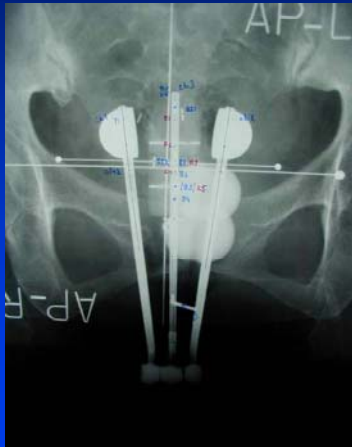
Multiple points along applicator

Bladder wall (or balloon or both)

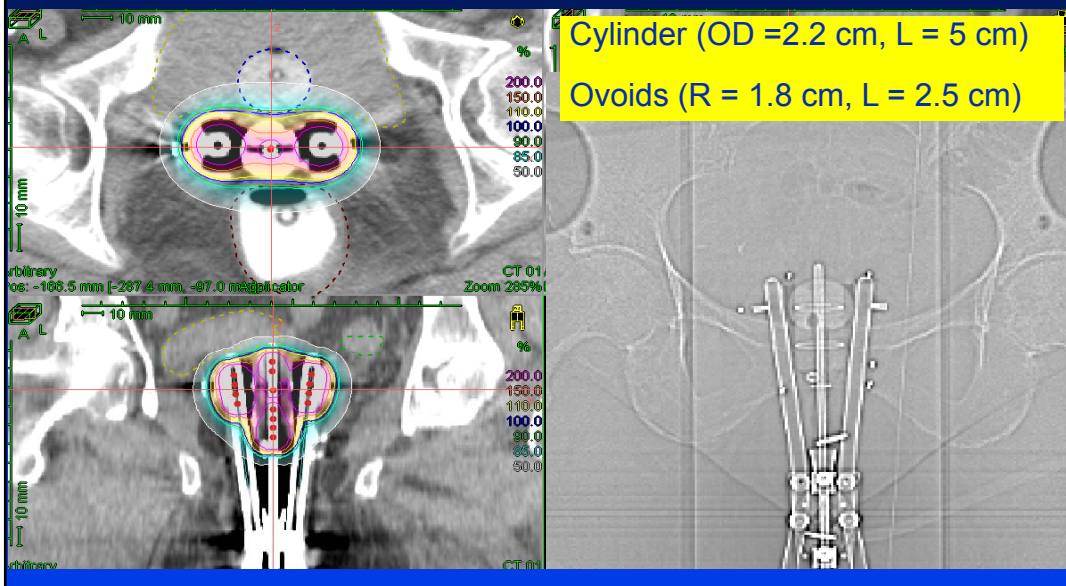
Rectal wall along length of applicator



Ovoid and Cylinder Treatment of vaginal apex and parametria

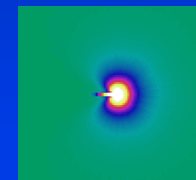
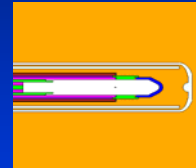


Ovoid and Cylinder Dosimetry





Electronic Brachytherapy (50 kVp)



