Advances in Image-guided Brachytherapy

Hospital Authority Convention 2016

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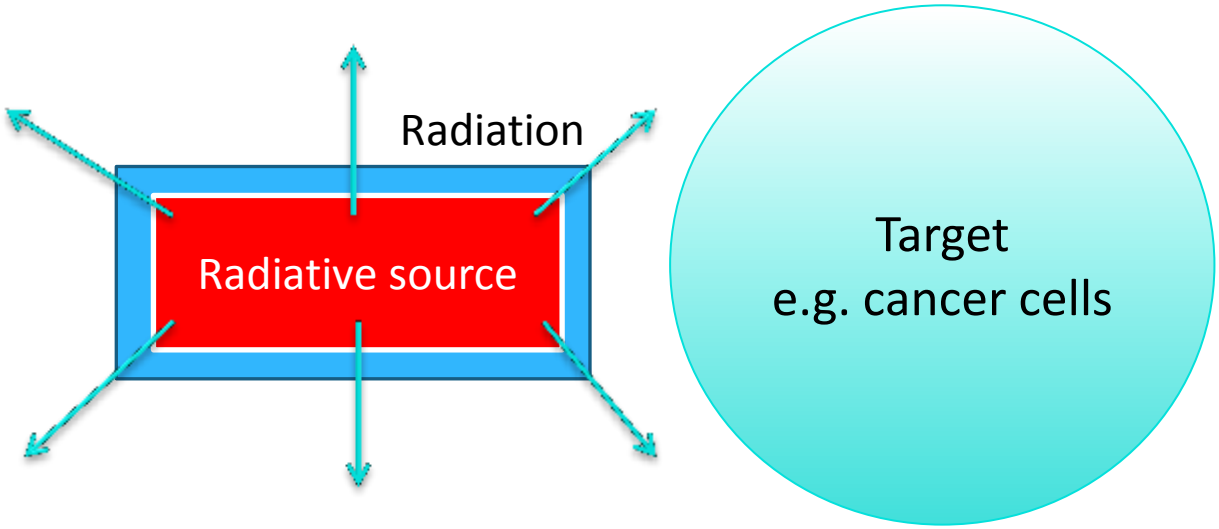
Introduction

What is **Brachy**therapy?

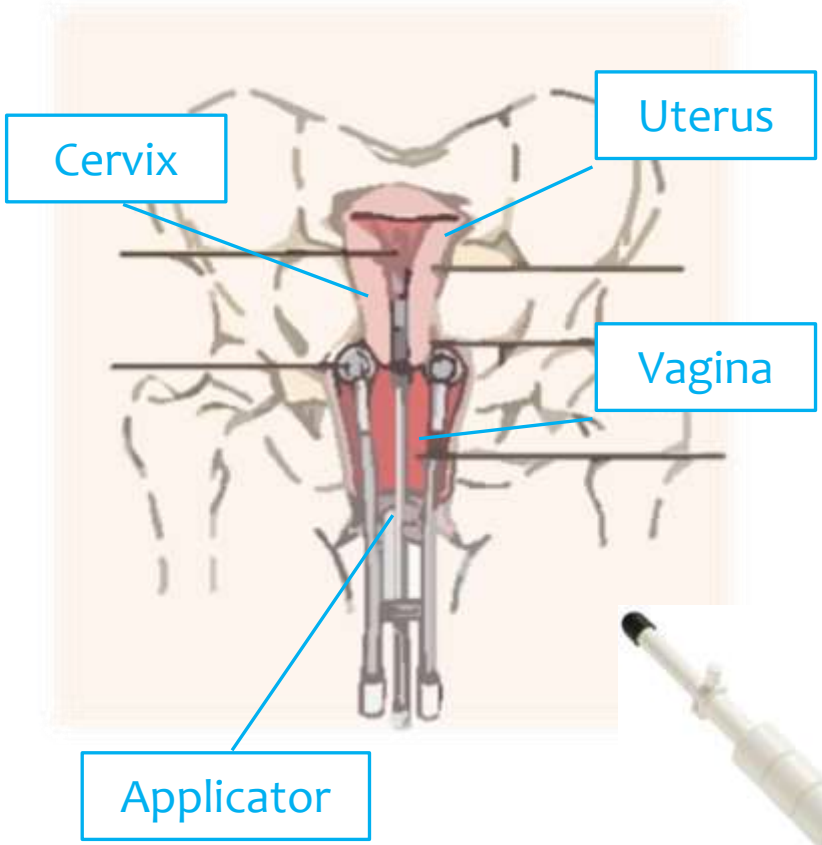
How we do it in a **traditional** way?

What is Brachytherapy

* Radiative source → **radiation** → destroy cells
* Brachy: **short distance** →Close to target → receive much more radiation

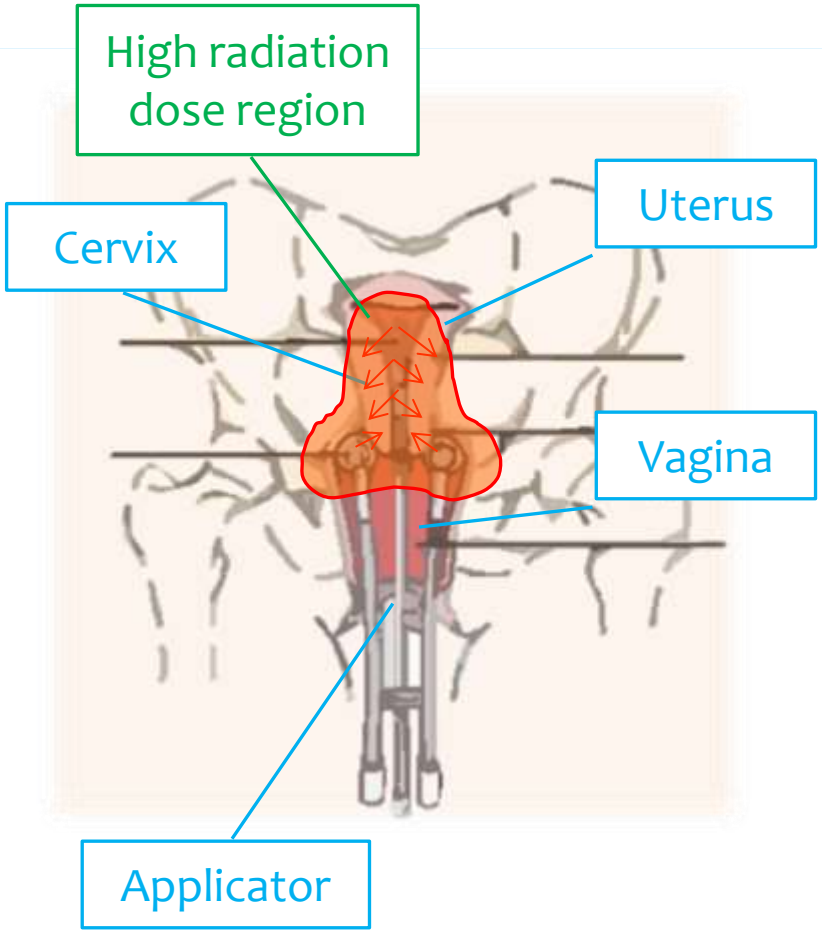


Standard treatment for Cervix Cancer



- Standard treatment for gynecological disease, especially cervix cancer
- Put an **applicator** into patient's body through natural cavity

