

*General Principles of Radiotherapy*  
*In*  
*Head & Neck Cancers*

**Department of Radiation Oncology**  
**Tata Memorial Hospital**  
**MUMBAI**

# The Silent Tsunami

**HNSCC** (Head & Neck Squamous Cell Carcinoma)

Accounts for about 4,50,000 cases worldwide

By 2020, incidence double

20% of cancer burden - 1,50,000 new cases in  
2000 in India\*

Oral Cancers

TMH - 12% of all new cases annually (1800)

> 75 % present with advanced disease

# HNSCC CANCER

## Patterns of failure

- Loco regional failure 75 - 90 %
- Distant Mets 05 -10 %
- Second Primary 10 - 20 %

# **HNSCC CANCER**

## **Multidisciplinary Team**

Surgical Oncologist  
Radiation Oncologist  
Medical Oncologist  
Medical Physicists  
Radiotherapy Technologist  
Dentistry / Prosthodontics  
Speech and Swallowing therapy  
Physical Medicine & Rehabilitation  
Social Services

# Role of radiotherapy

- Radical: External beam  
Brachytherapy: Interstitial  
Intraluminal
- Concurrent chemo-radiotherapy
- Adjuvant
- Palliative

# What is radiotherapy?

**The use of ionising radiation in the treatment of malignant and benign conditions**

## **Aim of radiotherapy**

**Deliver tumoricidal doses to the disease  
limit dose to surrounding normal structure to tolerance**

# **General Management Guidelines: HNSCC Cancers**

## **AIM**

**Highest loco-regional control**

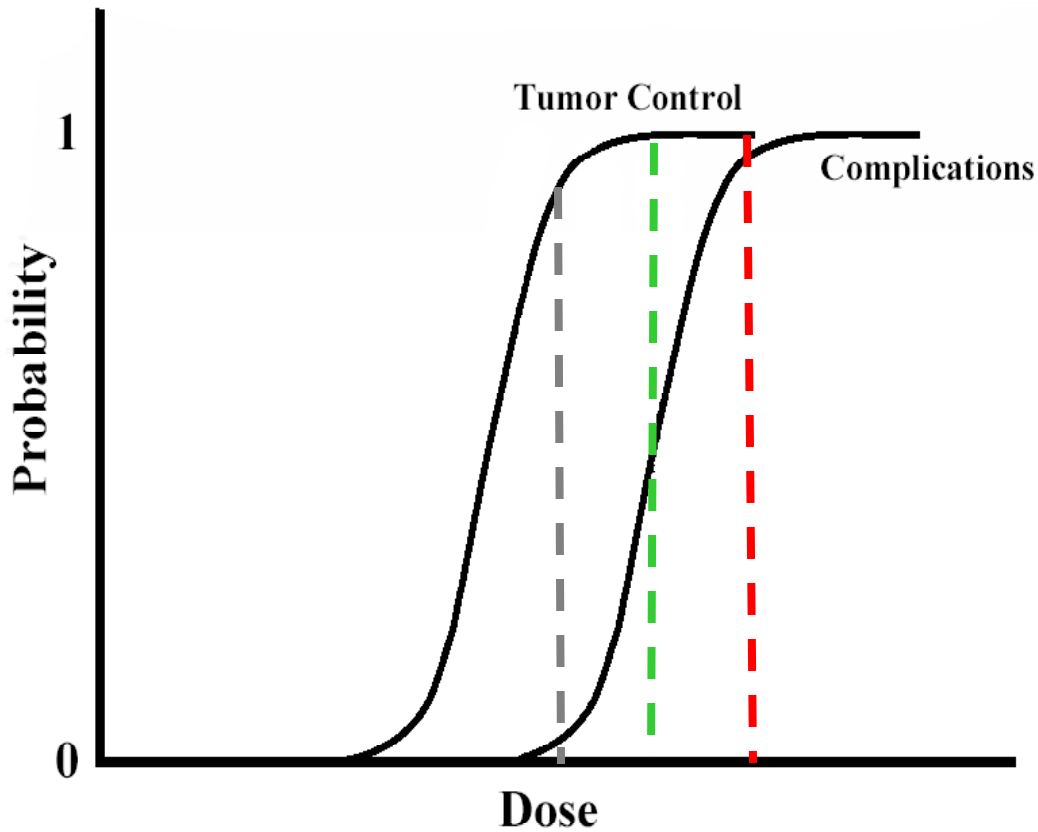
**Anatomical with functional Preservation**