Xoft Single Channel Vaginal Cylinder



Diameters:
2.0, 2.5, 3.0. and 3.5 cm

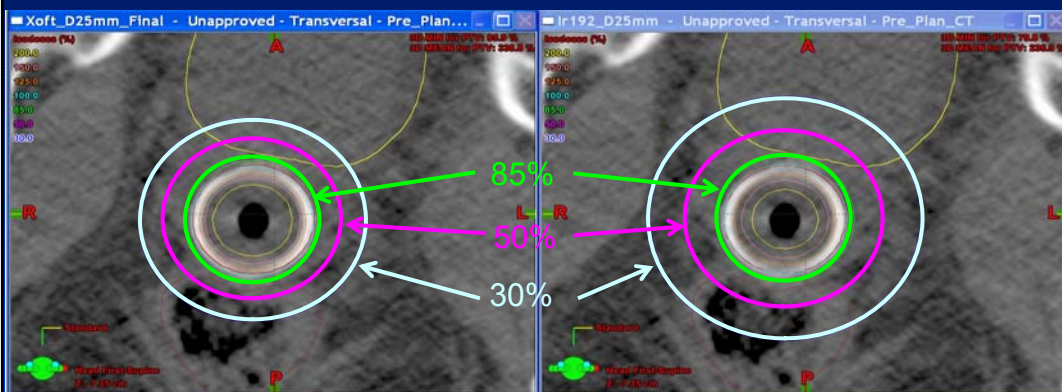
Applicator Length: 10 cm

Clinical Target: 3-5 cm of vagina

Prescription:
6 Gy x 5 to cylinder surface
or
7 Gy x 3 to 5 mm depth



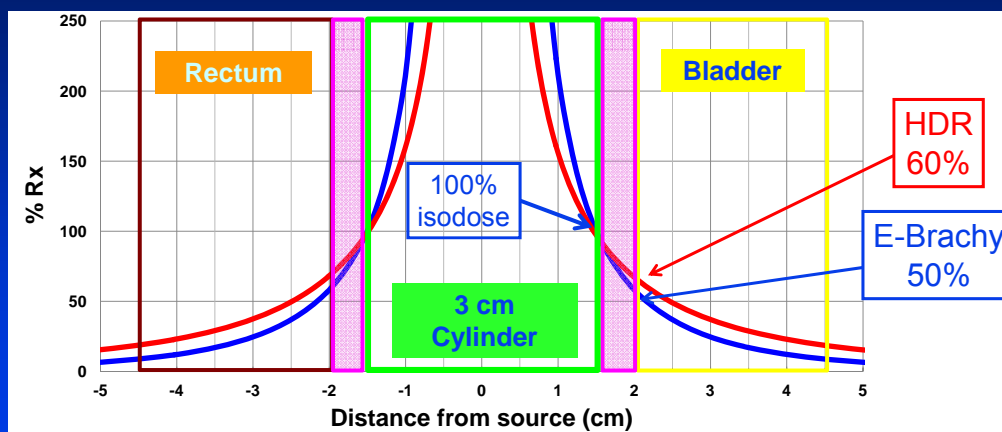
Single Channel Xoft vs. HDR Vaginal Cylinder



100% Rx at Cylinder Surface

E-Brachy vs. HDR: when 100% isodose at VC surface (vaginal mucosa)

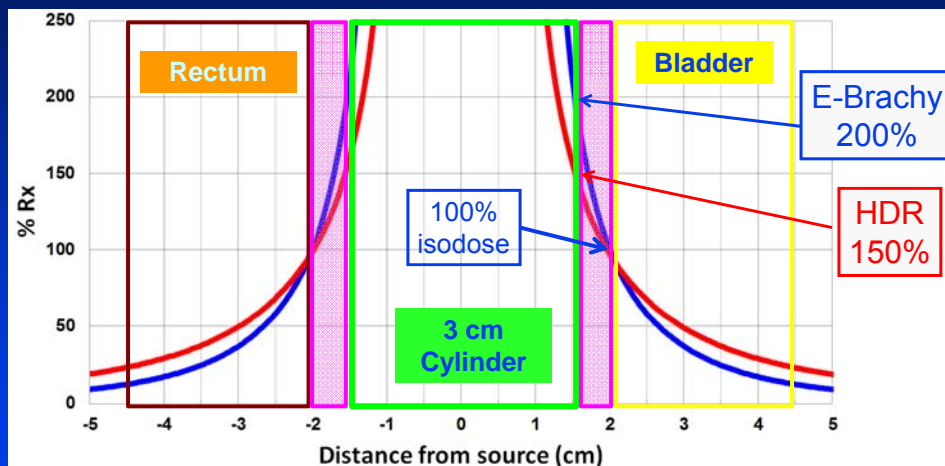
Target tissue and OAR are \approx 5mm from cylinder surface





E-Brachy vs. HDR: 100% at 5mm depth (also OAR)

Target tissue and OAR are \approx 5mm from cylinder surface



Postop vaginal cuff E-Brachy

N=16 (13 Endometrial and 3 Cervix)
Mean fu 21 mo

5 E-Brachy only (mean 6Gy x 5 or 30Gy)
8 E-Brachy 9-20 Gy (2-4 fx) + EBRT (45 Gy)

LRC 94% OS 88%

Toxicity Grade 2 or 3?

E-Brachy alone: (n = 0) – Why?

E-Brachy + EBRT: (n = 4) Gyn 4, GU 3, GI 0

*2 cases Gyn G3 = V_{150} 75% vs. 34% (all other cases)



Kamrava et al Brachytherapy 2013 v12p141



Vaginal EBRT + Brachytherapy Results Endometrial Cancer

EBRT with Brachytherapy			EBRT and vaginal brachytherapy			
Author/reference	N	Treatment ^a	Control/survival	Pelvic recurrences (%)	Vaginal recurrences (%)	Complications
Lybeert et al. (27)	291	Postop 40 Gy EBRT + 5 Gy × 4 at 0.5 cm (HDR)	5-y NED I: 88% II: 68% III/IV: 50%	2.7	2.7	No, Grade 3/4
Nori et al. (28)	300	40 Gy EBRT + 7 Gy × 3 at 0.5 cm (HDR)	20-y DFS, 96%	0.3	2	No, Grade 3/4
Algan et al. ^b (29)	81	45 Gy EBRT + 4 Gy × 3 at 0.5 cm (HDR) or 30 Gy surface (LDR)	5-y OS, 83%	3	4	
Cannon et al. (30)	50	45–51 Gy EBRT + 5 Gy × 3/7.8 × 2 at surface (HDR)	5-y OS, 82%	4	0	2%, Grade 3; 2%, Grade 4
Fayed et al. (31)	1179	50.4 Gy EBRT + 2 Gy × 6 at 0.5 cm (HDR)/60–70 Gy total at surface (LDR) ^c	5-y OS, 70% (LDR) and 68% (HDR)	9 (LDR); 14 (HDR) ^{d,e}		1.9%, Grade 3/4
Aalders et al. (25)	263	40 Gy EBRT 60 Gy at surface (LDR)	5-y OS, 91%	2 ^f		0.7%, Grade 5; 0.4%, Grade 4