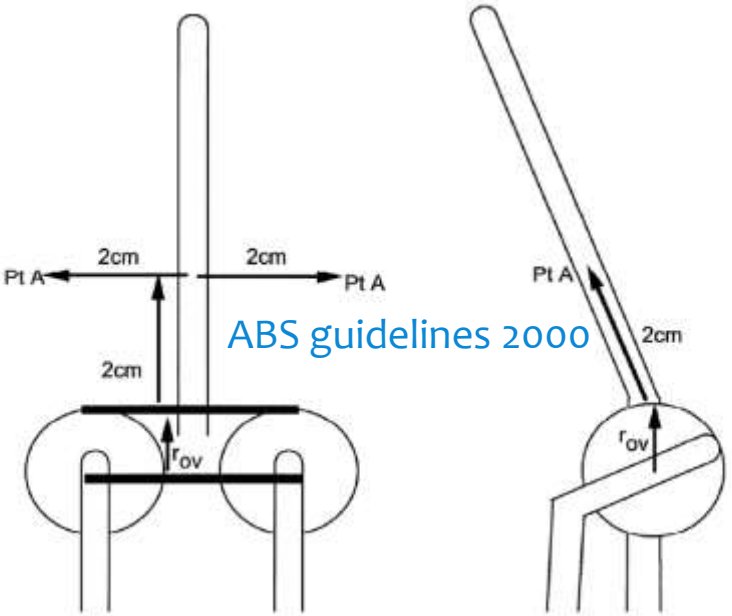
Standard treatment for Cervix Cancer



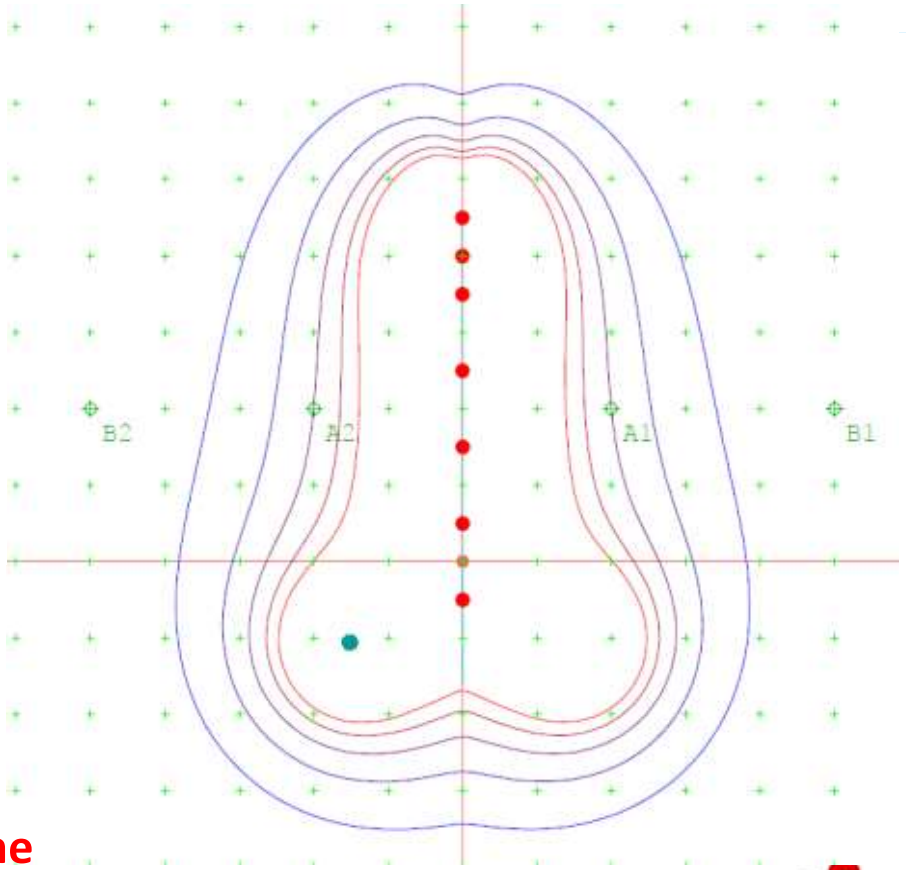
- Load **radiative source** into applicator (i.e. a path for radiative source)
- Giving **radiation dose** to the target (cancer cells)

Commonly used method:

Manchester point A system



ABS guidelines 2000



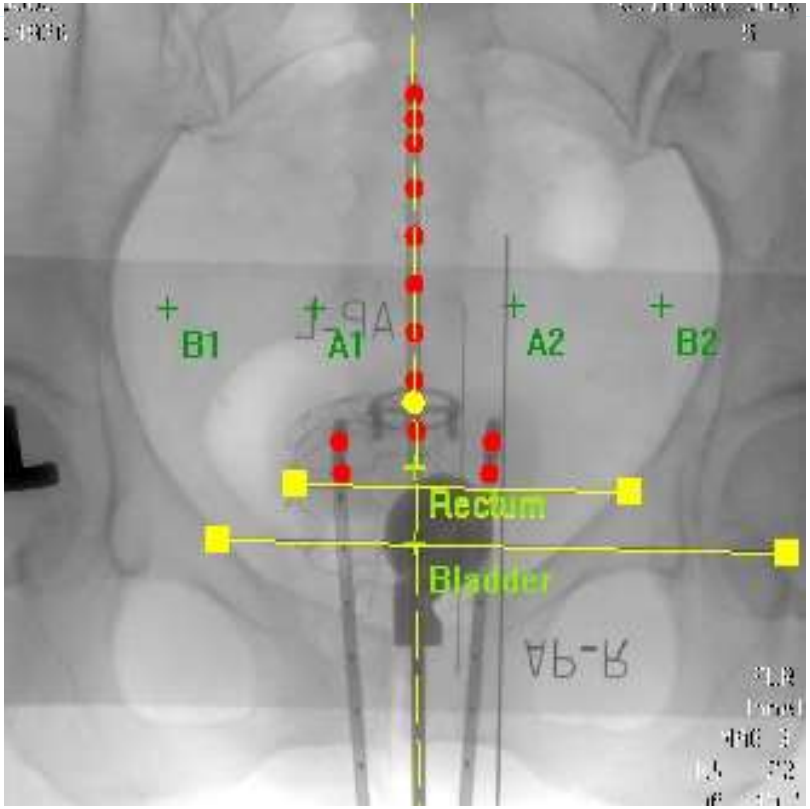
* Define a point A
* Prescribe dose to point A
* Create a **pear shape high dose volume**
* Suppose the target is within this high dose volume

Problems of
traditional **2D** planning ?

Why we need
Image-guided Brachytherapy (IGBT)?

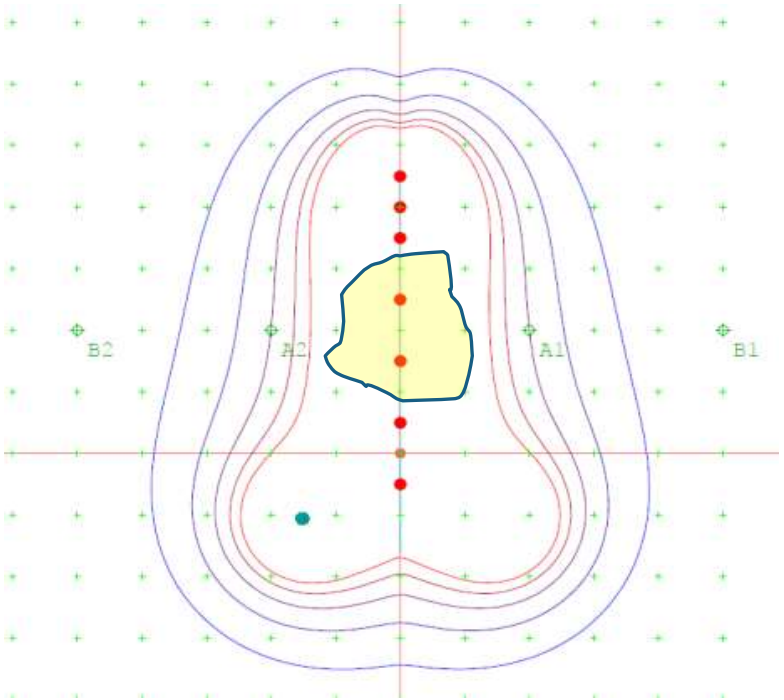
Lack of information

* From a 2D X-ray image, no contrast of soft tissue
* **Uncertain the geometry** of both target/normal tissue