- **Stage I / II** disease - Single modality ( Surgery or RT )
- **Stage III / IV** disease – Combined modality
  - \*Surgery + RT (in most patients)
  - \*Chemotherapy + RT in selected patients

# Basis of fractionation in radiotherapy can be understood today in terms of the principles of

- Repair of sublethal damage
- Reassortment of cells within the cell cycle
- Repopulation
- Reoxygenation
- Inherent radiosensitivity

# RADIOTHERAPY

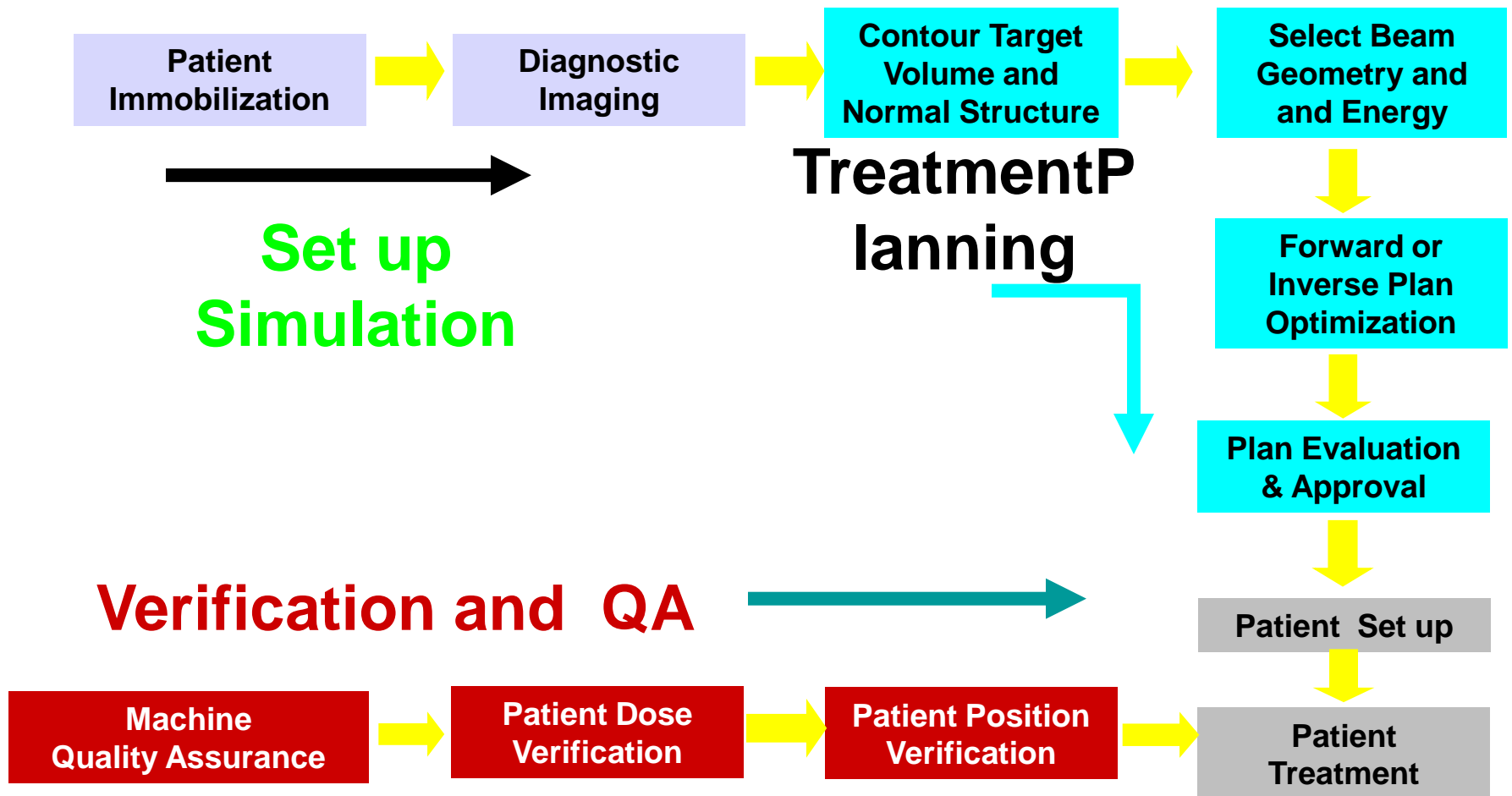


High tumour control,  
high risk of complications

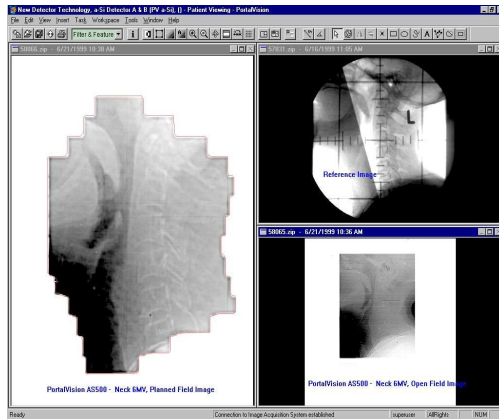
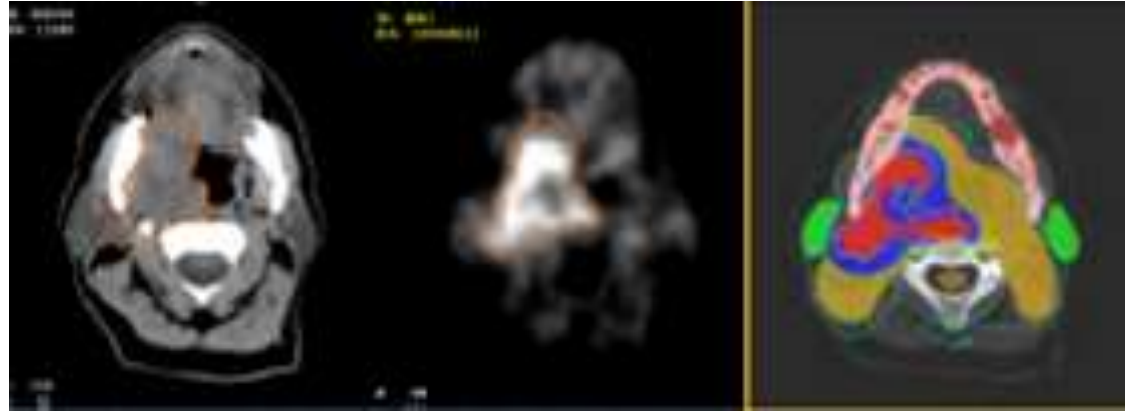
Low risk of complications,  
low tumour control

Medium tumour control,  
medium risk of complications

# RADIOTHERAPY PROCESS



# RADIOTHERAPY PROCESS



# Radical Radiotherapy

## Indications

Early stage disease

Inoperable (medical contra-indications)

