# ICRU 89: Time to move beyond point A?- Update in CT adaptation for brachytherapy

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**Medanta The Medicity**
**Gurgaon**

# Conflict of Interest

I have two pending IP rights on CT compatible Intravaginal templates for use in treatment of cervix cancer brachytherapy by IGABT.

# We will discuss.

Evolution of Volume based IGBT.

Relevant points of ICRU 89.

Relation between point based and volume based planning.

Problems of IGABT(MRI).

Advantages/ disadvantages  of CT guided BT.

CT guided IGABT guidelines.

Clinical results of CT guided BT.

Implementing CT guided IGABT in clinical practice.

# Preface of todays discussion

Margaret Cleves first used Radium in treatment of cervix cancer.

**Stockholm System- IC brachytherapy Started in 1910.**

**Paris System – ICBT started at Paris**

} ***Empirical system No prescription rules/ Not Point or Volume based.***

**Manchester system**

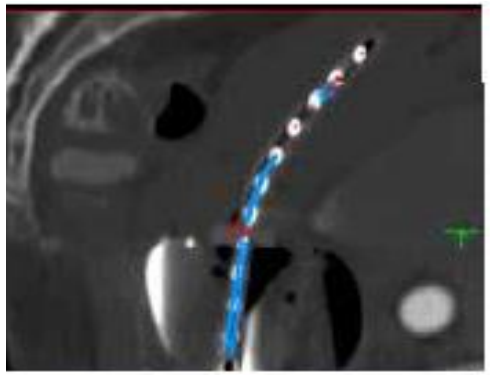
Todd and Meridith in 1930 -- Point based system and prescription rules. Concept of OARs

- Point Based ICRT ruled the arena for more than 70 years .
- Excellent control rates of cancer cervix in combination with EBRT and CCT.
- A technique of boast for Radiation oncologist offering unparallel cure rates compared to any other disease in the contemporary times.

# Evolution of imaging in brachytherapy and the corresponding literature

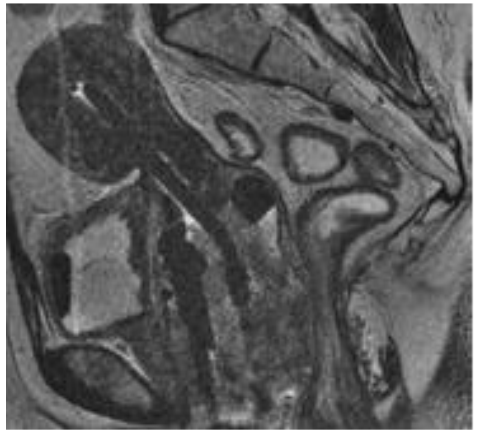
**Plain x ray**
**International standard until 2002**

**Numerous research articles.**
**ICRU 38 as Guidelines in 1985.**



**2002-2011, more and more centers started using CT based planning**

**Clinical results available from 2000 till date.**
**ESTRo/ABS/IBS Guidelines in 2021**



**Started around 1998, Multiple reports published By 2010.**

**GEC ESTRO group 2000.**
**Recommendations –2005-2012**
**Clinical Outcome results 2017/2021/**
**ICRU 89 - 2016**

# Why a need was felt to replace point A?

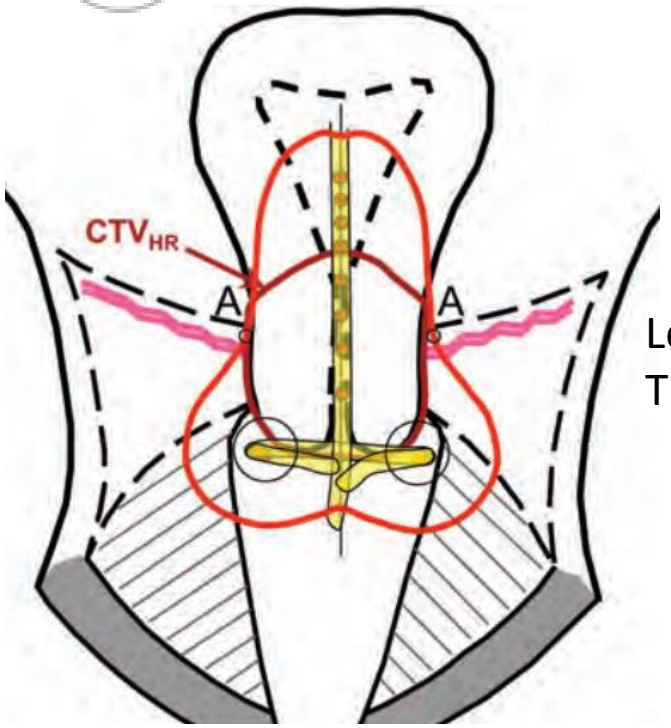
***Talks to replace Point A did not happened because of its inherent criticisms!***

- Not being a true anatomical point.
- Not reproducible in all fractions.
- Does not represents true tumour volume.
- Confusions about its true positions.
- Lack of correlation of dose and outcomes.

***Rather we attained new advancements and have new needs***.

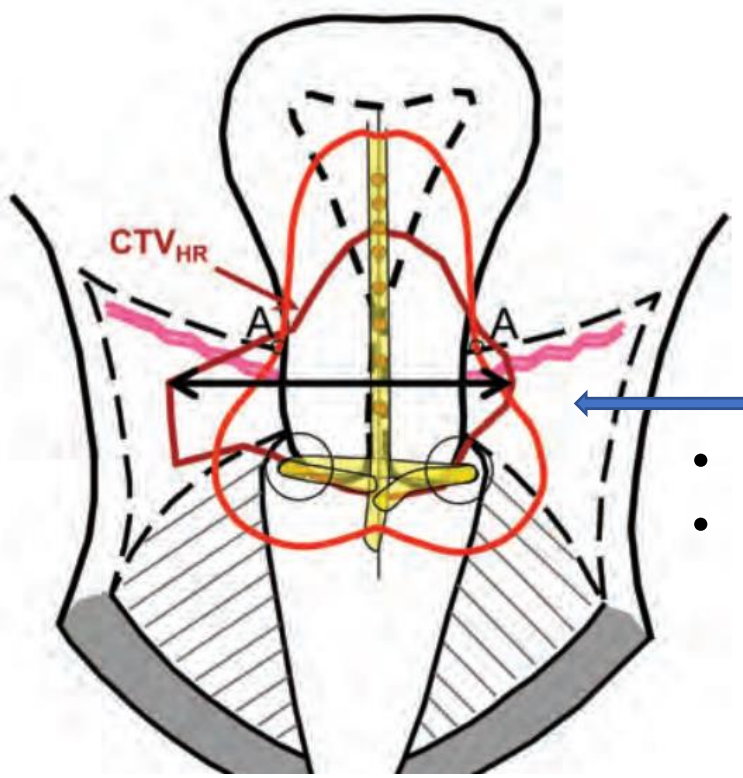
- Volumetric imaging at diagnosis and Brachytherapy.
- Compatible applicators.
- Understanding the contouring of target volumes.
- Better optimisation of treatment plans in volumetric planning.
- Advent of IC+IS techniques that mandates volumetric imaging and volume delineations.
- In pouring clinical results showing more control and less toxicities with IGBT.

# Volumetric images –Point A dose prescription is inadequate




Left/Rt - maximum width 2 cm.
The Point A dose is representative of CTVHR

- Maximum width of 4 cm Rt side.
- 45 Gy EBRT+ 7GyX4 HDR.
- Right EQD2 to 57 Gy (47%)

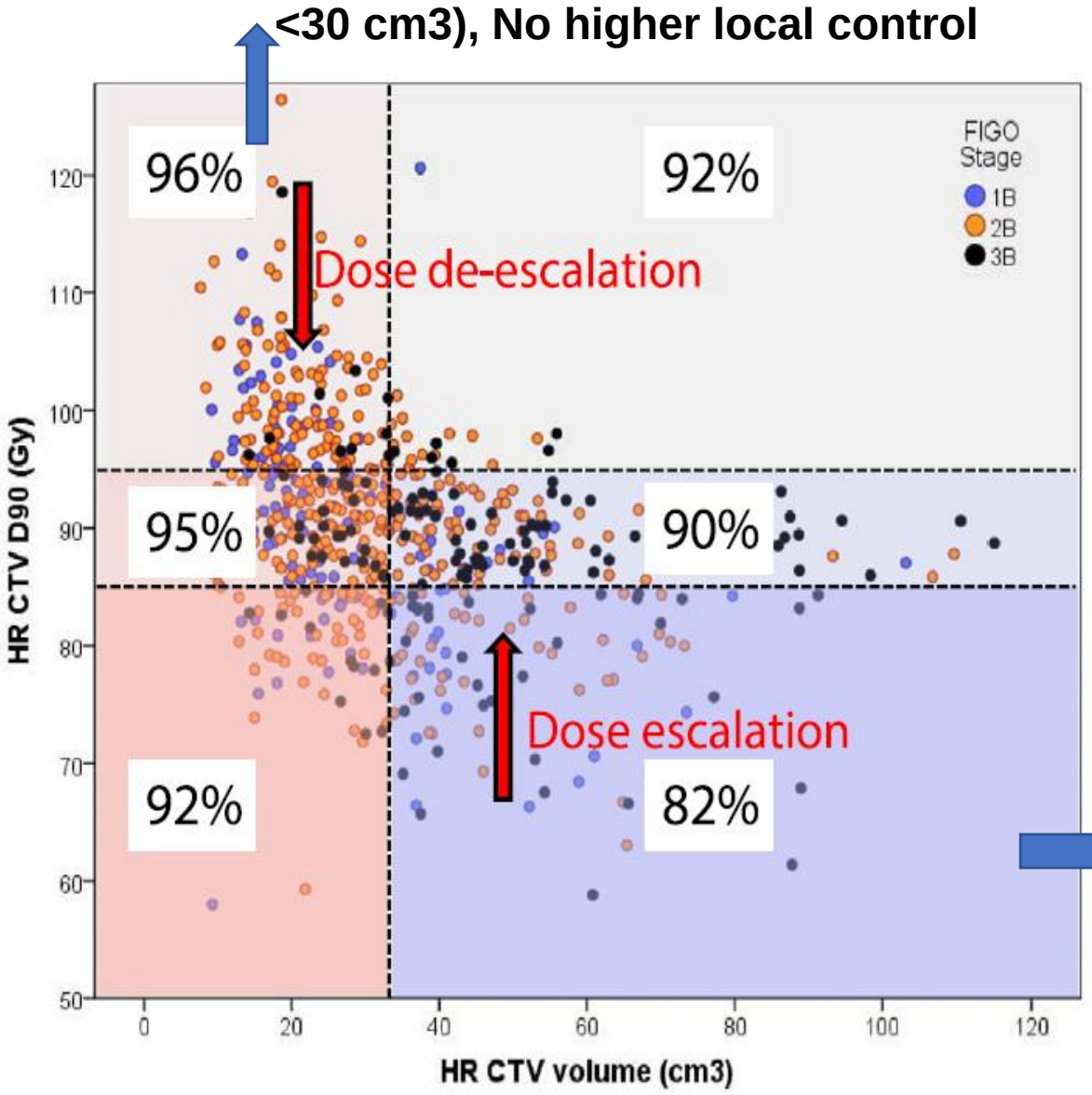



- Dmax HRCTV 2.5 cm
- Left EQD2 78 Gy EQD2 78 Gy(80%)

# IC+IS technique of Brachytherapy and IGABT

- In todays radiotherapy you treat only after  U see.
- Complex IC/IS techniques are not performed without imaging.
- A better method than Point A replacement can be discussed.

# IGABT and IC+IS BT are complimentary for better LC in advanced Ca Cervix

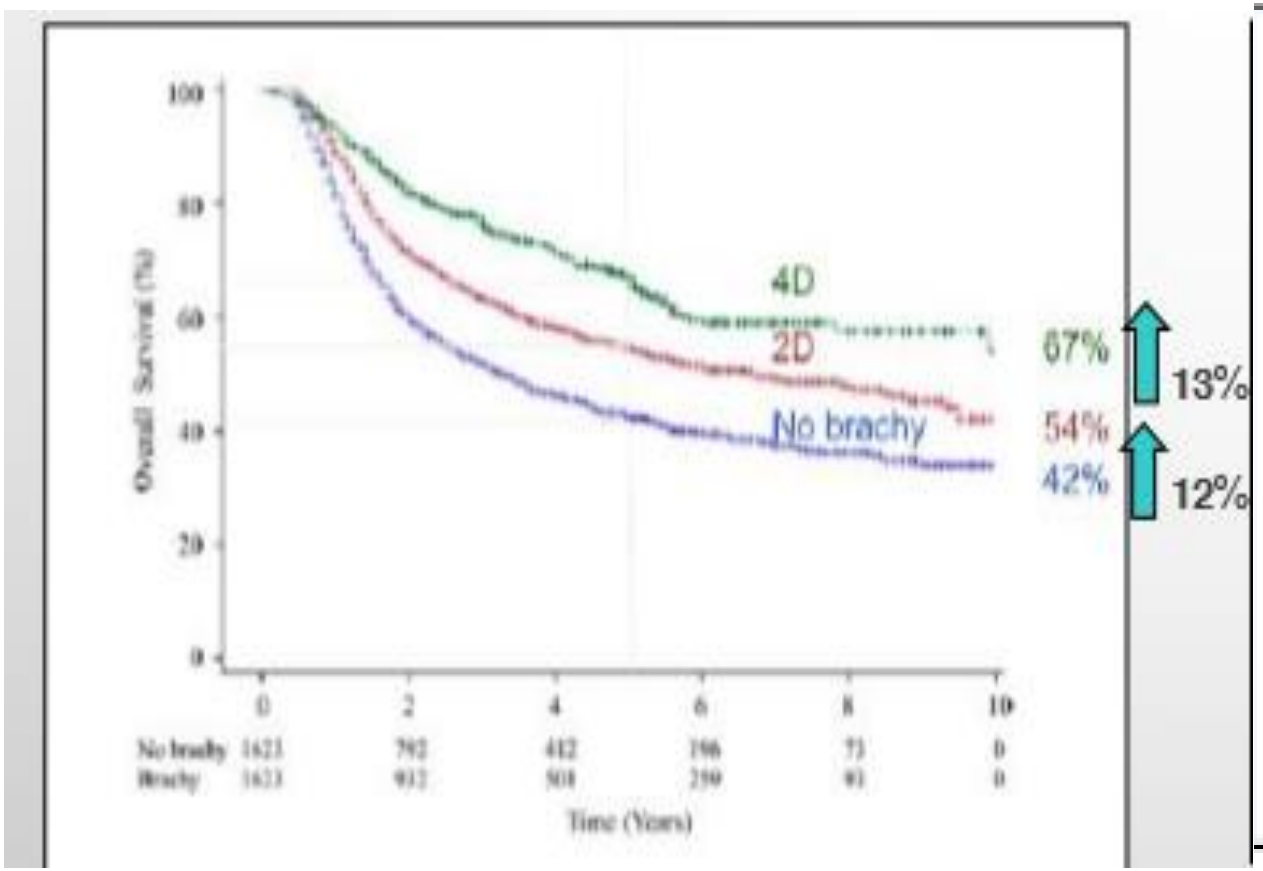



Distribution of CTVHR dose and volume in the

- Actuarial 3 years LC is shown for each box.
- For dose escalation and de- escalation two things are necessary
  **IGABT.**
  **IC+IS/ IS brachytherapy.**