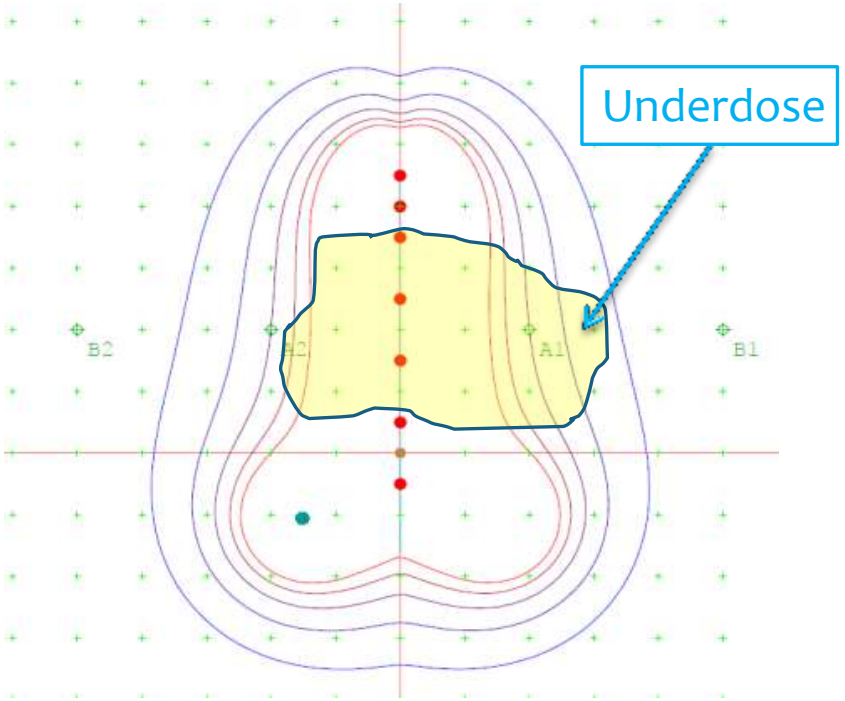


Because we cannot see the target unique radiation dosage

Small tumor

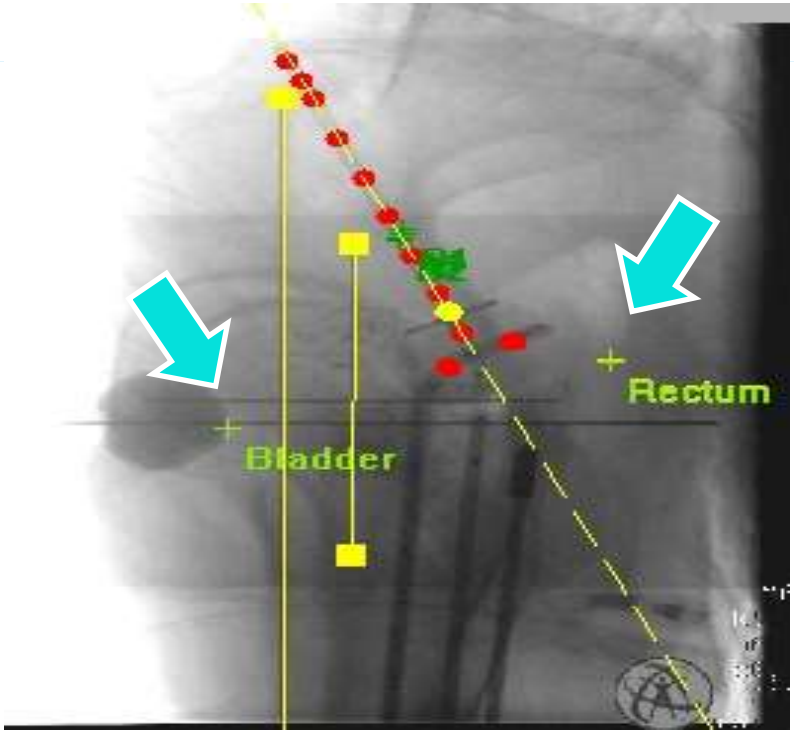


Big tumor



* Same dose for **all patient**, whatever size/shape of tumor
* Maybe **underdose** for more advanced stages/bulky tumors

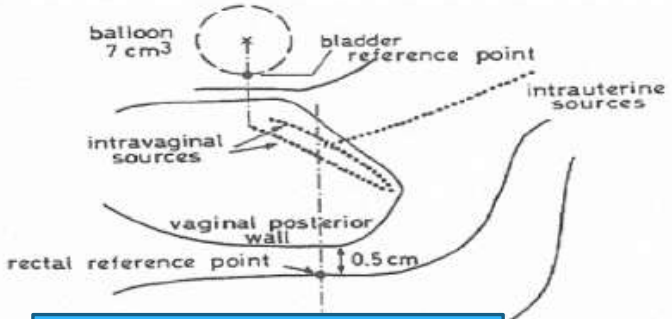
Defined point dose for normal tissue dose may not be representative



Bladder & rectal dose reference

ICRU 38

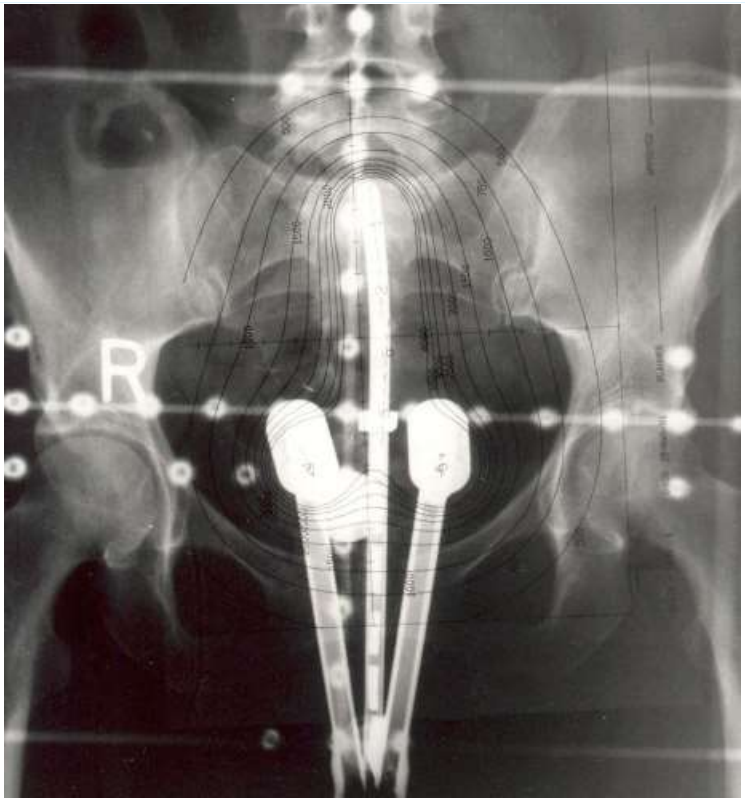
- Bladder: Point at the posterior surface from the centre of a 7cc Foley balloon set on the bladder trigone.
- Rectum: Point at 5mm behind the posterior vaginal wall (5mm behind the posterior surface of ovoids).



International protocol

- The dose at these points **may not correlate to the normal tissue complications very well**

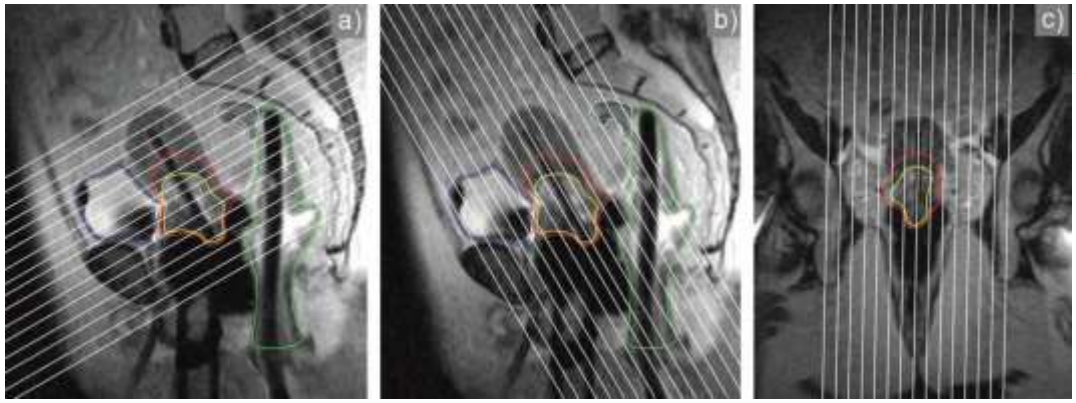
Can you detect improper applicator placement e.g. uterine perforation?



From **2D**?

From **3D**?