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Vaginal Brachytherapy Alone: Results Endometrial Cancer

Brachytherapy without EBRT			Brachytherapy alone			
Author/reference	N	Treatment	Control/survival	Total pelvic recurrences (%) ^a	Vaginal recurrences (%)	Complications
Sorbe and Smeds (5)	404		5-y OS, 92%	3.0	0.7	6.9%, clinically significant
Noyes et al. (6)	63	16.2 Gy × 2 ovoids at surface	OS, 98.5%	1.6	0	No, Grade 3/4
Fanning et al. (7)	60	7 Gy × 3 at 0.5 cm	3-y NED, 100%	0	0	No, Grade 3/4
Kloetzer et al. (8)	108	10 Gy × 4 to 0.5 or 1.0 cm	3-y OS, 96%	0	0–3	0–12.6%, Grade 3/4
Hong et al. (9)	44	7 Gy × 3 at 0.5 cm	5-y DFS, 92%	0	2.9	No, Grade 3/4
MacLeod et al. (10)	141	8.5 Gy × 4 at surface		2	1.4	No, Grade 3/4
Weiss et al. (11)	122	7 Gy × 3 at surface	5-y NED, 94%	4.1	1.6	No, Grade 3/4
Peterit et al. (12)	191	16.2 Gy × 2 ovoids at surface	4-y OS, 95%	0.5	0	0.5%, Grade 4
Chadha et al. (13)	38	7 Gy × 3 at 0.5 cm	5-y OS, 93%	0	0	No, Grade 3/4
Eltabbakh et al. (14)	332	30 Gy at 0.5 cm (LDR)	5-y DFS, 98.9%	0.6	0	2.1%, Grade 3/4
Anderson et al. (15)	102	5 Gy × 3 at 0.5 cm	5-y OS, 84%	1.9	1	No, Grade 3/4
Horowitz et al. (16)	164	7 Gy × 3 at 0.5 cm	5-y OS, 87%	0.6	1.2	No, Grade 3/4
Rittenberg et al. (17)	53	5.6 Gy × 3 at 0.5 cm	5-y OS, 91%	0	0	No, Grade 3/4
Jolly et al. (18)	50	5 Gy × 5 at 0.5 cm	4-y OS, 97%	2	2	No, Grade 3/4
Alektiar et al. (19)	382	7 Gy × 3 at 0.5 cm	5-y OS, 93%	0	0.8	0.5%, Grade 3; 0.25%, Grade 4
Solhjem et al. (20)	100	7 Gy × 3 at 0.5 cm	3-y OS, 97.9%	0	0	No, Grade 3/4
Cengiz et al. (21)	31	7 Gy × 3 at 0.5 cm (HDR) or 70 Gy at surface (LDR)	5-y OS, 93%	3.2	0	No, Grade 3/4
Atahan et al. (22)	128	5.5 Gy × 5 at 0.5 cm	5-y OS, 96%	1.6	0	No, Grade 3/4
Lin et al. (23)	42	7 Gy × 3 at 0.5 cm (HDR) 65 Gy at surface, 30 Gy at 0.5 cm (LDR)		0	2	No, Grade 3/4
McCloskey et al. (24)	75	7 Gy × 3 at 0.5 cm		2.6	1.3	
Aalders et al. (25)	277	60 Gy at surface (LDR)	5-y OS, 89%	6.9 ^b		1%, Grade 4
Knocke et al. ^c (26)	325	8.5 Gy × 4–5 with intravaginal and 7 Gy × 1–2 with intravaginal at 2 cm from the center of the source	5-y OS, 52.7%	13.8 ^b		3.1%, Grade 3/4
PORTEC-2 ^d (3)	213	7 Gy × 3 at 0.5 cm (HDR) 30 Gy at 0.5 cm (LDR)	5-y, 84.8%	3.8	1.8	2.3%, Grade 3; no, Grade 4



Conclusions: Vaginal Brachytherapy

Prevents LR in interm. Risk endometrial Ca (LN-)

Low morbidity (esp. monotherapy) – limited dose to OAR

HDR: convenient, radiation safe, better dosimetry than LDR

Multi-channel or custom app > better dosimetry than single channels

E-Brachy is valid alternative, but higher mucosal dose than HDR

HDR multi-channel: best therapeutic index (Target vs. OAR dose)