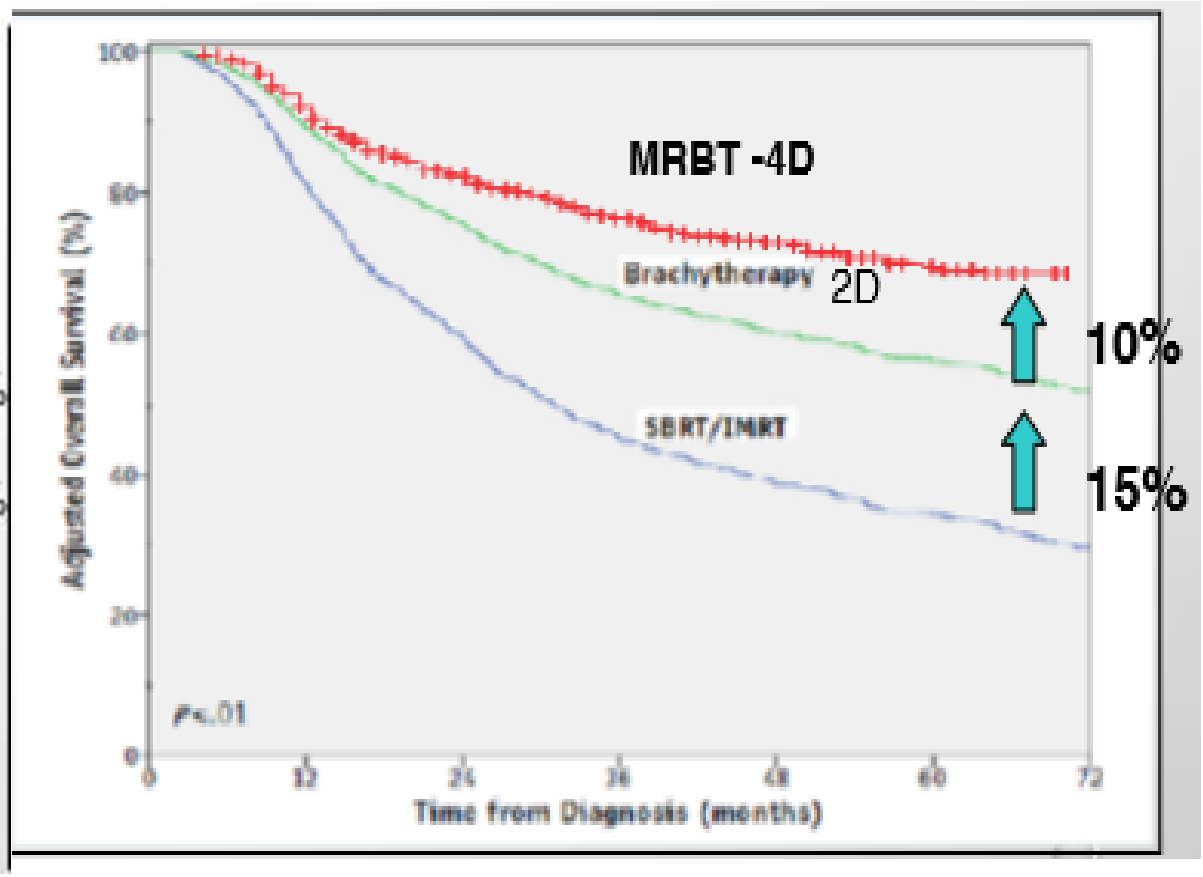
>30 cc,
Receiving less than 85 Gy so poor LC

# No Brachytherapy Vs 2D/3D Brachytherapy



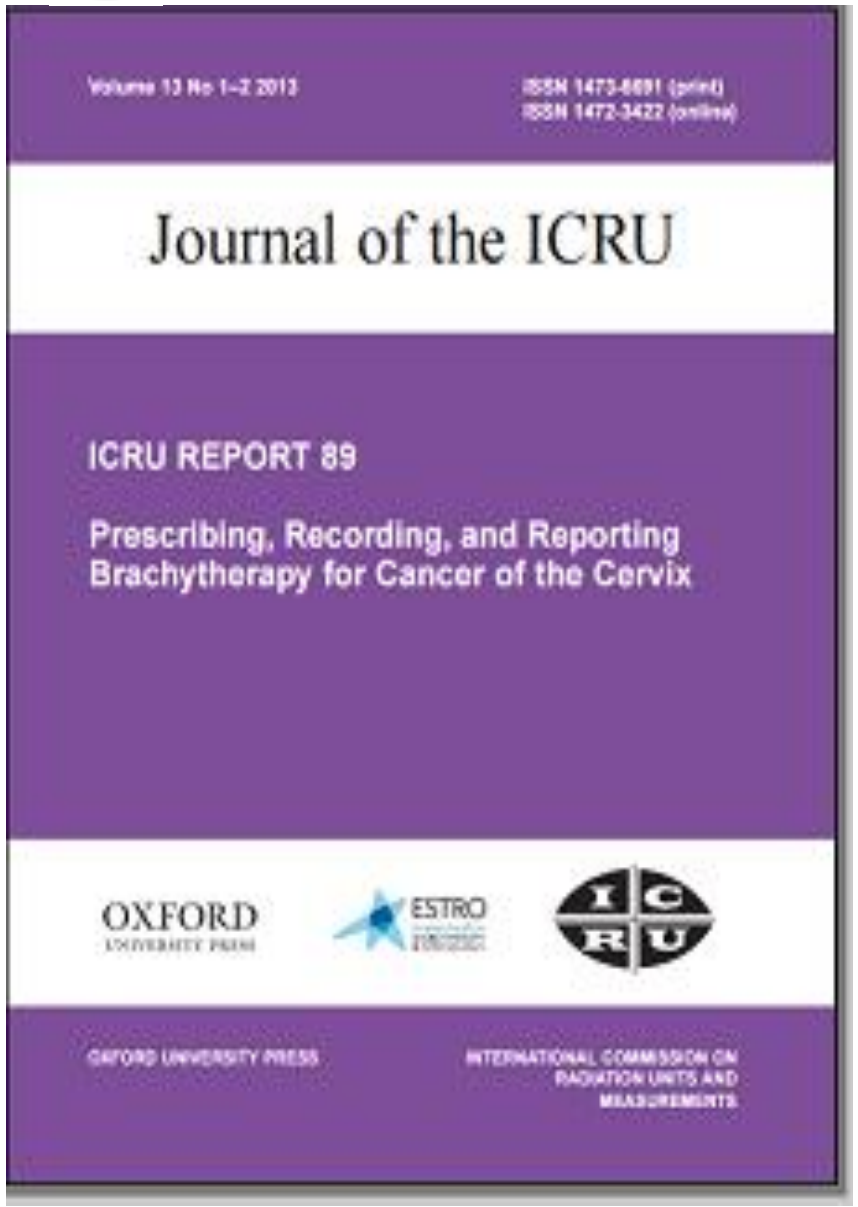

Total 25 % improvement in OS

# Brachy boost compared to IMRT boost and 2 D boost




GEC ESTRO teaching course slide

**ICRU 89 on basis of GECESTRO guidelines** validated by Retro embrace and EMBRACE trials.




Recommendations from Gynaecological (GYN) GEC-ESTRO Working Group☆ (I): concepts and terms in 3D image based 3D treatment planning in cervix cancer brachytherapy with emphasis on MRI assessment of GTV and CTV

Recommendations from gynaecological (GYN) GEC ESTRO working group (II): Concepts and terms in 3D image-based treatment planning in cervix cancer brachytherapy—3D dose volume parameters and aspects of 3D image-based anatomy, radiation physics, radiobiology

Recommendations from Gynaecological (GYN) GEC-ESTRO Working Group: Considerations and pitfalls in commissioning and applicator reconstruction in 3D image-based treatment planning of cervix cancer brachytherapy

Recommendations from Gynaecological (GYN) GEC-ESTRO Working Group (IV): Basic principles and parameters for MR imaging within the frame of image based adaptive cervix cancer brachytherapy

# ICRU report 89 (258 pages)

# Prescribing, Recording, and Reporting Brachytherapy for Cancer of the Cervix

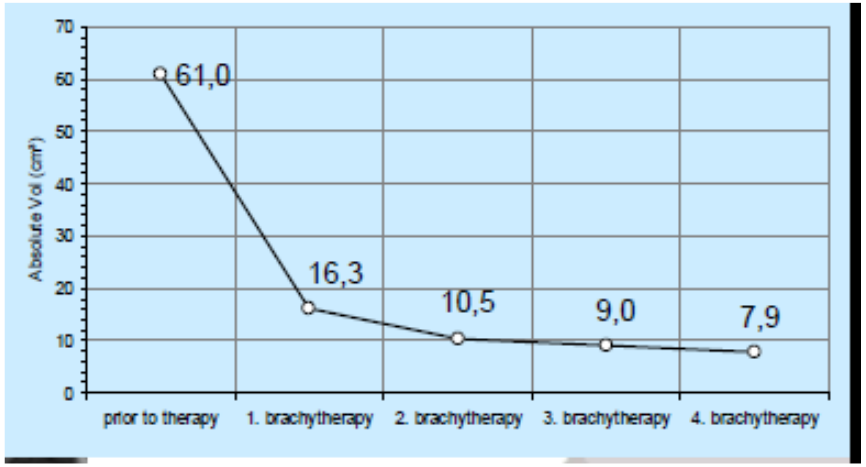
**Sections 1-12**
- Summary (end of each section)
- Key messages (1-4, 9, 12)
- Recommendations (5-8,10-11)

Chapter *(1)* – Introduction
Chapter *(2)* – Prevention, Diagnosis, Prognosis, Treatment and Outcome
Chapter *(3)* – Brachytherapy Techniques and Systems
Chapter *(4)* – Brachytherapy Imaging for Treatment Planning
Chapter *(5)* – Tumor and Target Volumes and Adaptive Radiotherapy
Chapter *(6)* – Organs At Risk and Morbidity-Related Concepts and Volumes
Chapter (7) – Radiobiological considerations
Chapter *(8)* – Dose and Volume Parameters for Prescribing, Recording, and Reporting Brachytherapy, Alone or combined with External Beam Therapy
Chapter *(9)* – Volumetric Dose Assessment
Chapter *(10)* – Radiographic Dose Assessment
Chapter *(11)* – Sources and Absorbed-Dose Calculation
Chapter *(12)* – Treatment planning
*Chapter (13) – Summary of The Recommendations*

Appendix A: 9 Comprehensive Clinical Examples (various clinical/technical scenarios)

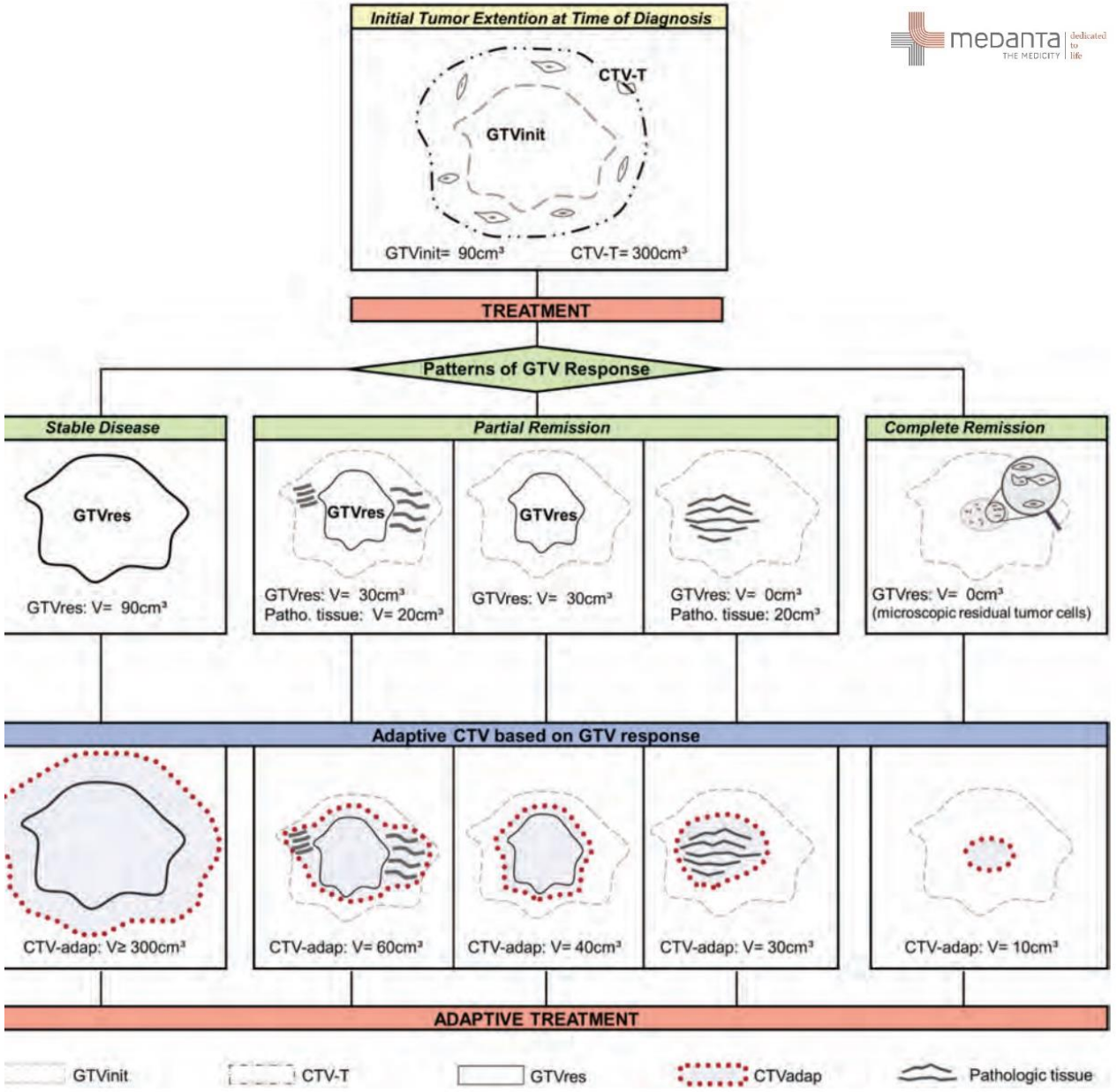
# ICRU 89 Adaptive IGBT

- Emphasizes adaptive,  4D( 3 D and time) treatment approach.
- Improve the efficacy/toxicity ratio by exploiting the tumor-volume regression



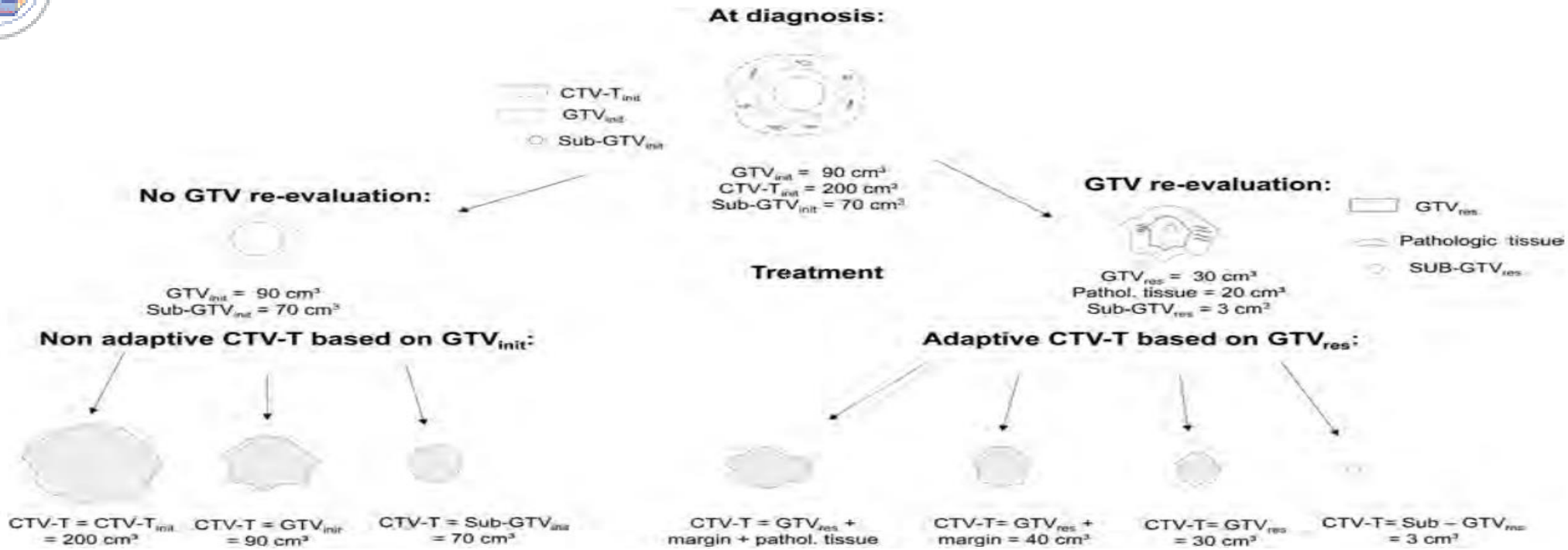

Dimopoulos et al. IJROBP 2006

*Tumor and Target Volumes and Adaptive Radiotherapy*




5.3. Schematic diagram indicating various forms of response of the initial GTV to treatment, resulting in various forms of residual

# Adaptive planning for a Volumes- opinions can differ




- Initial GTV plus margins.
- Initial GTV alone
- Initial sub-GTVs

- Residual GTV + residual pathologic tissue in the area of the initial GTV + tumor-bearing organ
- Res GTV plus residual pathologic tissue in the area of the initial GTV.
- Residual GTV alone plus margins
- Residual GTV alone.
- Residual sub-GTVs.