Image-guided Brachytherapy (IGBT)

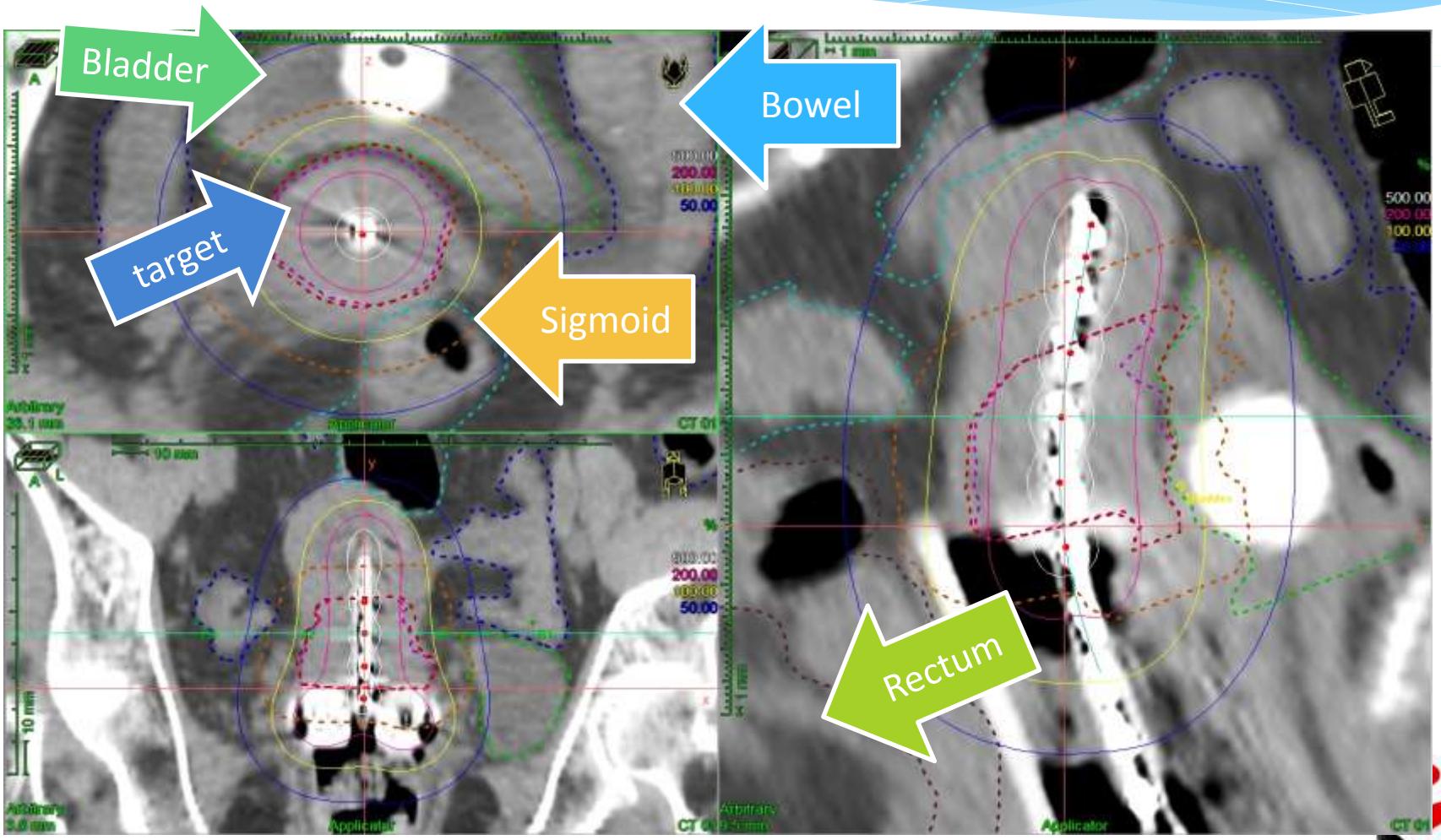


3D Volumetric images

Moving from **2D planning to 3D planning**

Let us **solve the problems**!

Computed Tomography (CT)



Magnetic Resonance Imaging (MRI)

Gold Standard

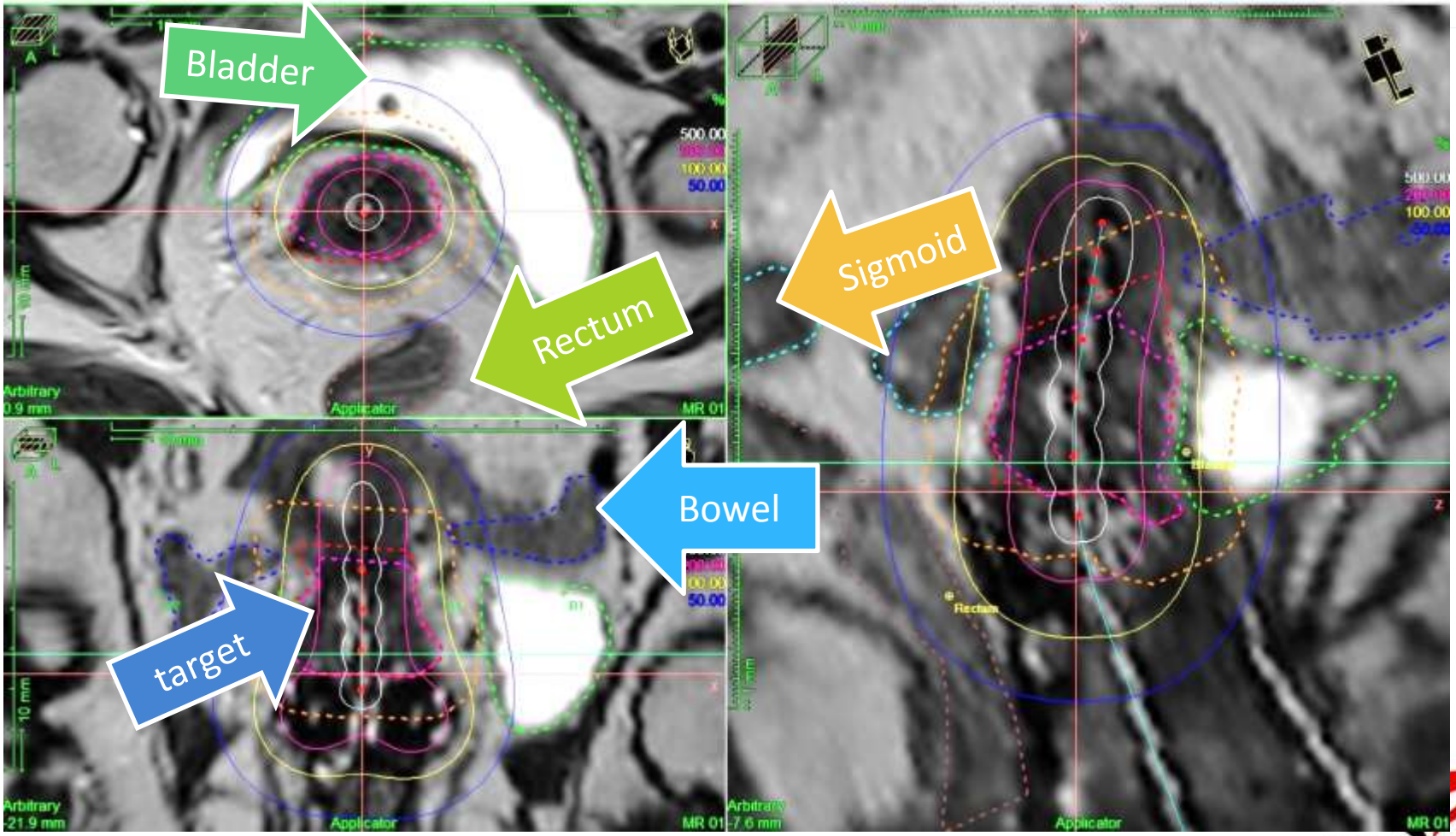


Image guided Brachytherapy

from 2D to 3D

* With **volumetric images**, you can
  * **See and outline** the target and normal tissue
  * **Verify applicator position**, detect uterine perforations
  * **Optimize the dose**: more dose to target and less dose to normal tissue
  * **Adaptive treatment**

GEC ESTRO recommendations and new ICRU guidelines

Target

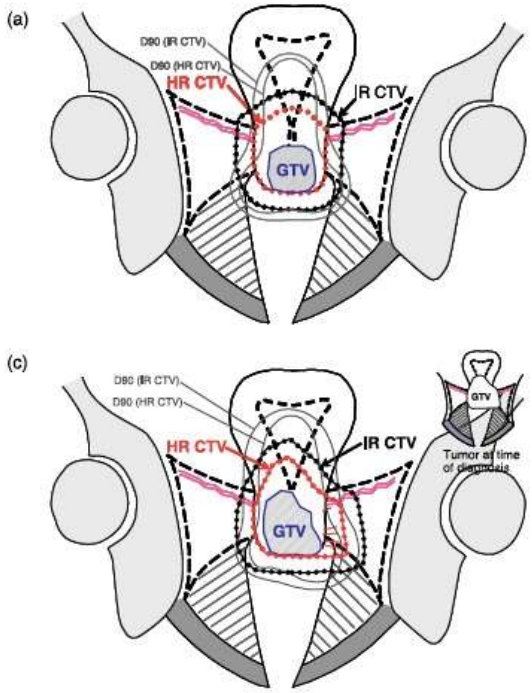
~~Dose to point A~~

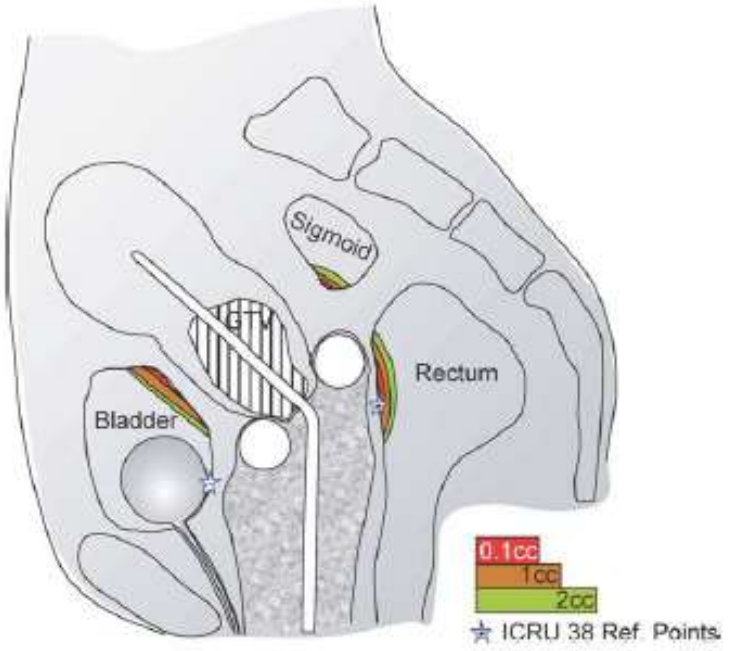
Dose to volumes

Normal tissue

~~Dose to ICRU points~~

Dose to volumes



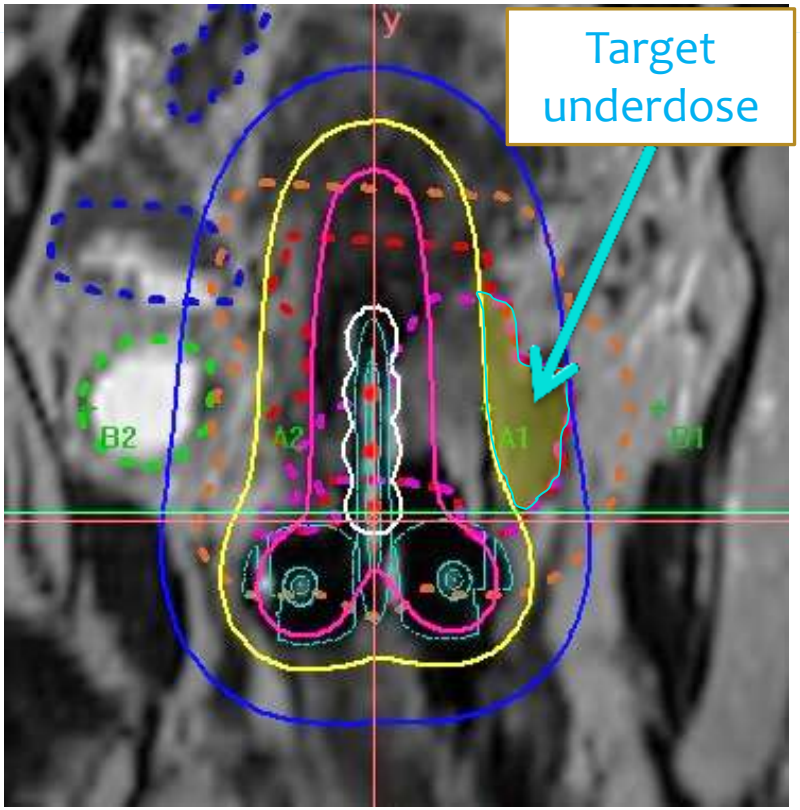


GEC ESTRO I Haie-Meder 2005

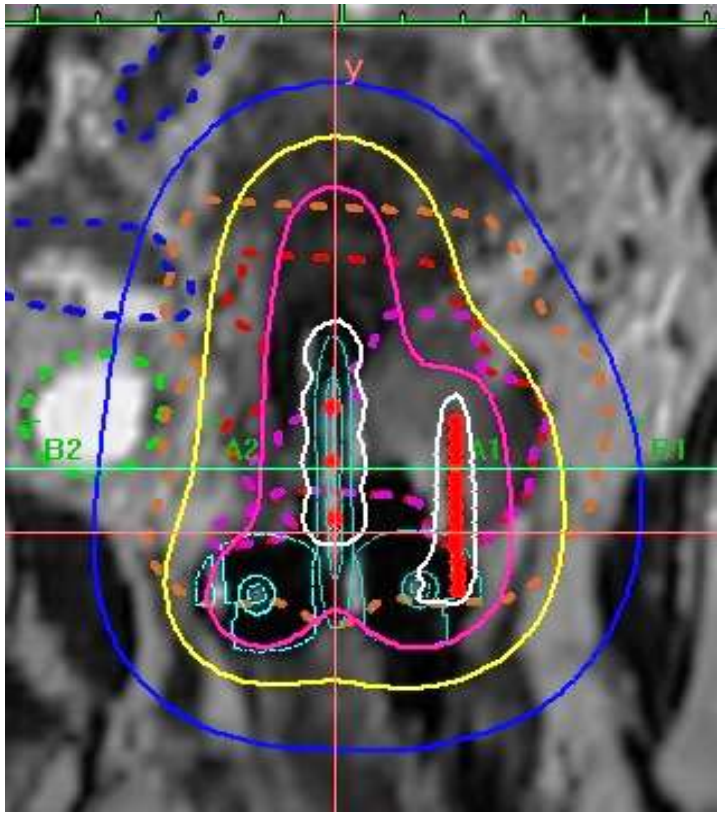
GEC ESTRO II Potter 2006

Interstitial Needles

new path for radiation source



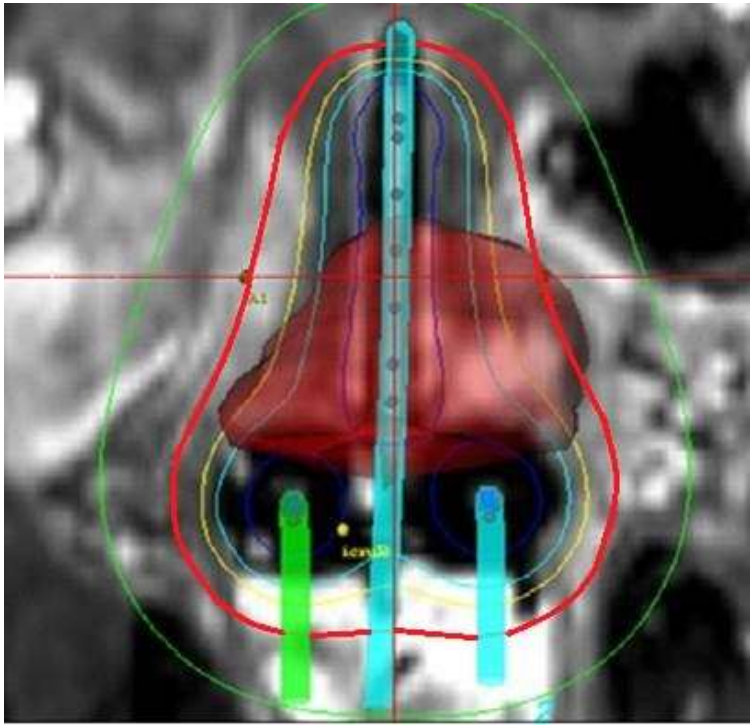
Without needle



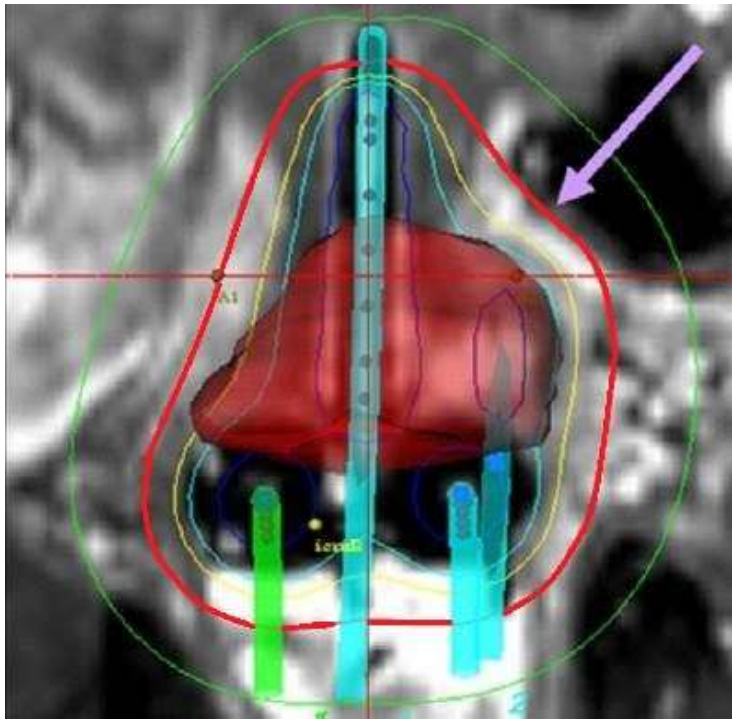
With needle
Larger high dose volume
to cover target