# Target volume concepts

**High Risk CTV** :

GTV at time of brachytherapy

In all cases includes:

GTV + whole cervix

Presumed tumour extension in adjacent tissues **Clinical assessment**
**Residual grey zones on MRI**

NO SAFETY MARGINS

**IntermediateRiskCTV** :

GTV at time of diagnosis

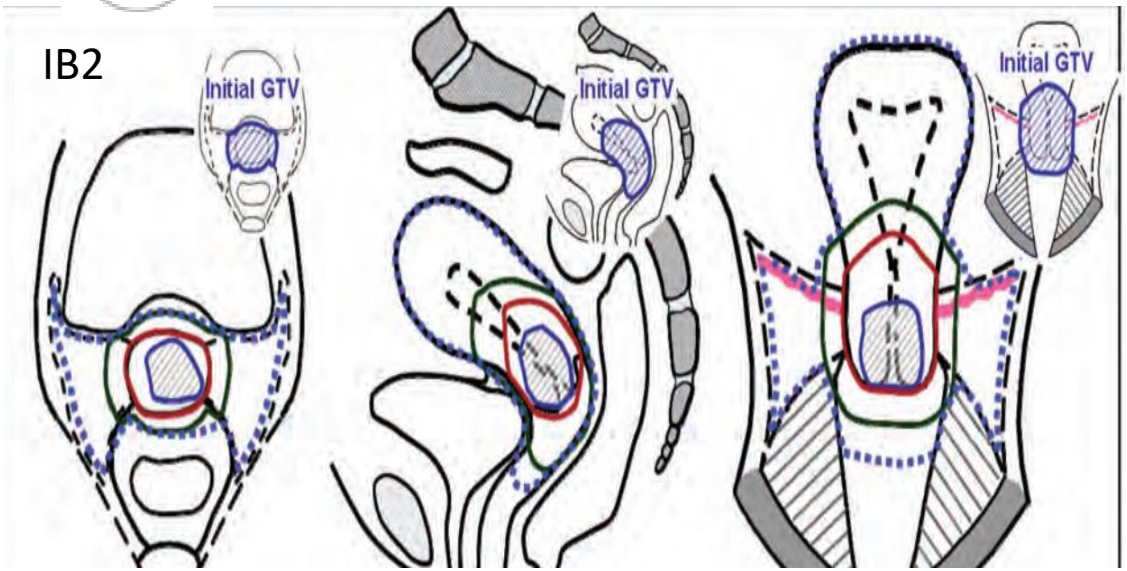
In all cases includes:

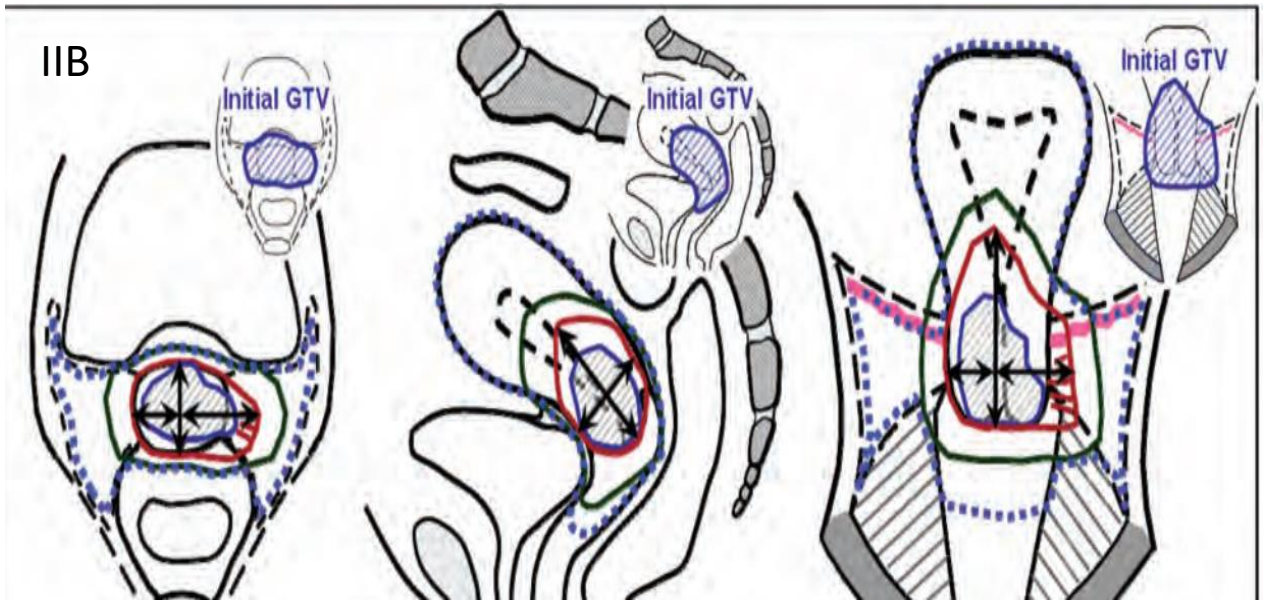
HR-CTV

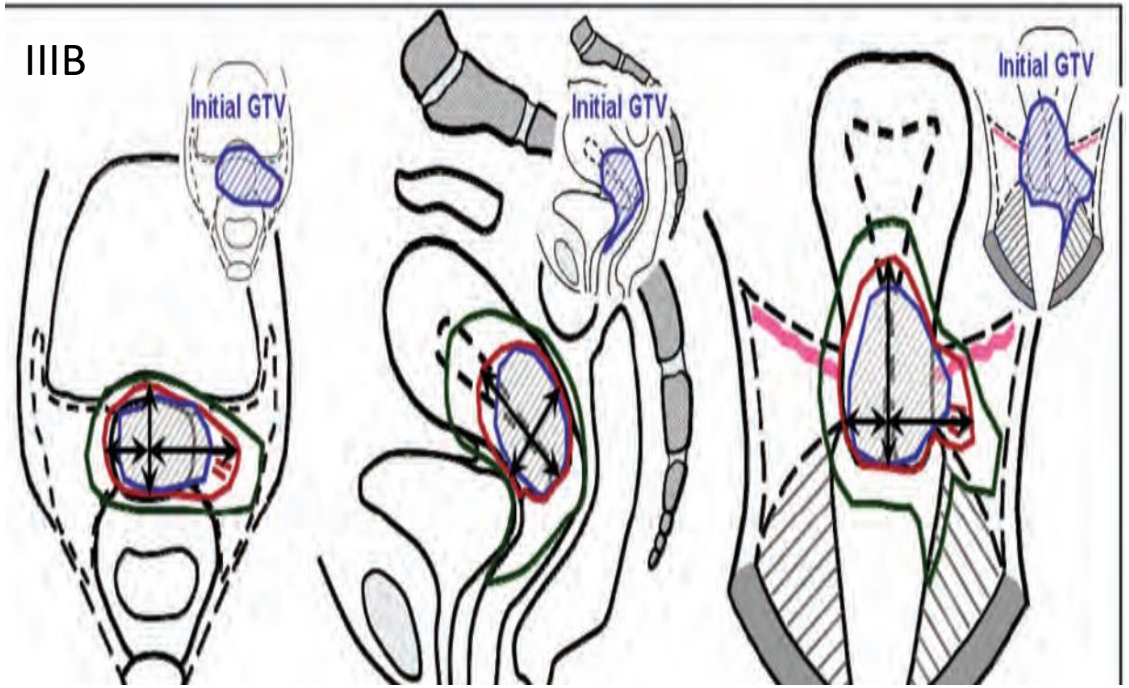
Integrates initial GTV

SAFETY MARGINS

# Concept of adaptive concept as per ICRU89



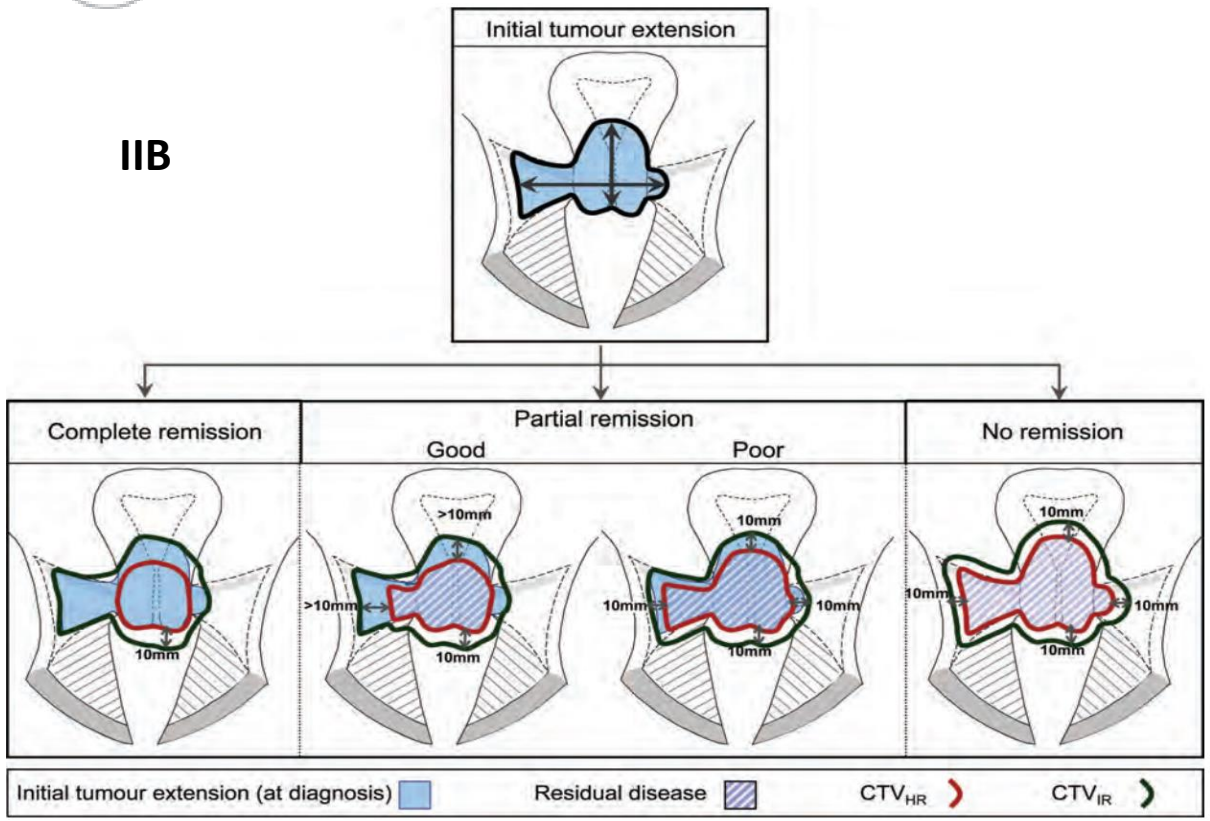

**GTV Res + Cervix+ Grey Zones(in region of previous GTV)= HRCTV**

**Initial GTV + HRCTV Cervix + Margin= IRCTV**

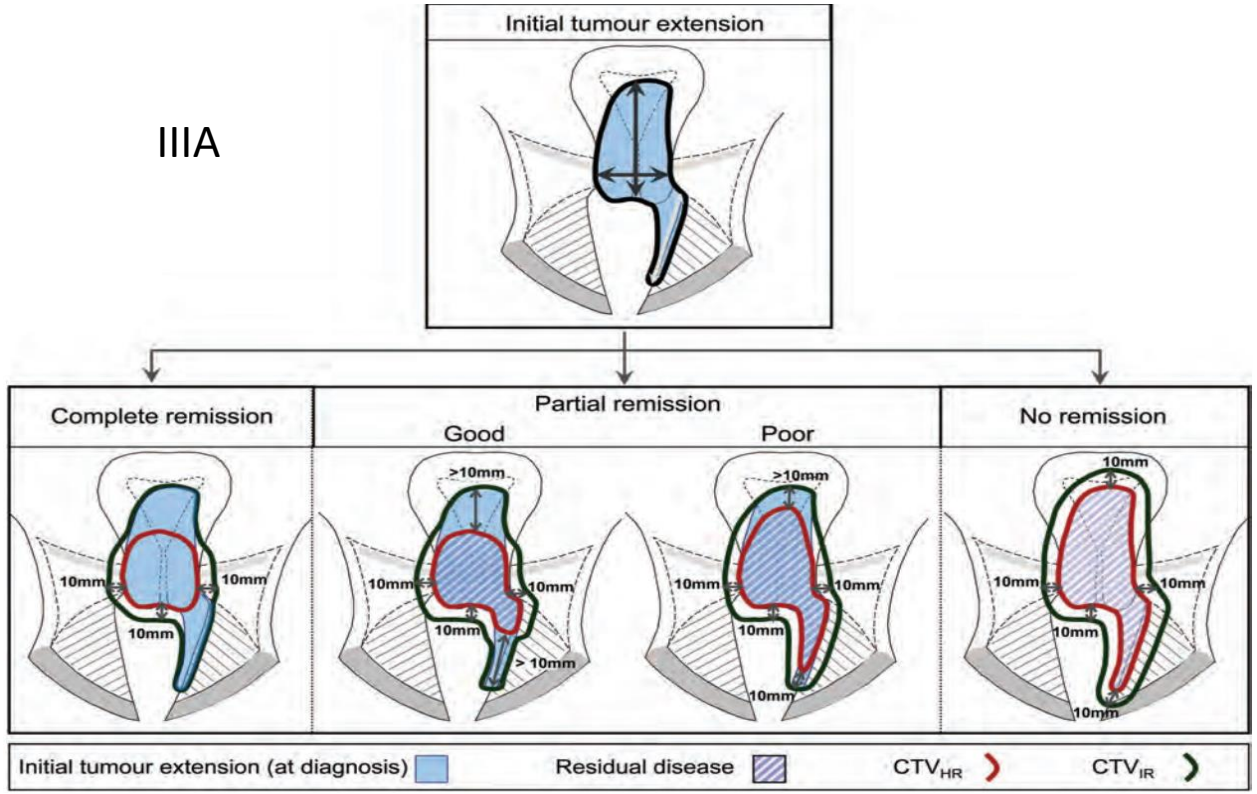
**CTVLR= Treated during EBRT**

# IRCTV margins

IIB

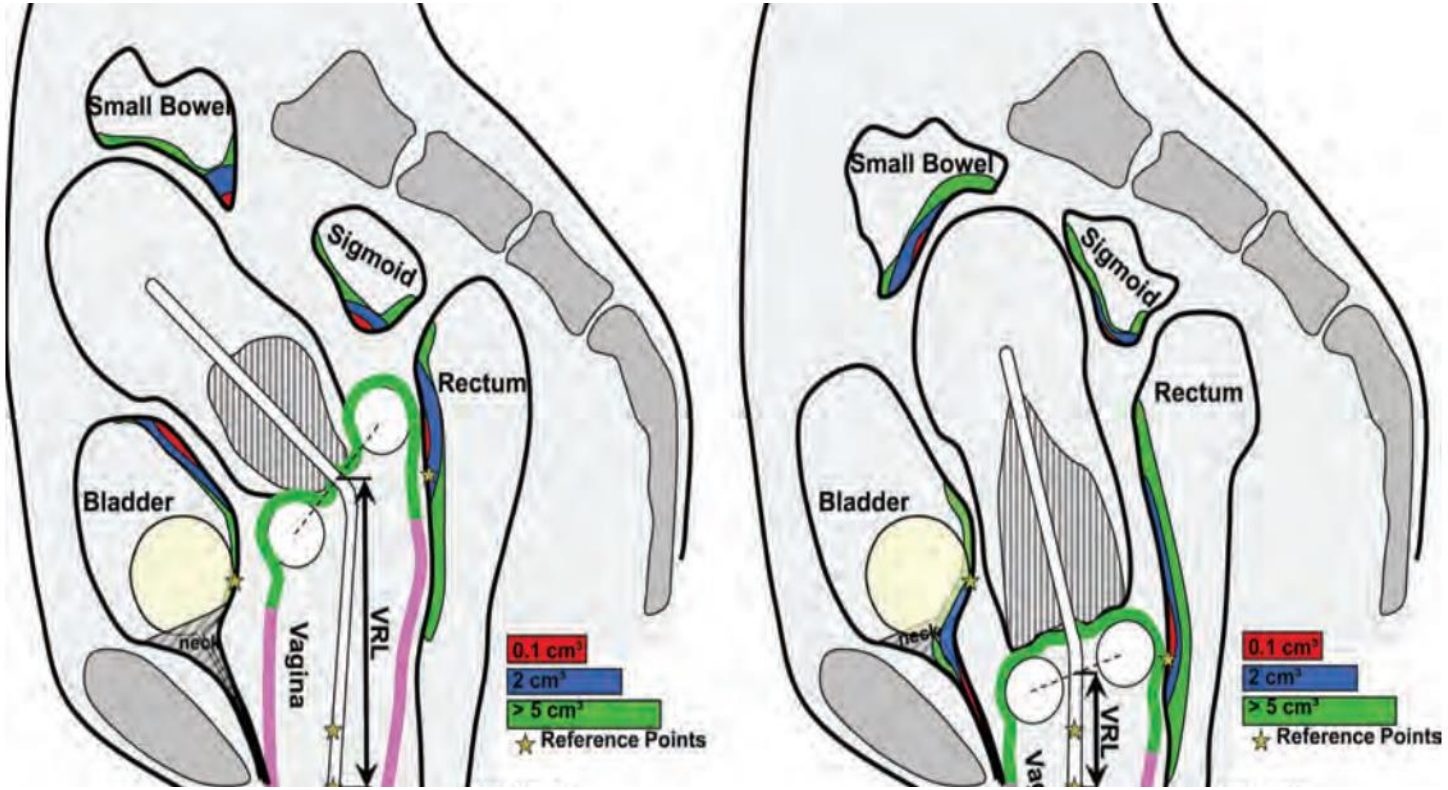



IIIA




- The GEC ESTRO - 10 mm margin in the Lat and CC directions and 5 mm AP direction.
- Margin at the borders of the CTV-THR where there was no initial GTV-T.
- Stable disease, CTV-THR becomes similar to the GTV-T init, with margins for IRCTV.
- In the case of rectal/bladder invasion, CTV-T margins should not go into the organ lumen

# OAR dose uncertainties, evaluation




Different positions of the vaginal part of the utero-vaginal applicators, the cervix tumor, the uterus, and the reference volumes of OARs in two different patients.

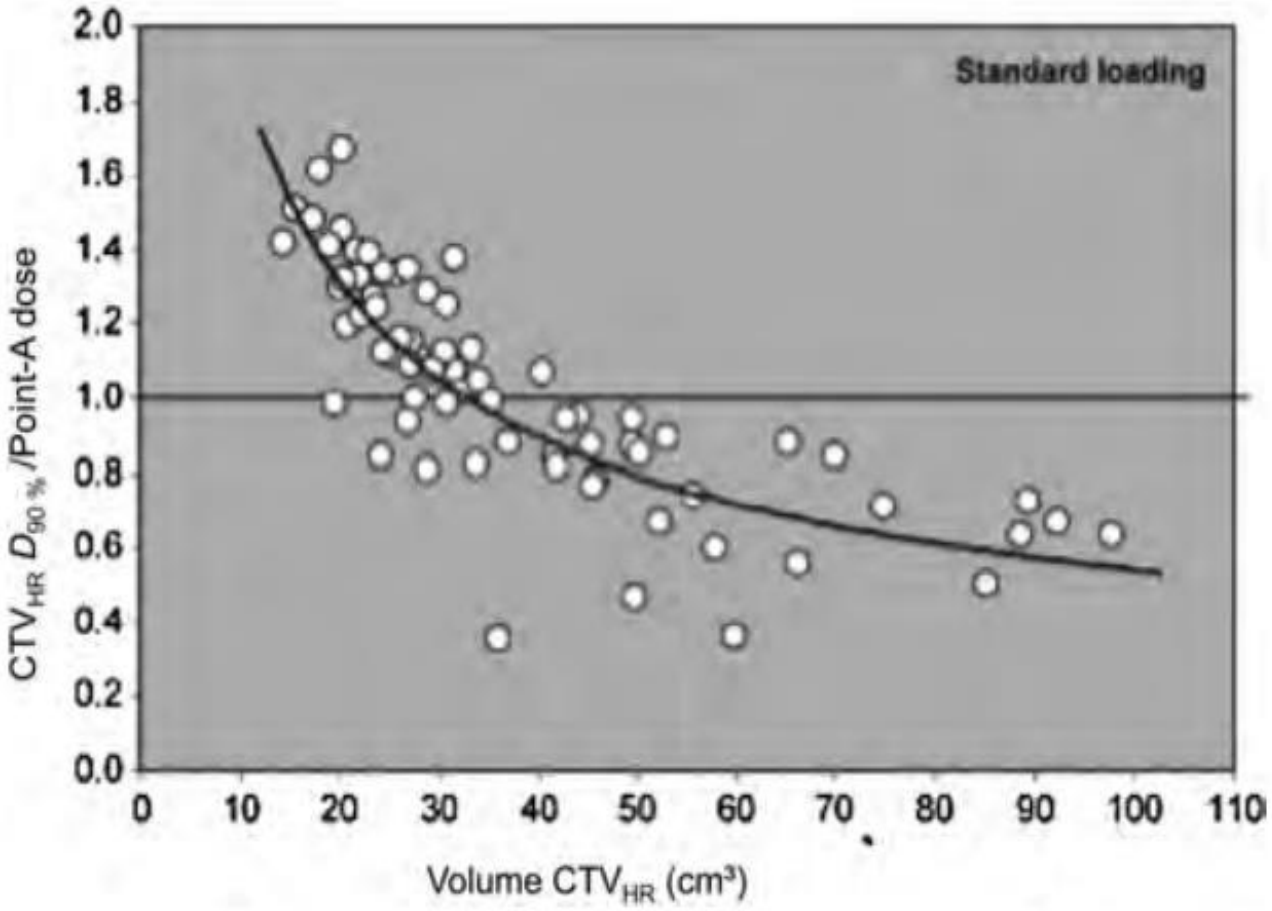
- BT-related morbidity are usually linked to small volumes receiving high absorbed doses.
- For small OAR planning and reporting (0.1 or 2 cm3 it is sufficient to delineate one outer contour.
- Telangiectasia, ulceration, necrosis, or fistula dose to 0.1 or 2cc .

## Page 66 ICRU use of alternate images for HRCTV drawing

- USG may become essential- even competitive with MRI.
- The adaptive volumetric CTV-THR concept can be applied on CT images and clinical examination are available for treatment planning.
- GTV-Tres can only be defined based on the clinical examination.
- Height of HRCTV cannot be assessed from CT images or clinical examination.
- Can be followed in Radiograph with limited accuracy.

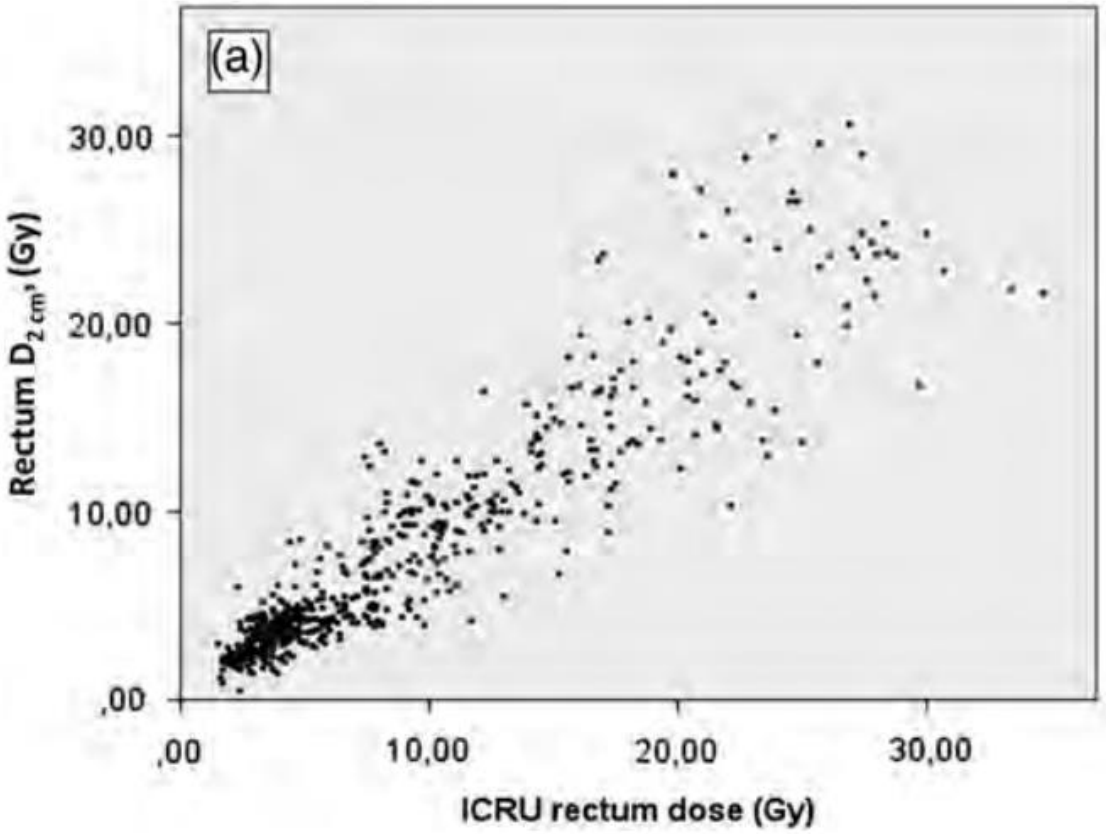

You can't move forward
until you look back.
Cornel West

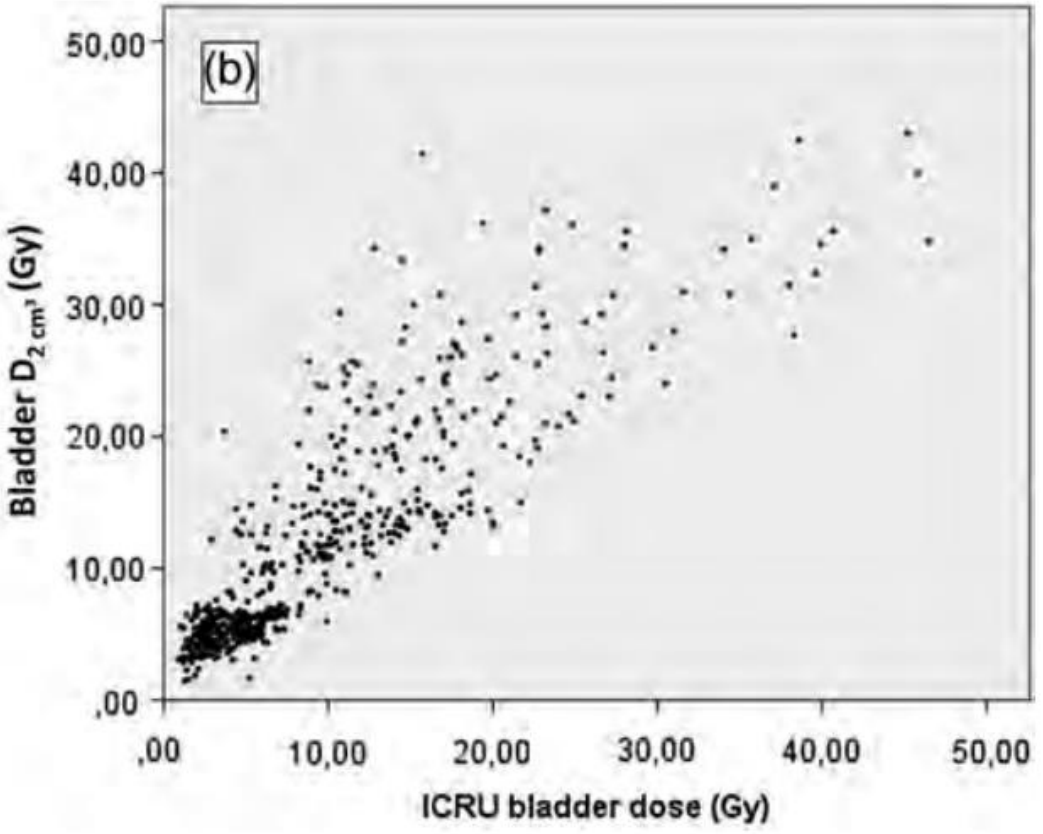
# Relationship between point A/HRCTV/IRCTV




- The Point-A absorbed dose cannot predict the target absorbed dose in individual patients
- It provides a reasonable estimate of the average CTVHR D90 % for a population with a balanced disease-stage Distribution.
- it is possible to proceed from the average dose prescription at Point A to the average dose prescribed to the CTVHR.
- The treatment to the 60 Gy isodose line approximate the CTVIR.

# OAR points and volume relationship




**The data exhibit a largely linear relationship but with a sizable variation for individual patients (EMBRACE, 2015)**

# Clinical relevance of the bladder and rectal reference points

- ICRU Rectal point doses- not a good predictor of D2cm3 in the individual patient.
- 20 % larger with (SD**40 %)**
- ICRU bladder dose -is almost 20 % smaller than bladder D2cm3(SD **32 %).**
- ICRU rectal point has clinical correlation.
- Bladder reference point no clinical correlation proved.