Dose optimization

more dose to target and less dose to normal tissue



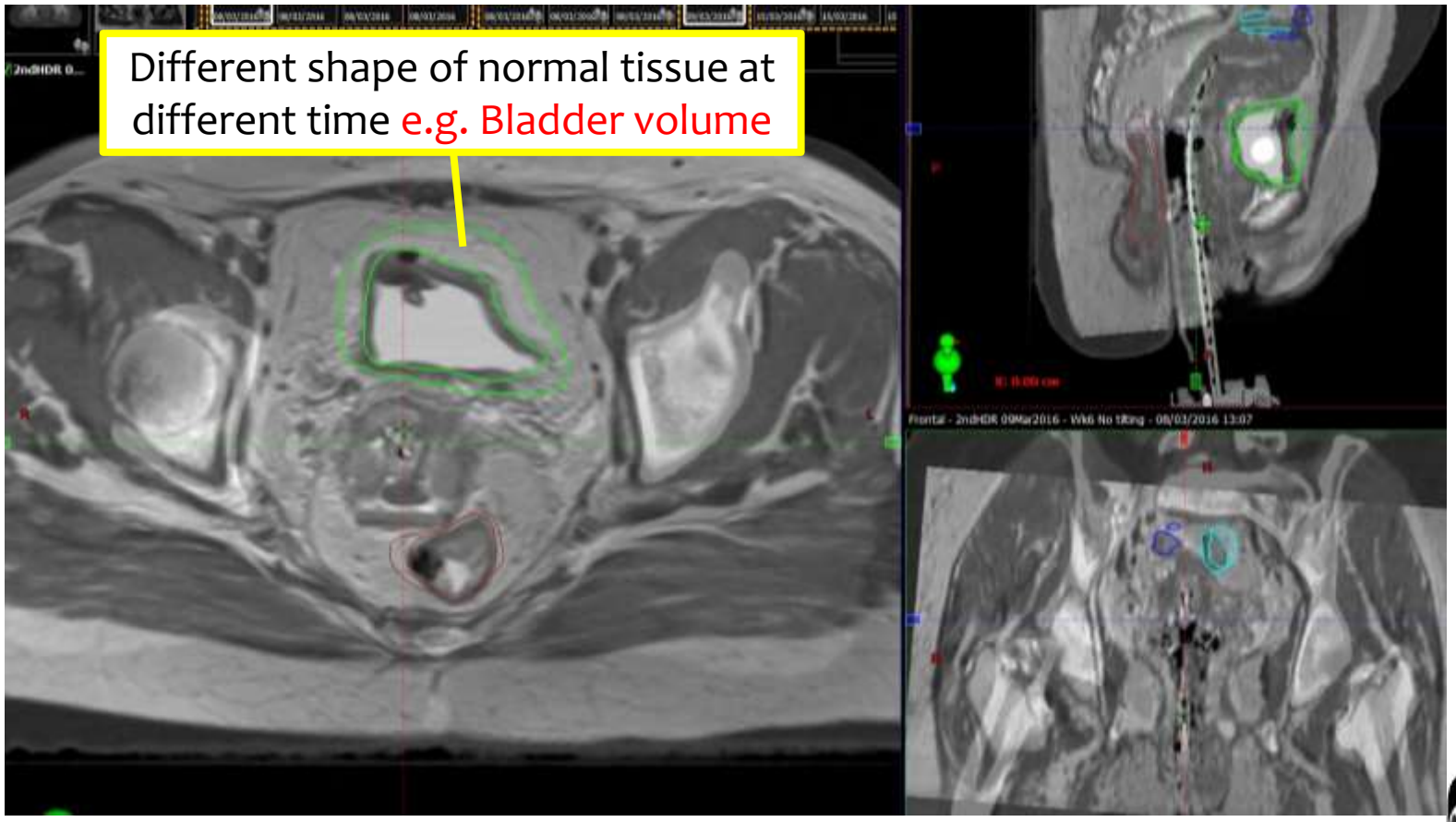
Standard plan



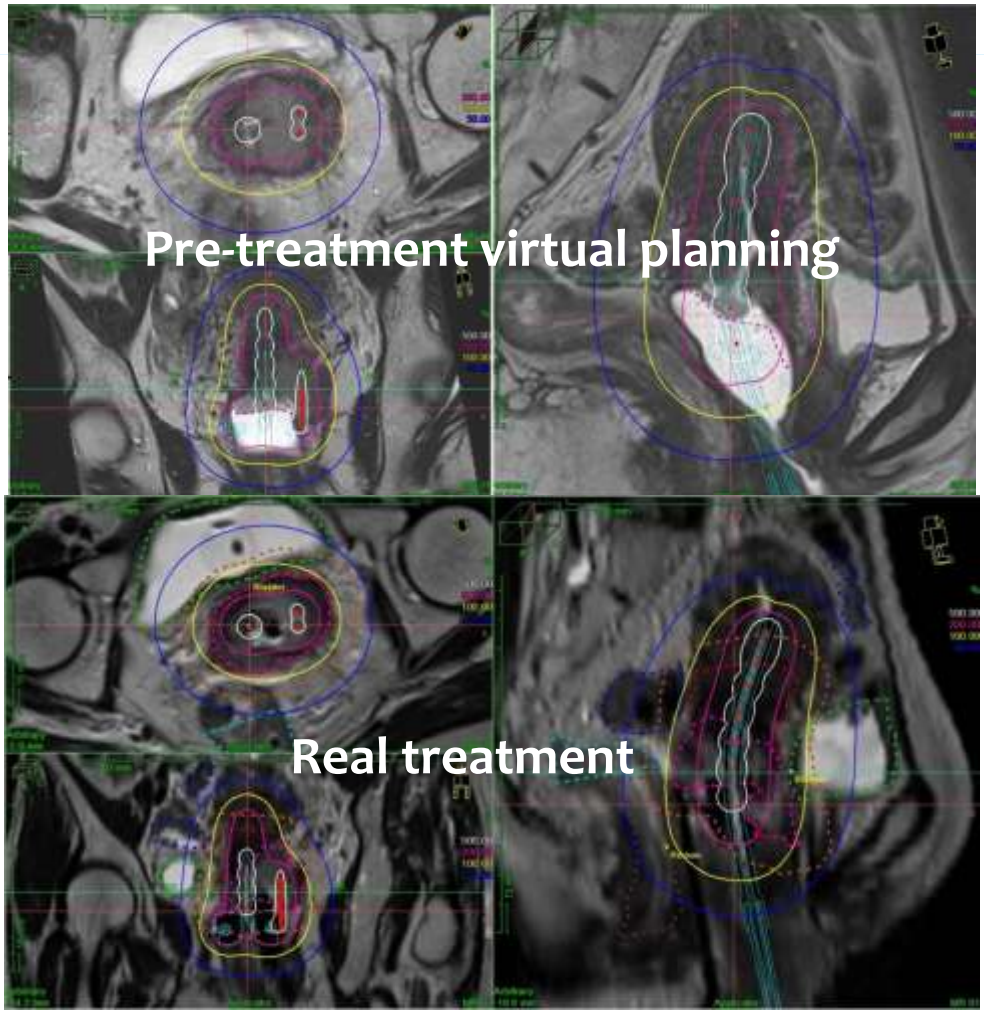
Optimized plan

Adaptive planning

re-contour the normal tissue each fraction



Pre-treatment virtual planning

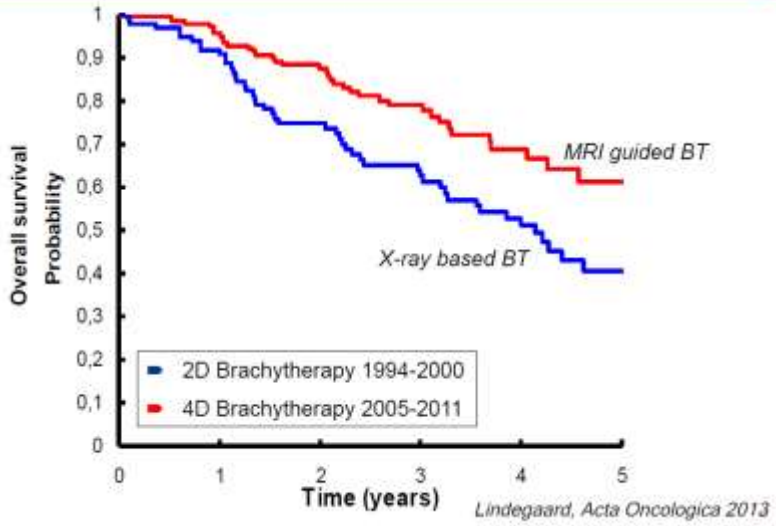


- **Predict the dose** of real treatment
- **Optimize treatment** e.g. determine needle position and length
- Help **decision making**

Favorable outcome of IGBT

overseas experience

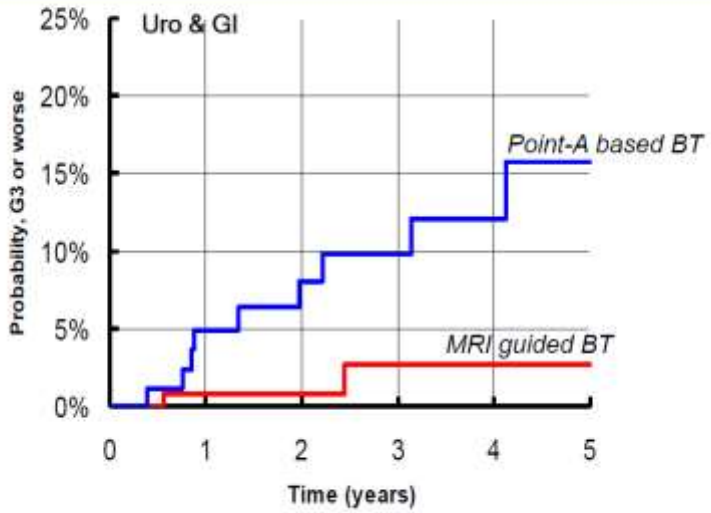
Aarhus experience – overall survival



Improved survival