# Modalities and their uses in cervix cancer BT

| | Target Volumes | OAR delineation | Treatment Planning | Ease of access |
|---|---|---|---|---|
| Clinical examination under sedation ***and Documentation*** | Gold Standard | Vaginal (both OAR and Target) extent of disease. | NA | Available |
| MR | Gold standard | Very accurate | More training than CT based Planning required | Difficult outside clinical trial. |
| CT | Needs supplementary information. | Accurate | Widely available | Easily available. |
| USG | Comparable to MRI (Training required ) | Not encouraged. | Not practised in India | Can be made easily available. |

ORIGINAL ARTICLE Gynaecologic Cancers

# Treatment of locally advanced carcinoma cervix with special emphasis on brachytherapy: A practice pattern survey among young radiation oncologist of India

Anis Bandyopadhyay, Poulami Basu, Kaushik Roy, Suman Das[1], Susovan Banerjee[2]

| | |
|---|---|
| ISRT applicators used | |
| MUPIT | 3 (5.3) |
| Syed-Neblett template | 2 (3.5) |
| Vienna | 2 (3.5) |
| None/ISRT not performed | 50 (87.7) |
| Total | 57 (100.0) |
| Imaging modality | |
| No routine imaging, standard plan based | 6 (10.5) |
| C arm/X-ray-based 2D imaging | 16 (28.1) |
| CT-based imaging | 30 (52.6) |
| MRI aided | 5 (8.8) |
| Total | 57 (100.0) |

India. South Asian J Cancer 2018;7:231-5.

# Patterns of cervical cancer brachytherapy in India: results of an online survey supported by the Indian Brachytherapy Society

Abhishek Chatterjee, MD[1], Surbhi Grover, MD, MPH[2], Lavanya Gurram, MD[1], Prof. Supriya Sastri, MD[1], Prof. Umesh Mahantshetty, MD[1]

centers) in more than 30% of cases. Some form of imaging was performed for planning by 97% (57/59 centers) of respondents, with CT scan (65%, 38/59 centers) and

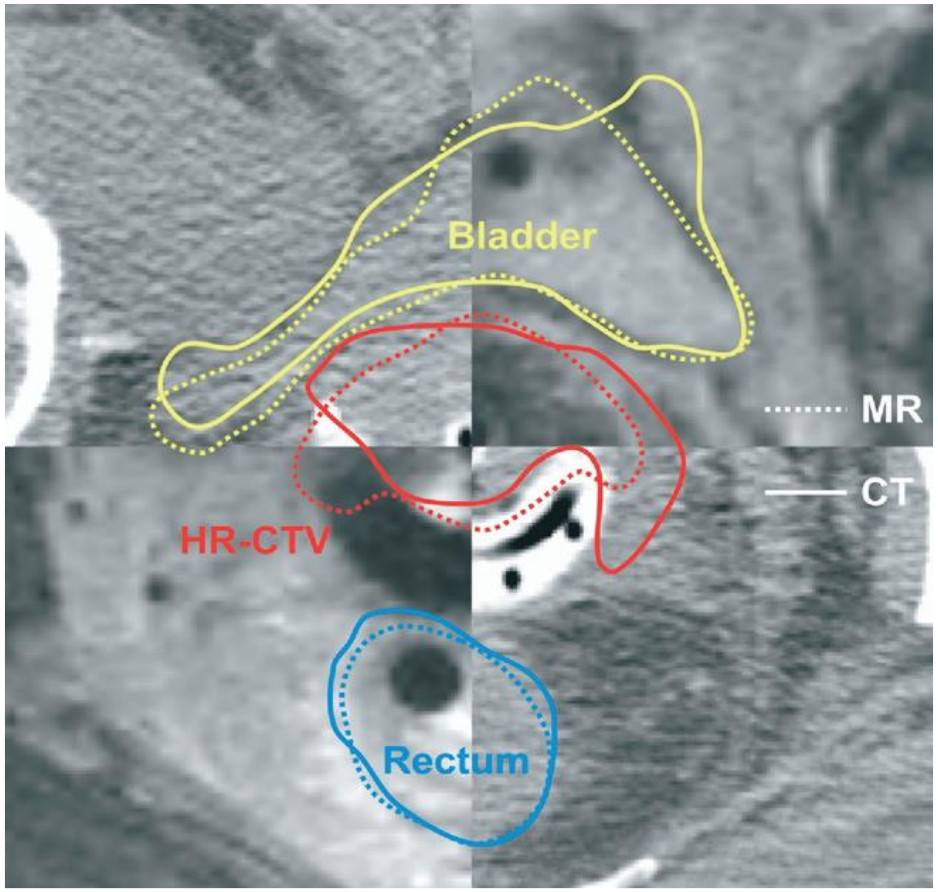
J Contemp Brachytherapy 2019; 11, 6: 527–533
DOI: https://doi.org/10.5114/jcb.2019.90448

Image verification

3% No
23% X-ray
3% Ultrasound
64% CT
10% MRI

*G. Suneja et al. / Brachytherapy ■ (2016) ■*

# Contouring of normal organs in IGABT




- MR represents better resolution even for normal organ contouring.
- Contouring or outer wall only is recommended.

- Whole lumen contouring makes CT contouring comparable with MR.
- Bladder is a complex organ to contour.

# Scope to improve HRCTV in CT-IGABT

Int. J. Radiation Oncology Biol. Phys., Vol. 68, No. 2, pp. 491–498, 2007

0360-3016/07/$–see front matter

ELSEVIER

doi:10.1016/j.ijrobp.2006.12.021

**CLINICAL INVESTIGATION** **Cervix**

## COMPUTED TOMOGRAPHY VERSUS MAGNETIC RESONANCE IMAGING-BASED CONTOURING IN CERVICAL CANCER BRACHYTHERAPY: RESULTS OF A PROSPECTIVE TRIAL AND PRELIMINARY GUIDELINES FOR STANDARDIZED CONTOURS

AKILA N. VISWANATHAN, M.D., M.P.H.,* JOHANNES DIMOPOULOS, M.D.,† CHRISTIAN KIRISITS, SC.D.,† DANIEL BERGER, M.SC.,† AND RICHARD PÖTTER, M.D.,†

*Department of Radiation Oncology, Brigham and Women's Hospital, Dana-Farber Cancer Institute, Boston, MA; †Department of Radiotherapy and Radiobiology, Medical University of Vienna, Vienna, Austria

- The contouring methods didn't tool other complimentary imaging like USG in view.
- No contrast used in CT scan.
- A more meticulous mapping may improve the HRCTV drawn on CT.
- A must read paper to understand the message delivered.

# MR VS CT based IGABT

- Gold standard in delineation.
- Experience  widely published in last 15 years.
- Clinical results are  excellent both in tumour control and toxicity.
- Standard guidelines , Validated by Multicentric study.

- Not available in most centres for BT.
- MR compatible applicators are considered fragile and costly.
- Applicator reconstruction needs expertise.
- The benefits of IGABT specially IC+IS techniques cant reach where needed most.

- Commonly available in most department even in developing countries.
- Considered more user and pocket friendly.
- Literature is adding up.
- Time to disseminate benefits of IGABT by use of CT

- Complementary findings and imaging.
- Easily available.
- Easy applicator and catheter recon.
- Results of MR-IGABT yet to be replicated..

# Conventional ICRT vs IGBT

**2D**

- Cheap and cost effective
- Treatment of mass
- Time tested
- Unpredictable toxicity.
- I just love my first Bike.

**4D-CT IGBT**

- More Safe.
- Affordable and cost effective
- Costly than Bike on initial investment,
- Better for long drive (bigger tumors )
- Less late toxicity.
- NO GPS(Printed Map and asking others).

**4D -MRIGBT**

- Real time GPS to reach destination(HRCTV Dose).
- Back Camera ( More visible OARs).
- Costly/ Not all can afford.

# Recognising CT as standard volumetric imaging modality

Educational Article

Original paper

## Indian Brachytherapy Society Guidelines for radiotherapeutic management of cervical cancer with special emphasis on high-dose-rate brachytherapy

Umesh Mahantshetty, MD[1], Shivakumar Gudi, MD[1], Rashni Singh, MD[1], Ajay Sasidharan, MD[1], Supriya (Chopra) Sastri, MD[1], Lavanya Gurram, MD[1], Dayanand Sharma, MD[2], Selvaluxmy Ganeshrajah, MD[3], Janaki MG, MD[4], Dinesh Badakh, MD[5], Abhishek Basu, MD[6], Francis James, MD[7], Jameema V Swamidas, PhD[8], Thayalan Kuppuswamy, PhD[9], Rajendra Bhalavat, MD[10]

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Brachytherapy ■ (2016) ■

BRACHYTHERAPY

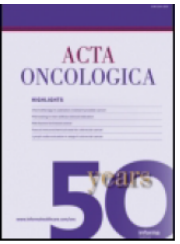
## American Brachytherapy Society: Brachytherapy treatment recommendations for locally advanced cervix cancer for low-income and middle-income countries

Gita Suneja[1,*], Derek Brown[2], Amy Chang[3], Beth Erickson[4], Elena Fidarova[5], Surbhi Grover[6,7], Umesh Mahantshetty[8], Subir Nag[9], Kailash Narayan[10], Memory Bvochora-Nsingo[11], Celia Viegas[12], Akila N. Viswanathan[13], Ming Yin Lin[10], David Gaffney[14]

[1]*Duke University, Durham, NC*

[2]*University of California San Diego, San Diego, CA*

- **CT can be used for planning as an alternative to MRI.**
- **CT for delineation of organs at risk and evaluation of volume histogram parameters is routine.**
- **Tumor-related target area of current research.**
- **The use of CT imaging for treatment planning is**



Acta Oncologica

Taylor & Francis

ISSN: 0284-186X (Print) 1651-226X (Online) Journal homepage: https://www.tandfonline.com/loi/ionc20

# Complementary clinical and imaging

High-risk clinical target volume delineation in CT-guided cervical cancer brachytherapy: Impact of information from FIGO stage with or without systematic inclusion of 3D documentation of clinical gynecological examination

Neamat Hegazy, Richard Pötter, Christian Kirisits, Daniel Berger, Mario Federico, Alina Sturdza & Nicole Nesvacil

- 35 patients.
- Information of comprehensive 3D documentation of repetitive gynecological examination in the HRCTV of CT.
- Use of 3D clinical drawings , significantly improves the HRCTV volume and width estimation .

Radiation Oncology biology • physics

www.redjourn

Clinical Investigation—Gynecologic Cancer

## A Prospective Comparison of Computed Tomography with Transrectal Ultrasonography Assistance and Magnetic Resonance Imaging—Based Target-Volume Definition During Image Guided Adaptive Brachytherapy for Cervical Cancers

Umesh Mahantshetty, MD, DNB,* Pushpa Naga CH, MD, DNB,* Chira Ranjan Khadanga, MD,* Shivakumar Gudi, MD,* Supriya Chopra, MD,* Lavanya Gurram, MD,* Swamidas Jamema, Msc, PhD,* Yogesh Ghadi, MSc, DRP,* and Shyamkishore Shrivastava, MD, DNB†

*Departments of *Radiation Oncology and Medical Physics, Tata Memorial Centre, Homi-Bhabha*

- 25 patients
- Use of Clinical exam, MRI at diagnosis and TRUS at BT
- The mean differences in HR-CTV width between CTandMRI contours at various levels, only 0.1 to 0.4 cm
- Almost like Gold standard.

# Mapping of the disease from clinical/Radiological information.

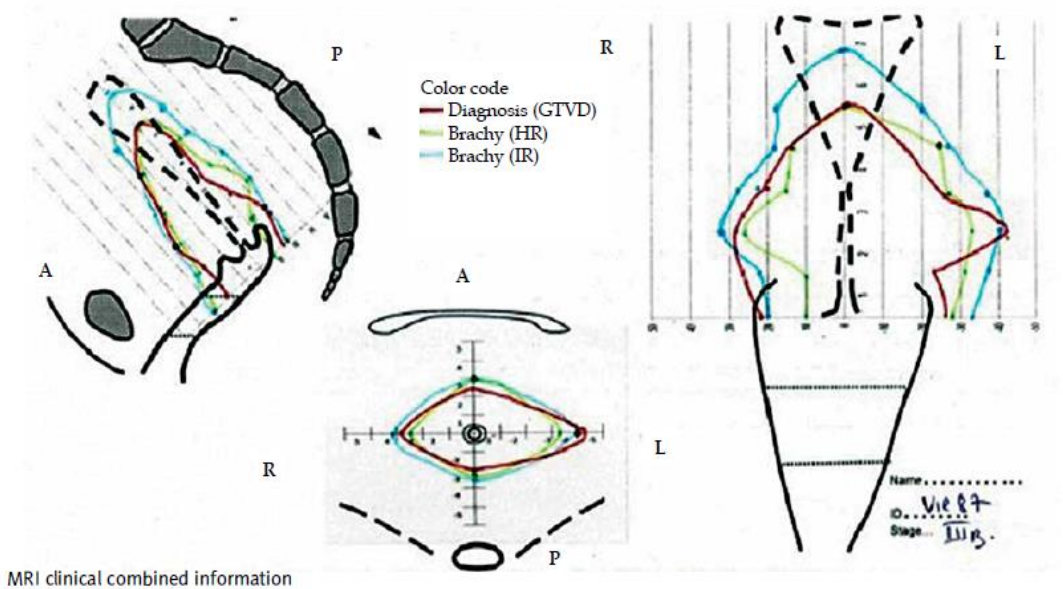
Clinical Investigations

Original paper **JCB2021**

## Quantitative and qualitative application of clinical drawings for image-guided brachytherapy in cervical cancer patients

Prof. Umesh Mahantshetty, MD, DNB[1], Susovan Banerjee, MD[2], Alina Sturdza, MD[3], Prof. Christian Kirisits, DSc[3], Katarina Majercakova, MD[3], Maximilian P Schmid, MD[3], Vinod Handle, MBA[1], Prof. Richard Pötter, MD[3]

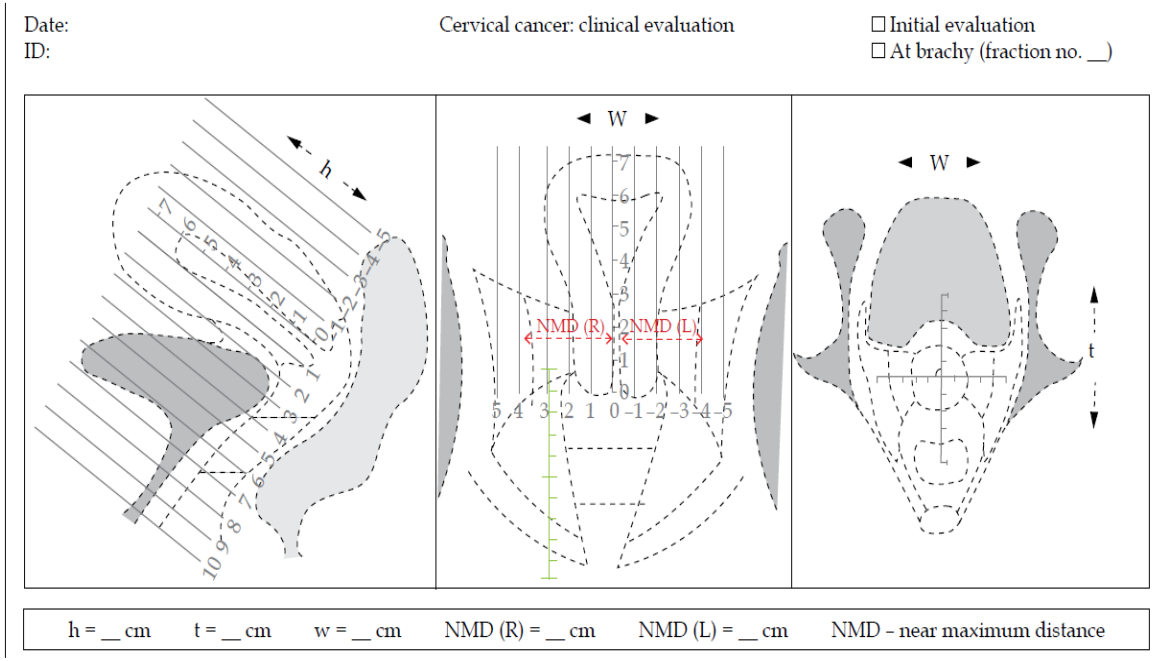
[1]Department of Radiation Oncology, Tata Memorial Hospital, Mumbai, India, [2]Division of Radiation Oncology, Medanta – The Medicity, Gurgaon, Haryana, India, [3]Department of Radiation Oncology, Comprehensive Cancer Center, Medical University of Vienna, General Hospital of Vienna, Vienna, Austria




MRI clinical combined information

Quantitative documentation of Clinical examinations- an essential adjunct for CTIGABT.

**IBS guidelines**




- NMD
- Incorporating Radiological information.
- Width of the disease.

Published in final edited form as:
*Int J Radiat Oncol Biol Phys*. 2014 October 1; 90(2): 320–328. doi:10.1016/j.ijrobp.2014.06.005.

# Comparison and Consensus Guidelines for Delineation of Clinical Target Volume for CT- and MR-Based Brachytherapy in Locally Advanced Cervical Cancer

**Akila N. Viswanathan**[1], **Beth Erickson**[2], **David K. Gaffney**[3], **Walter Bosch**[4], and **members of the CT/MR Atlas Committee**[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20]

[1]Brigham & Women's Hospital/Dana-Farber Cancer Institute, Boston, MA

*Journal of Radiation Research*, Vol. 58, No. 3, 2017, pp. 341–350
doi: 10.1093/jrr/rrw109
Advance Access Publication: 10 November 2016

# Recommendations for high-risk clinical target volume definition with computed tomography for three-dimensional image-guided brachytherapy in cervical cancer patients

Tatsuya Ohno[1*], Masaru Wakatsuki[2], Takafumi Toita[3], Yuko Kaneyasu[4], Ken Yoshida[5], Shingo Kato[6], Noriko Ii[7], Sunao Tokumaru[8], Hitoshi Ikushima[9], Takashi Uno[10], Shin-ei Noda[1], Tomoko Kazumoto[11] and Yoko Harima[12], the Working Group of the Gynecological Tumor Committee of the Japanese Radiation Oncology Study Group (JROSG)



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journal homepage: www.thegreenjournal.com

Original Article

# IBS-GEC ESTRO-ABS recommendations for CT based contouring in image guided adaptive brachytherapy for cervical cancer

Umesh Mahantshetty[a,*], Richard Poetter[b,*], Sushil Beriwal[c], Surbhi Grover[d], Gurram Lavanya[e], Bhavana Rai[f], Primoz Petric[g], Kari Tanderup[h], Heloisa Carvalho[i,j], Neamat Hegazy[k], Sandy Mohamed[l], Tatsuya Ohno[m], Napapat Amornwichet[n]

*The need of CT based contouring was acknowledged and multiple Guidelines are in place*

Published in final edited form as:
*Int J Radiat Oncol Biol Phys*. 2014 October 1; 90(2): 320–328. doi:10.1016/j.ijrobp.2014.06.005.

# Comparison and Consensus Guidelines for Delineation of Clinical Target Volume for CT- and MR-Based Brachytherapy in Locally Advanced Cervical Cancer

Akila N. Viswanathan[1], Beth Erickson[2], David K. Gaffney[3], Walter Bosch[4], and members of the CT/MR Atlas Committee[1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20]

[1]Brigham & Women's Hospital/Dana-Farber Cancer Institute, Boston, MA

- Safety Margin for height.
- Uncertainty of lateral borders
- Recognising inputs from ancillary findings

- No parametrial extension-**Identical HCTV(MR/CT).**
- Parametrial extension & poor response-**Identical HCTV(MR/CT).**
- Parametrial extension with a CR-**More -difference in HRCTV.**
- MRI volumes are smaller than CT.
- CT volumes- higher level of agreement

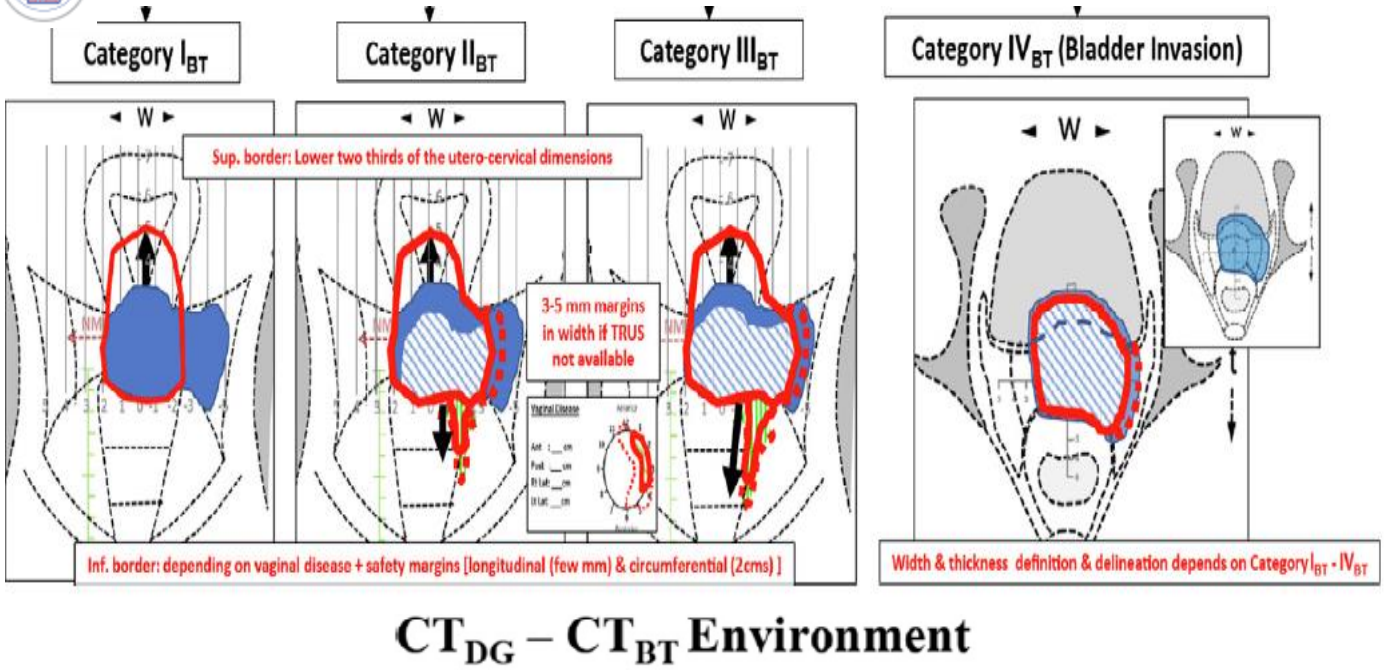
# Categorisation of response –for drawing HRCTV in CT

| Category of BT | Cervix | Parametrium | Vagina | Uterine corpus | bladder/rectum |
|---|---|---|---|---|---|
| $I_{BT}$ | No residual disease<br>Or<br>Residual disease confined to cervix | No residual disease | No residual disease<br>Or<br>Residual disease < 2 cm of upper vagina | No residual disease<br>Or<br>Residual disease in proximal third of utero-cervical junction | No residual wall/mucosa involvement |
| $II_{BT}$ | Significant residual disease | Proximal parametrial disease | Residual disease within upper one third | Residual disease not beyond mid corpus | No residual wall/mucosa involvement |
| $III_{BT}$ | Significant residual disease | Distal/upto pelvic wall parametrial disease | Residual disease in mid or lower third | Residual disease into distal corpus/Up to fundus | No residual wall/mucosa involvement |
| $IV_{BT}$ | Any residual disease | Proximal parametrial disease | Residual disease within upper one third | Residual disease not beyond mid corpus | Residual disease involving neighboring organ wall/ mucosa (bladder/ rectum) |
| | | Distal/upto pelvic wall parametrial disease | Residual disease in mid or lower third | Residual disease into distal corpus/Up to fundus | Residual disease involving neighboring organ wall/ mucosa (bladder/ rectum) |

- **Categorisation by response assessment.**
- **GTV cannot be drawn unless confined to cervix.**
- **Concept of NMD.**
- **Meticulous mapping of disease(CE/Vol imging).**
- **CT imaging protocol….**
- **Concept of safety margin in HRCTV**

# Guide of CT based guidelines-

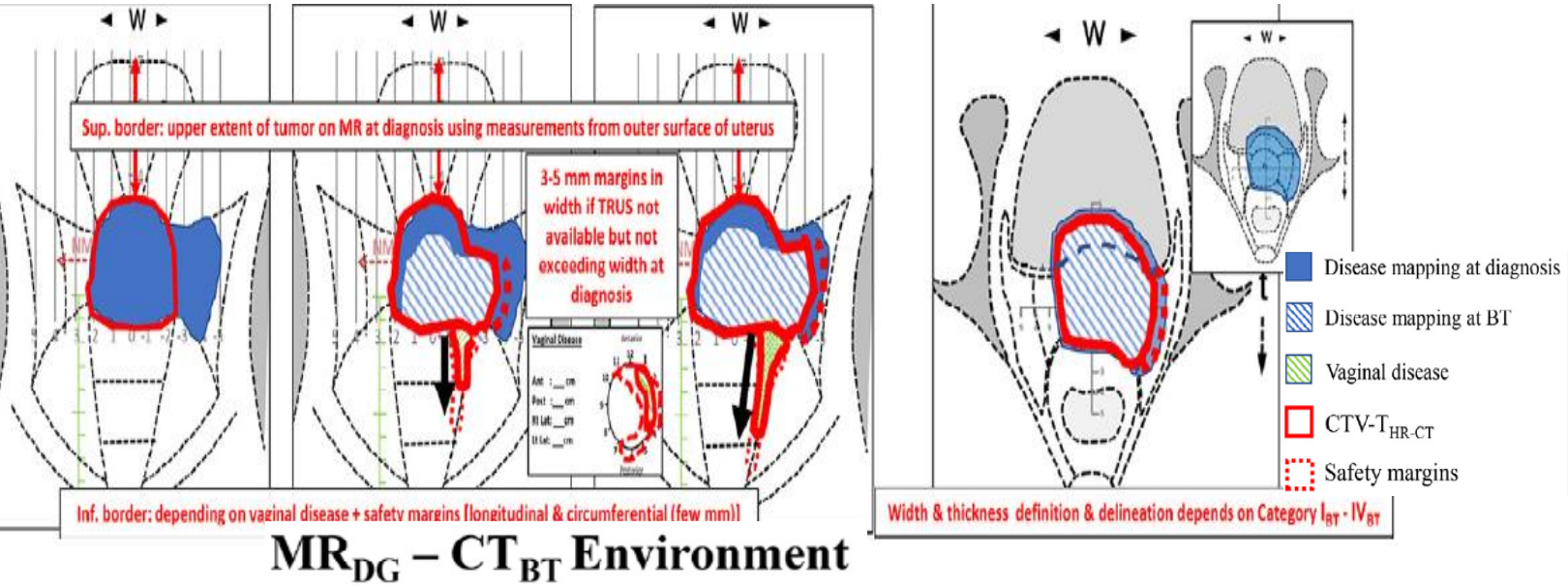
U. Mahantshetty et al., IBS-GEC ESTRO-ABS recommendations. for CT based IGBT,F




$CT_{DG} - CT_{BT}$ Environment

## CT –CT

- Include Lower 2/3 of Uterocervical dimension.
- Lateral uncertainty Margin.
- 2 cm circumferential margin for vaginal extn.



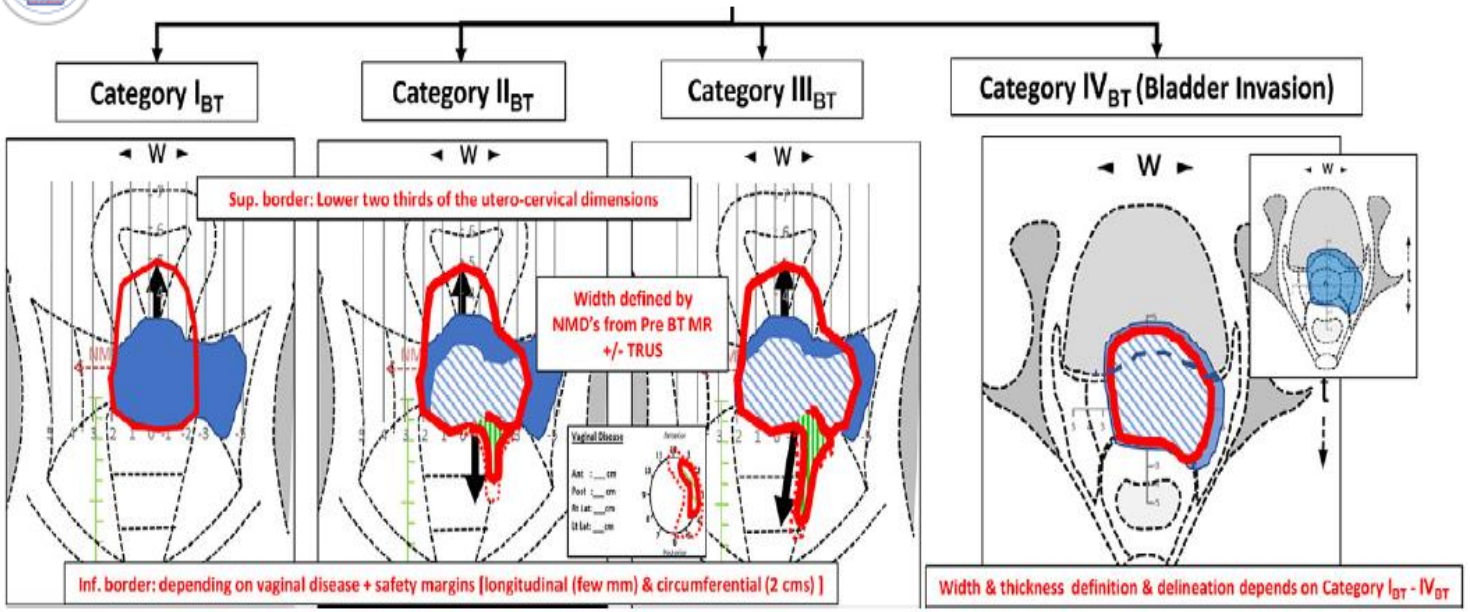

$MR_{DG} - CT_{BT}$ Environment

## MR -CT

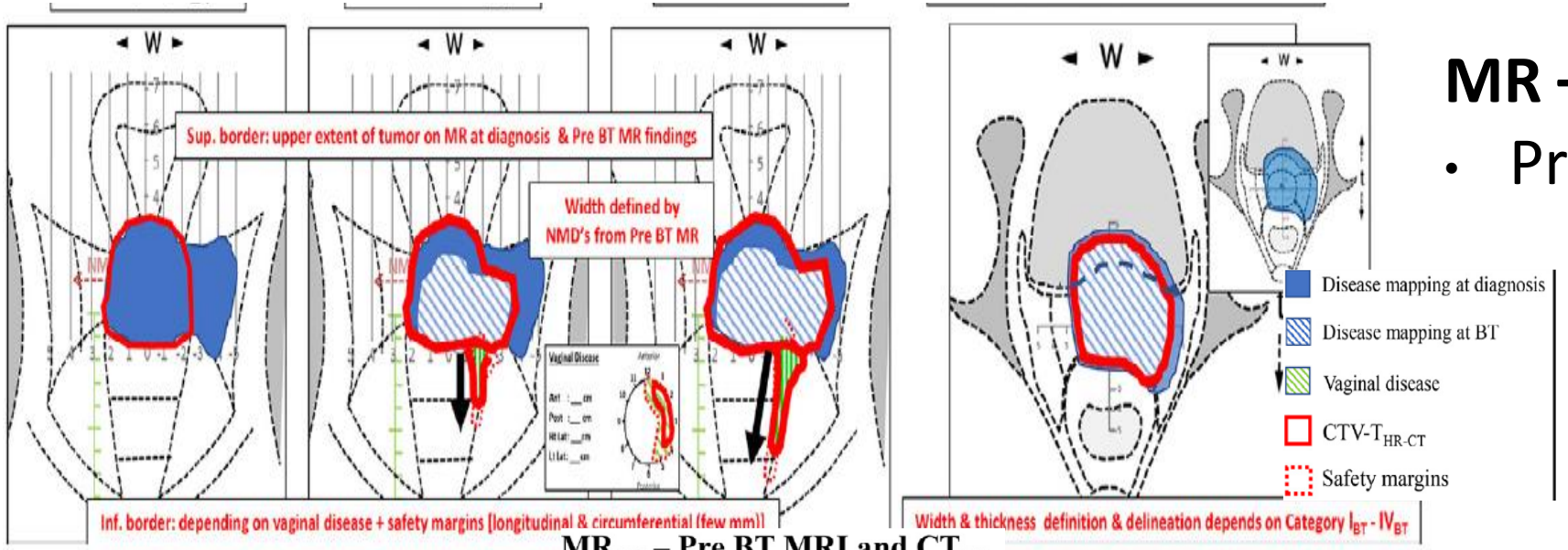
- Pre EBRT Height to consider.
- Uncertainty margin laterally.