Reduced toxicity

Aarhus experience – G3-4 morbidity



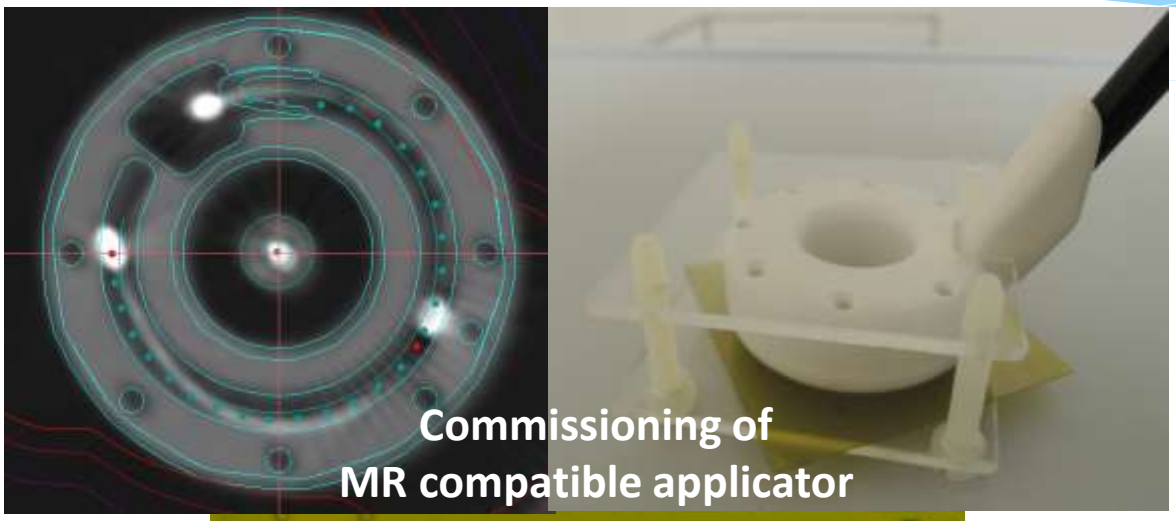
IGBT experience in PYNEH

* IGBT for cervical cancers since **January 2015**
* **1st MRI based planning** in Hong Kong
* MRI/CT based planning for all cases
* **1st interstitial needle case** in Hong Kong in September 2015
* **Pre-treatment virtual planning** to optimize the treatment

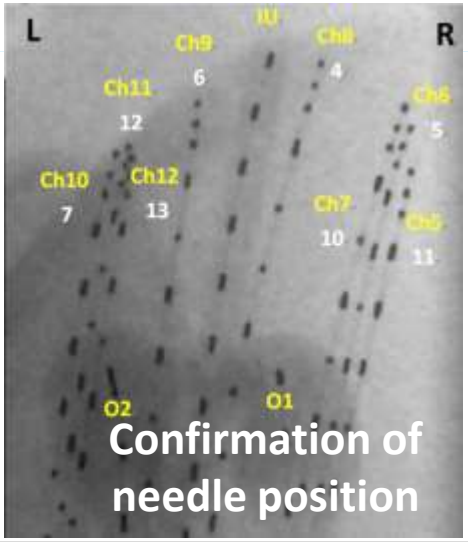
Role of Physicists in IGBT

Commissioning & Quality Assurance

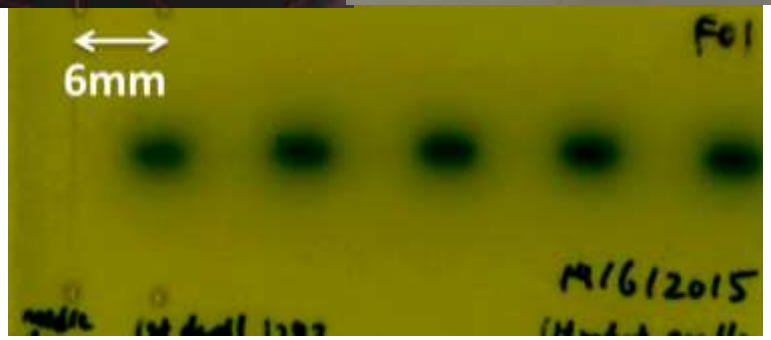
make sure the intended dose is delivered accurately to the intended location