# Guide of CT based guidelines-

U. Mahantshetty et al., IBS-GEC ESTRO-ABS recommendations. for CT based IGBT,RC




$CT_{DG}$ – Pre BT MRI and $CT_{BT}$




$MR_{DG}$ – Pre BT MRI and $CT_{BT}$

## CT –MR+CT

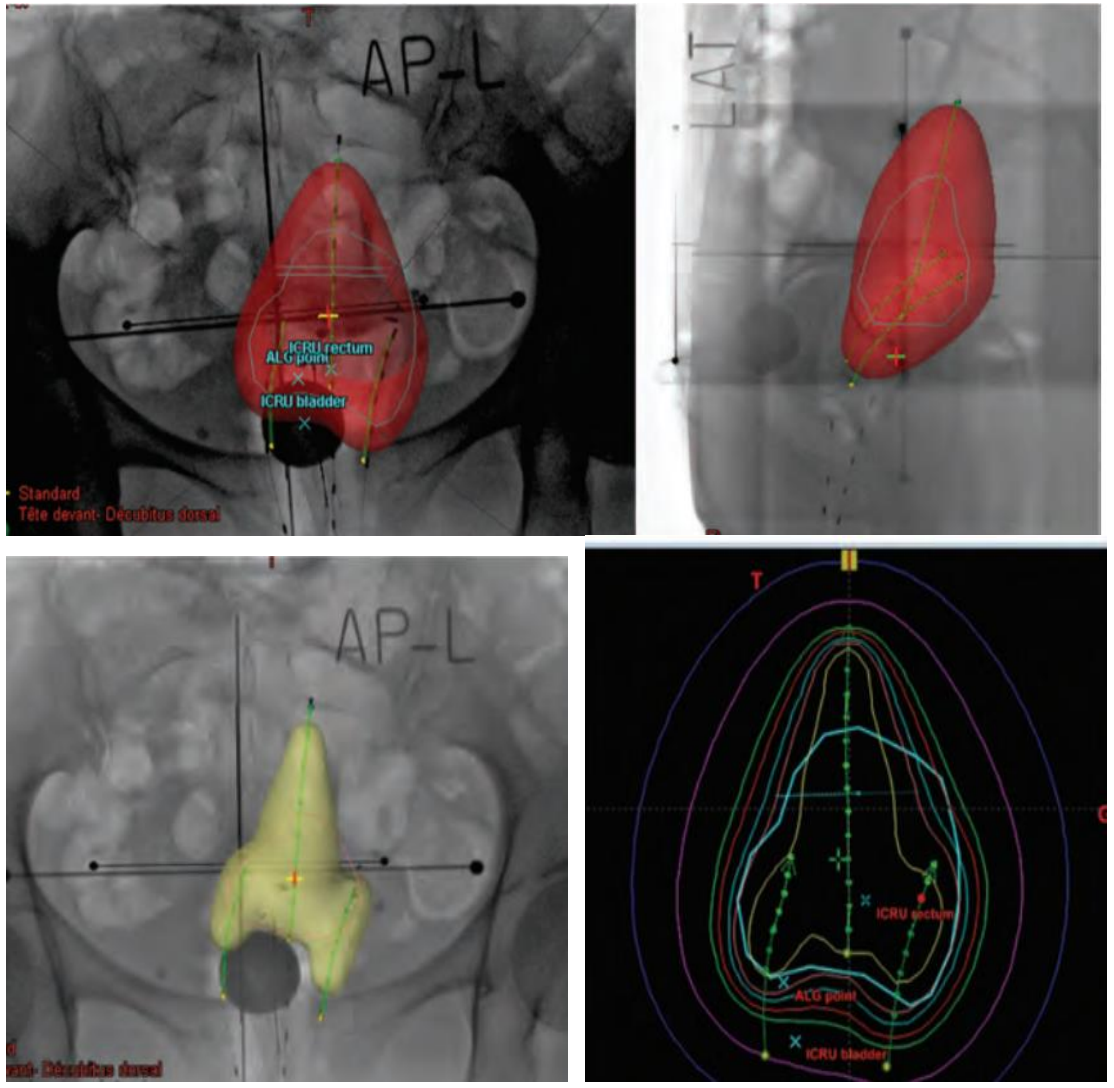
- Include Lower 2/3 rd of Uterocervical dimension.
- 2 cm circumferential margin for vaginal extn.

## MR – MR+CT

- Pre EBRT Height to consider.

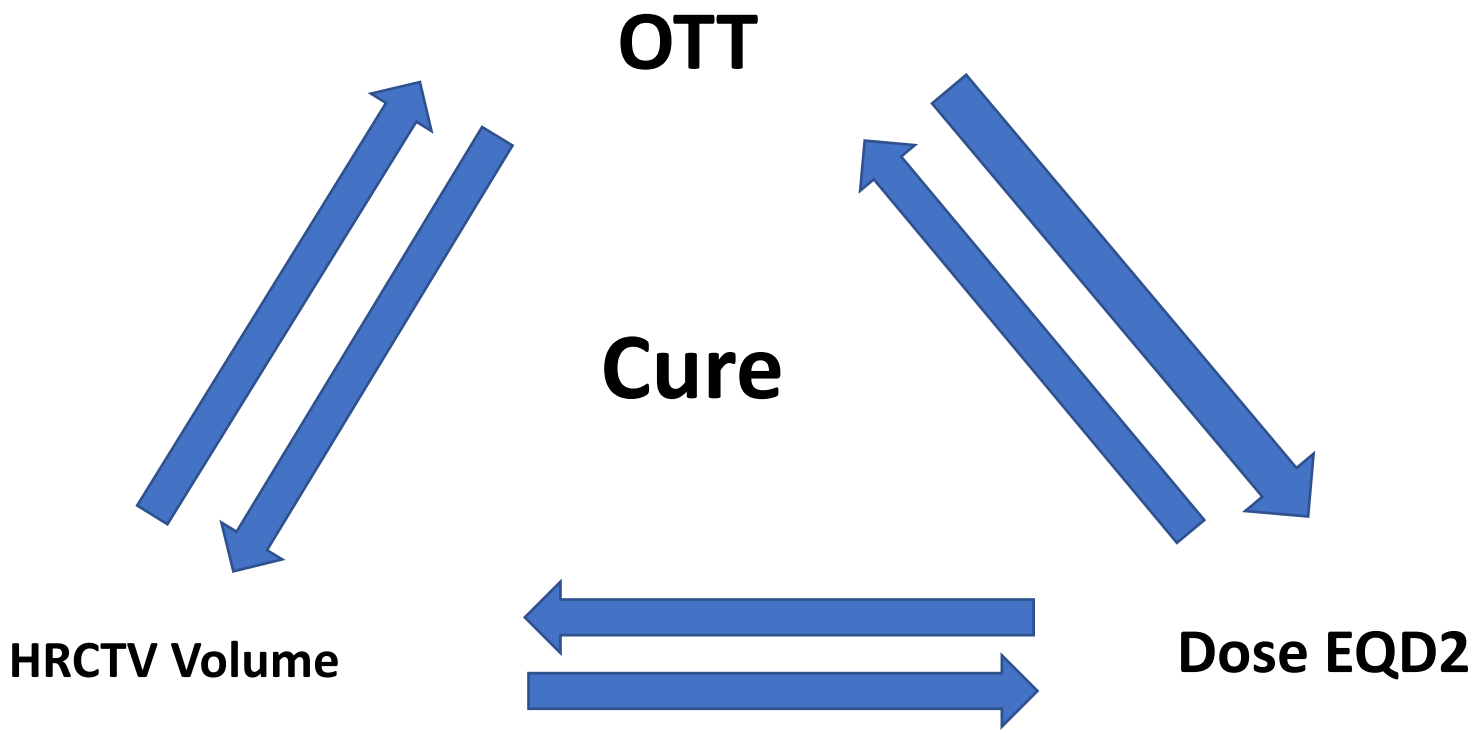
# What happens to 30 percent centres doing X ray based planning?

- X Ray planning is still the minimum standard required in all guidelines and ICRU89.
- 2.5D planning with clinicians effort.
- Treatment of patients should not be delayed by referring patients if only X ray facilities are available unless the disease is sure to be missed.
- A meticulous 2D treatment conducted at right time may be a clinical preference rather that wating for a 3 D  planning.




ICRU 89 images

# Treatment of cervix cancer 3 factors



# Point A based planning- current status

original reports

## Standard Chemoradiation and Conventional Brachytherapy for Locally Advanced Cervical Cancer: Is It Still Applicable in the Era of Magnetic Resonance–Based Brachytherapy?

See accompanying articles doi:https://doi.org/10.1200/JGO.17.00152 and https://doi.org/10.1200/JGO.18.00074

abstract

**Purpose** Recent guidelines recommend magnetic resonance imaging–based brachytherapy (MRBT) for locally advanced cervical cancer. However, its implementation is challenging within the developing world. This article reports the outcomes of patients with locally advanced cervical cancer treated with chemoradiation and point A–based brachytherapy (BT) using x-ray– or computed tomography–based planning.

**Methods** Patients treated between January 2014 and December 2015 were included. Patients underwent x-ray– or computed tomography–based BT planning with an aim to deliver equivalent doses in 2 Gy (EQD2) > 84 Gy10 to point A while minimizing maximum dose received by rectum or bladder to a point or 2 cc volume to < 75 Gy EQD2 and < 90 Gy EQD2, respectively. The impact of known prognostic factors was evaluated.

**Results** A total of 339 patients were evaluated. Median age was 52 (32 to 81) years; 52% of patients had stage IB2 to IIB and 48% had stage III to IVA disease. There was 85% compliance with chemoradiation, and 87% of patients received four or more cycles. Median point A dose was 84 (64.8 to 89.7) Gy. The median rectal and bladder doses were 73.5 (69.6 to 78.4) Gy3 and 83 (73.2 to 90.0) Gy3, respectively. At a median follow-up of 28 (4 to 45) months, the 3-year local, disease-free, and overall survival for stage IB to IIB disease was 94.1%, 83.3%, and 82.7%, respectively. The corresponding rates for stage III to IVA were 85.1%, 60.7%, and 69.6%. Grade III to IV proctitis and cystitis were observed in 4.7% and 0% of patients, respectively.

**Conclusion** This audit demonstrates good 3-year outcomes that are comparable to published MRBT series. Conventional BT with selective use of interstitial needles and MRBT should continue as

Prachi Mittal
Supriya Chopra
Sidharth Pant
Umesh Mahantshetty
Reena Engineer
Jaya Ghosh
Sudeep Gupta

jgo.org JGO – Journal of Global Oncology

- Point A based/2 D planning is effective.
- Volume of HRCTV, OTT, HRCTVD90-98, Clinicians judgement

# Comparing CT and MR based planning , clinical results



Published in final edited form as:
*Gynecol Oncol*. 2017 May ; 145(2): 284–290. doi:10.1016/j.ygyno.2017.03.004.

**Comparison of outcomes for MR-guided versus CT-guided high-dose-rate interstitial brachytherapy in women with locally advanced carcinoma of the cervix**

Sophia C. Kamran, MD[1,2], Matthias M. Manuel, MD[3,*], Linda P. Cho, BA[3,*], Antonio L. Damato, PhD[2,3,*], Ehud J. Schmidt, PhD[2,4], Clare Tempany, MD[2,4], Robert A. Cormack, PhD[2,3], and Akila N. Viswanathan, MD, MPH[2,3,*]

- 29 MR, 27 CT patients
- MFU 19.7 months (MR) and 18.4 months (CT)
- 2-year LC MR CT treatments were 96% and 87%.(p=0.65) ).
- Inconclusive due to arms differently chosen/ less patients.

# Contemporary reports on CT guided IGABT

| Study | Patient/Stage | Prescription | tech | Dose | Results | Comments |
|---|---|---|---|---|---|---|
| **Anish et al 2021** | 53 IIA/IIB | Point A | IC | 50 Gy + &GyX3 Fr | 75% LV at 3 years | HR-CTV D90 EQD2 79.75 Gy |
| **Kawashima 2018** | 84 (Stages IB-IVA) | PointA/HRCTV(optimisation) | IC | 40 Gy +CS | 3-yr LC 89% | Mean EQD2 for HR-CTV D90 was 73.4 Gy, |
| **Murakami 2014** | 51 (Stages IB-IVA) | Point A | IC | 40 Gy +CS 2–5 times of 6 Gy HDR-ICBT | 3 yr LC rate 91.7% | D90 for HR-CTV was 60 |
| **Kusuda 2018** | 68 IB1-IVA | Point A | IC | 40 Gy +CSHDR18 Gy in 3 | 2 yr 92 % | HR-CTV D90 >60 Gy |

# Finally GBT is cost-effective & economically rewarding to patient & society

ELSEVIER

BRACHYTHERAPY

Brachytherapy 14 (2015) 29–36

## Cost-effectiveness analysis of 3D image-guided brachytherapy compared with 2D brachytherapy in the treatment of locally advanced cervical cancer

Hayeon Kim[1,*], Malolan S. Rajagopalan[1], Sushil Beriwal[1], M. Saiful Huq[1], Kenneth J. Smith[2]

[1]*Department of Radiation Oncology, University of Pittsburgh Cancer Institute, Pittsburgh, PA*

[2]*Department of Medicine, University of Pittsburgh School of Medicine, Pittsburgh, PA*

*3D IGBT for locally advanced cervical cancer is*

*a more cost-effective option compared with 2D brachytherapy*

ELSEVIER

BRACHYTHERAPY

Brachytherapy ■ (2017) ■

## Income generated by women treated with magnetic resonance imaging-based brachytherapy: A simulation study evaluating the macroeconomic benefits of implementing a high-end technology in a public sector healthcare setting

Santam Chakraborty*, Umesh Mahantshetty, Supriya Chopra, Shirley Lewis, Vinod Hande, Shivakumar Gudi, Rahul Krishnatry, Reena Engineer, Shyam Kishore Shrivastava

*Department of Radiation Oncology, Tata Memorial Hospital, Parel, Mumbai, India*

*Improved outcomes resulting from MR-IGBT have a potential to translate into large macroeconomic gains for the nation even after meeting all expenditures.*

# Thumb rule of Contouring in CT

- **Minimum requirements are clinical examination & documentation, CT or MR imaging at diagnosis**
- **CT imaging with the applicator in place during BT**
- **Width –MR Gold standard/ Complimentary information must.**
- **Height - add for uncertainties/Pre EBRT height.**
- **Thickness – Cervical thickness/ only rectal/bladder wall for IVA.**

**(HRCTVMR will get more dose than HRCTVCT)**

# Medanata AOLO a CT compatible applicator for advanced cancer Cervix BT

Original paper

Preliminary Report

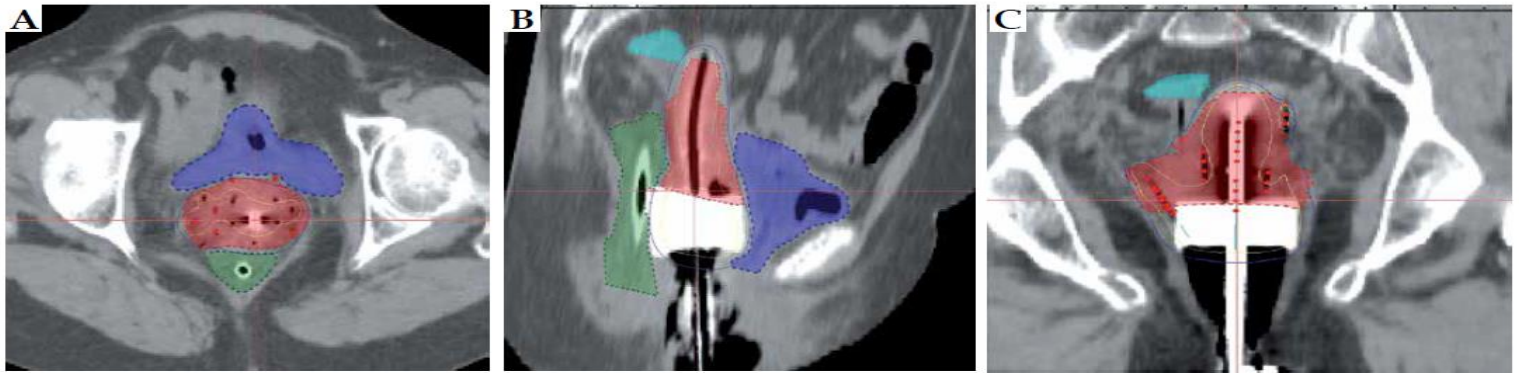
## The Medanta AOLO template for locally advanced cancer cervix brachytherapy: design and clinical implementation

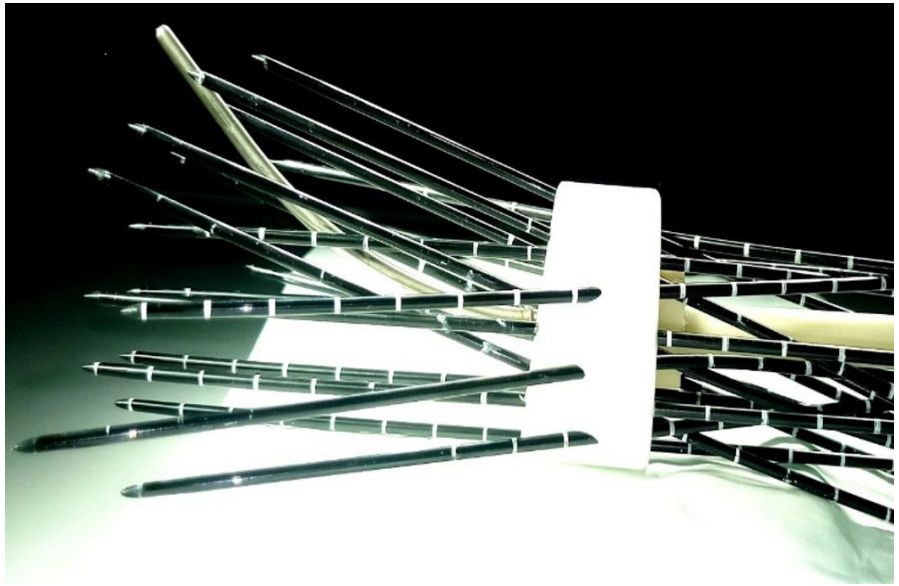
Susovan Banerjee, MD, Venkatesan Kaliyaperumal, MSC, Tejinder Kataria, MD, DNB, Dayanidhi Kamaraj, MSC
Division of Radiation Oncology, Medanta – The Medicity, Gurgaon, Haryana, India

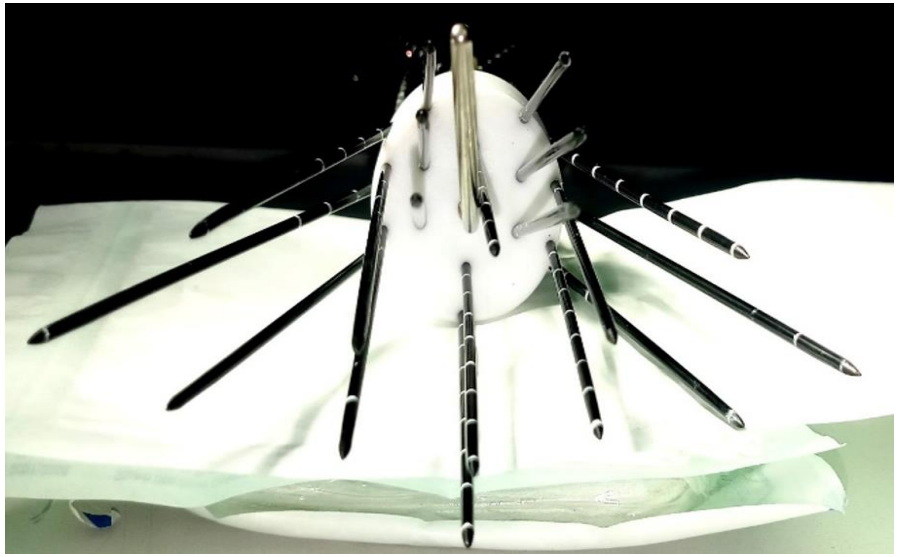
**Table 1.** Results of two clinical applications

| | HRCTV volume (cc) | Bladder 2 cc | Rectum 2 cc | Sigmoid 2 cc | HRCTV $V_{90}$ | COIN |
|---|---|---|---|---|---|---|
| Application 1 | 55 cc | 11.0 Gy | 9.36 Gy | 8.6 Gy | 97% | 0.79 |
| Application 2 | 54 cc | 11.4 Gy | 8.96 Gy | 8.5 Gy | 96% | 0.84 |
| $EQD_2$ (Gy) (EBRT + brachytherapy) | 75 | 80.9 | 74.3 | 72.24 | 75 | NA |

*EBRT – external beam radiotherapy, cc – cubic centimeter, $EQD_2$ – 2 Gy equivalent dose: a/b for rectum, bladder, and sigmoid is 3, for HRCTV is 10. COIN – conformal index = PTVPD / VPTV × PTVPD / VPD, PTVPD – PTV receiving prescription dose, VPD – target volume receiving prescription dose, VPTV – volume of PTV*



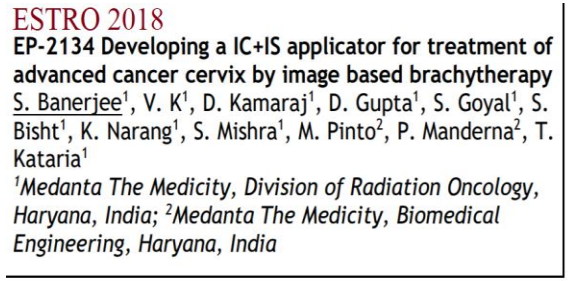


**Journal of Contemp Brachytherapy; Vol 12; 2020.**

# Results

- 12 patients of advanced cancer cervix FIGO stage II B-IIIC; mean age was 61 years (Range 46-71).
- A HDR dose of 24-28 Gy in 4 fractions was planned. Mean HRCTV volume was 90 cc(range:58-120 cc).
- The mean EQD2 (considering alpha/beta=10) of D90 and D98 for HRCTV was 93 Gy and 80 Gy respectively.
- Mean EQD2 of 2 cc rectum and bladder was 79 Gy and 86 Gy respectively.
- All patients had complete clinical and radiological response with no >Grade 2 toxicity.

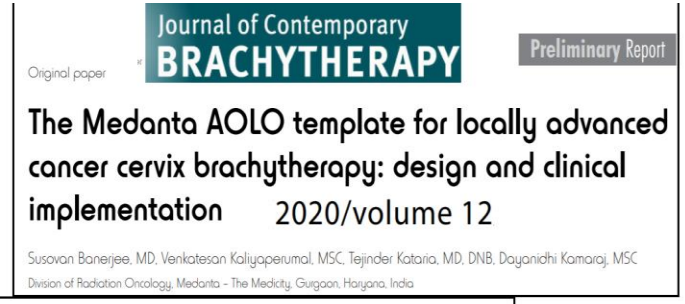
- The details of applicators and its validation have been published and presented in national and internal platform.


ESTRO 2018

**EP-2134 Developing a IC+IS applicator for treatment of advanced cancer cervix by image based brachytherapy**

S. Banerjee[1], V. K[1], D. Kamaraj[1], D. Gupta[1], S. Goyal[1], S. Bisht[1], K. Narang[1], S. Mishra[1], M. Pinto[2], P. Manderna[2], T. Kataria[1]

*[1]Medanta The Medicity, Division of Radiation Oncology, Haryana, India; [2]Medanta The Medicity, Biomedical Engineering, Haryana, India*


Original paper

Journal of Contemporary BRACHYTHERAPY

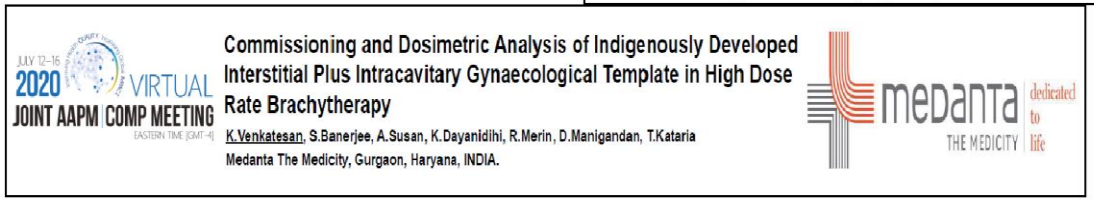
Preliminary Report

**The Medanta AOLO template for locally advanced cancer cervix brachytherapy: design and clinical implementation** 2020/volume 12

Susovan Banerjee, MD, Venkatesan Kaliyaperumal, MSC, Tejinder Kataria, MD, DNB, Dayanidhi Kamaraj, MSC

Division of Radiation Oncology, Medanta - The Medicity, Gurgaon, Haryana, India


**IBS Dharamshila NH Hospital Bracytherapy conference 2019**


JULY 12–16 2020 VIRTUAL JOINT AAPM | COMP MEETING EASTERN TIME (GMT-4)

**Commissioning and Dosimetric Analysis of Indigenously Developed Interstitial Plus Intracavitary Gynaecological Template in High Dose Rate Brachytherapy**

K.Venkatesan, S.Banerjee, A.Susan, K.Dayanidihi, R.Merin, D.Manigandan, T.Kataria

Medanta The Medicity, Gurgaon, Haryana, INDIA.

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**3104**

**Experience With Indigenously Designed Novel Cylindrical Intravaginal Template For Volumetric Brachytherapy Of Advanced Cervical Cancers By Intracavitary + Interstitial (IC+IS) Technique**

ASTRO2020

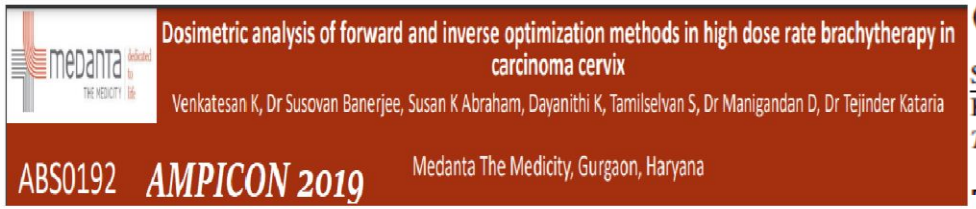
S. Banerjee, V. Kaliyaperumal, D. Kamraj, D. Gupta, S.S. Bisht, K. Narang, G. Singh, and T. Kataria; *Medanta Cancer Institute, Medanta-The Medicity, Gurgaon, India*


ALFIM DMP SOFIMECH

24th ICMP 8th ALFIM 2nd SOFIMECH

24th ICMP, 8th ALFIM and 2nd SOFIMECH Conference

DOSIMETRIC ANALYSIS OF INDIGENOUSLY MADE INTRACAVITARY AND INTERSTITIAL (IC+IS) GYNECOLOGICAL APPLICATOR IN IMAGE-BASED BRACHYTHERAPY


medanta dedicated to life THE MEDICITY

**Dosimetric analysis of forward and inverse optimization methods in high dose rate brachytherapy in carcinoma cervix**

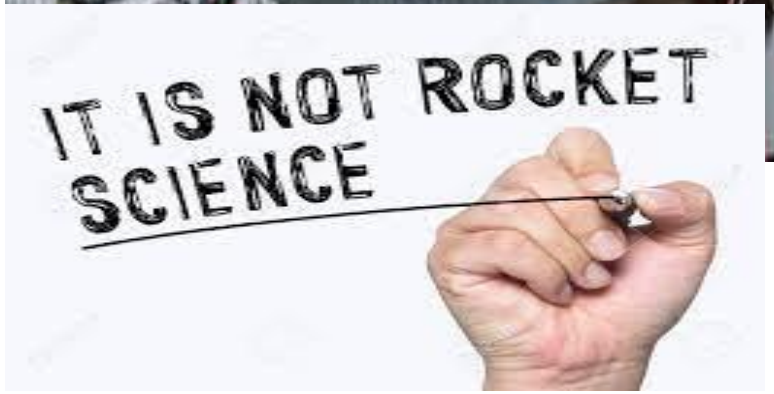
Venkatesan K, Dr Susovan Banerjee, Susan K Abraham, Dayanithi K, Tamilselvan S, Dr Manigandan D, Dr Tejinder Kataria

ABS0192 *AMPICON 2019* Medanta The Medicity, Gurgaon, Haryana

# Summary

- Point A based Brachytherapy has been backbone of cervix brachy.
- Point based and Volume based brachytherapy have correlations but with unacceptable standard deviation.
- ICRU 89 explains  concepts of Volumetric and image guided brachytherapy for cancer cervix.
- MRI is the gold standard of IGABT.
- Complementary imaging, clinical examination and documentation can improve HRCTV volumes considerably.
- IC+IS Brachytherapy does not allow us to continue prescription to point A.
- 2D brachytherapy is not obsolete .

# Take home message




**Some training and experience is required.**

# Thank them -that we are here