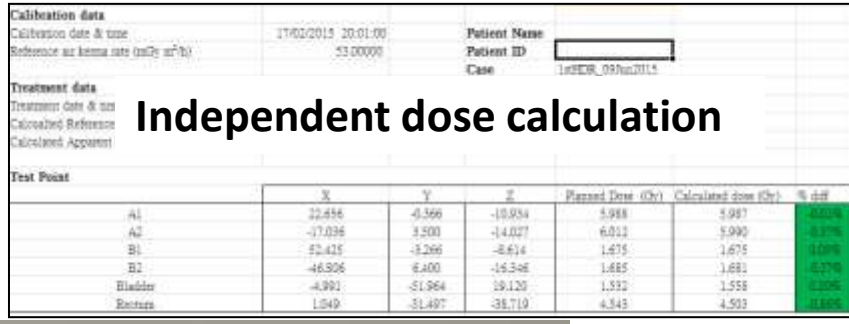


Commissioning of
MR compatible applicator



Confirmation of
needle position





Independent dose calculation

Confirmation of needle length

Role of Physicists in IGBT

Treatment Planning

stimulate the dose in patient for the treatment

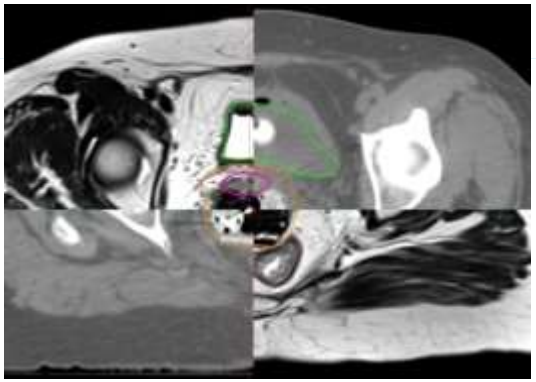
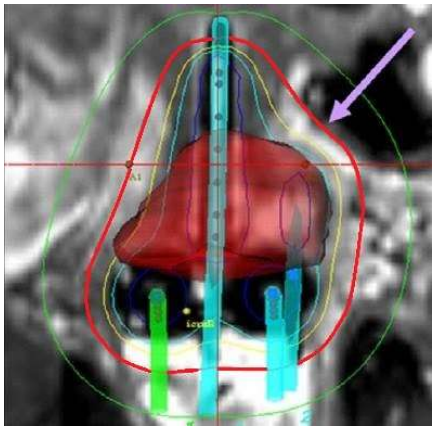
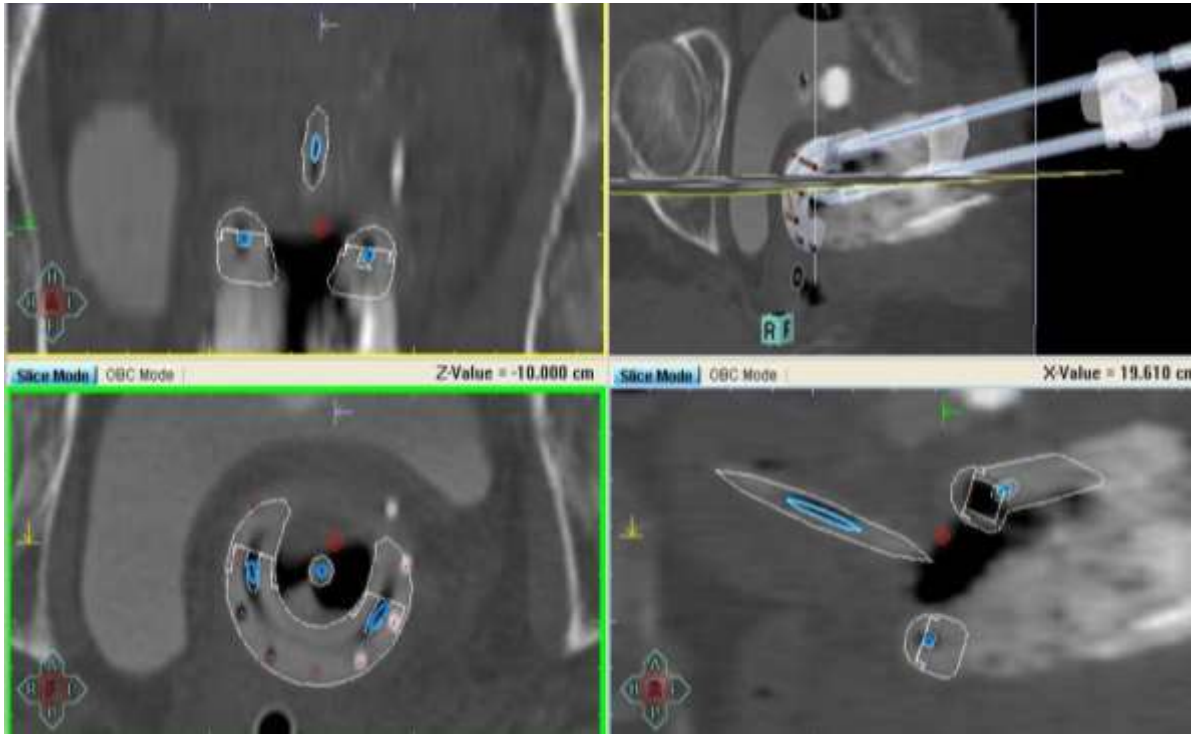


Image registration



Dose Optimization



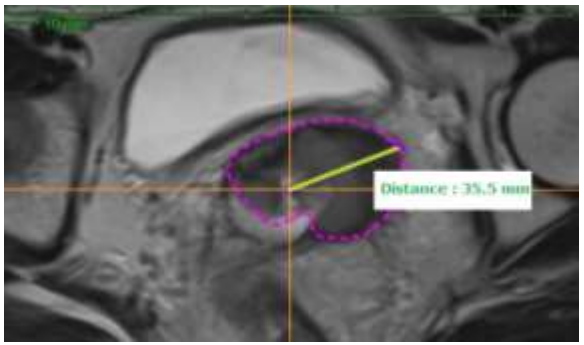
Applicator reconstruction

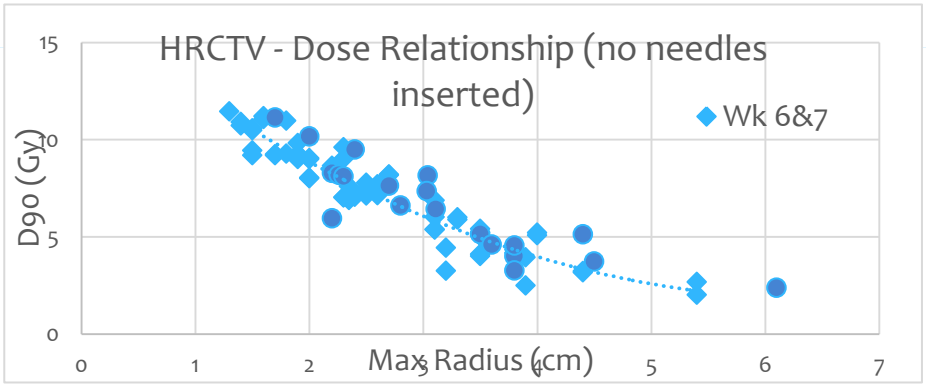
Role of Physicists in IGBT

Research and Education

Effectiveness of week 5 MRI virtual preplanning for Image-Guided Brachytherapy for cervical cancers

A Chang[1], F Cheung[2], T Wong[2], IS Soong[2], A Law[1], E Wong[2], F Cho[2], C Yip[1], M Lee[2], R Yeung[1]
Department of Clinical Oncology[1] , Medical Physics[2] and Radiology[3] , Pamela Youde Nethersole Eastern Hospital, Hong Kong SAR





Target size vs dose coverage

IGBT workshop 2015 at PYNEH

Summary

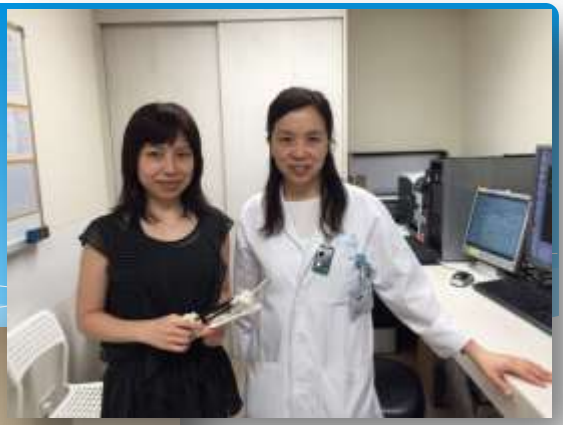
* **IGBT:** the movement from 2D planning to **3D planning (CT/MRI)**
* IGBT has the potential that makes brachytherapy **more accurate, safe and effective**
* IGBT has been **implemented in PYNEH** last year

Team work

Collaboration among different disciplines

* Oncologists
* Gynecologists
* Radiologists
* Anesthesiologists
* Nurses
* Radiation therapists
* Physicists

Our IGBT team



Thank You!