Surgery is morbid

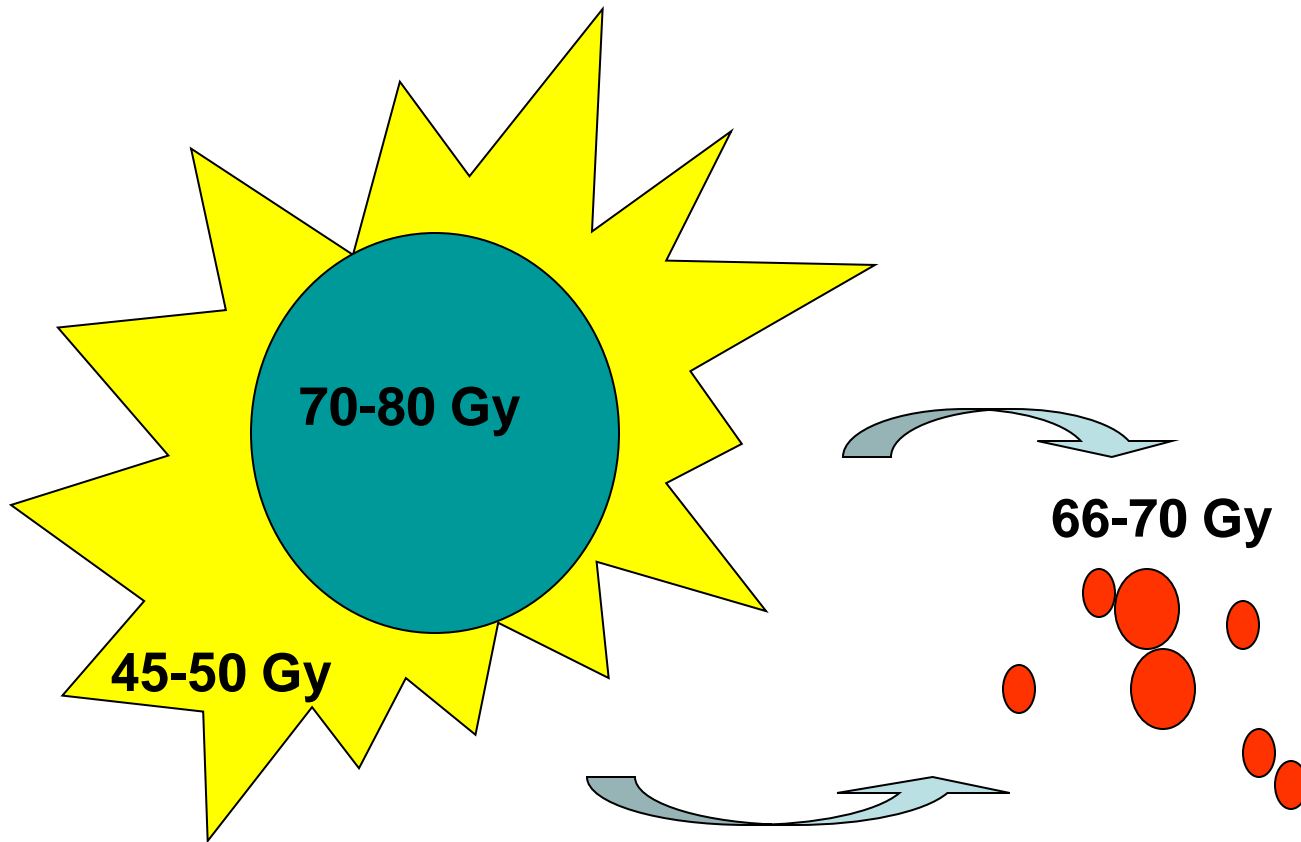
Combination of EBRT+ Brachytherapy

EBRT alone

Radical Brachytherapy

# Radical Radiotherapy

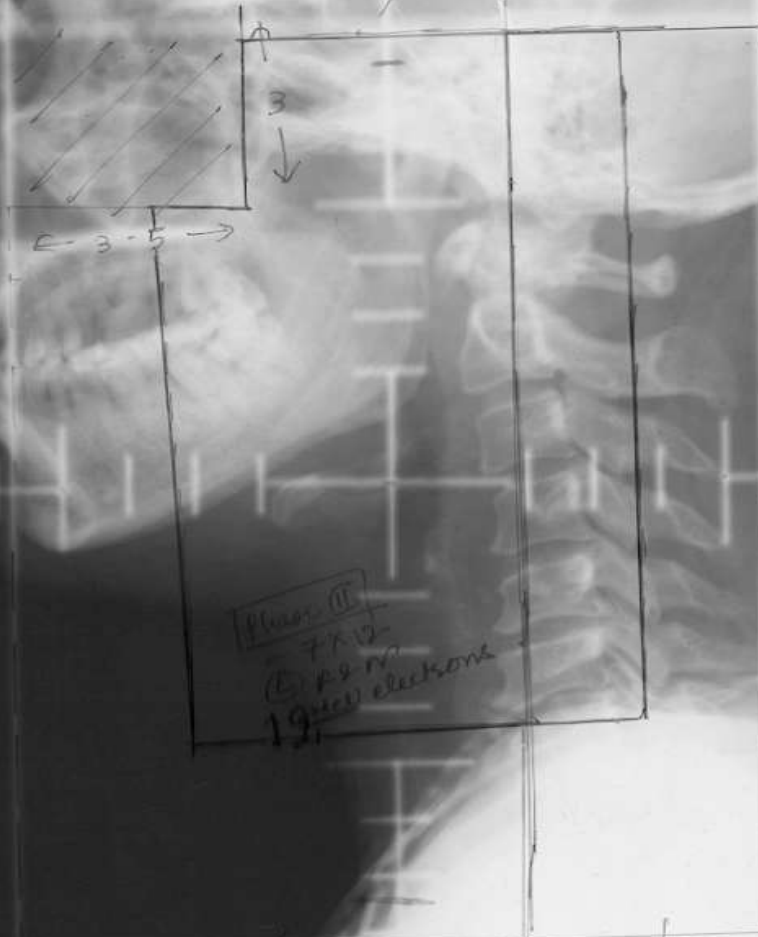
Volume:





Vaha Agniborn  
BR-9820

Phase I - PS-11x16 on orbit  
40 Gy/20# GMV



Phase II  
7x10  
19 Gy/5#  
19 Gy electrons

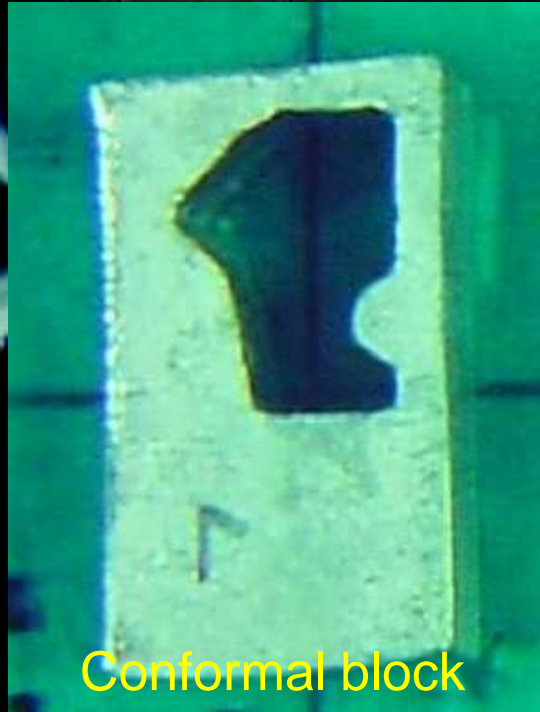
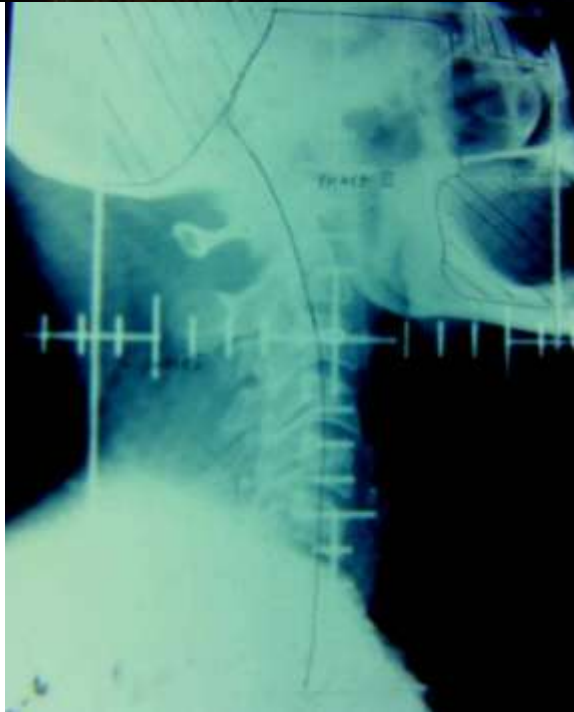
Phase II  
Post PS IV  
PS: 7x10  
10 Gy/5#

Phase III  
Post neck - Bil neck electrons  
GMV  
10 Gy/5#  
PS: 3.5x16

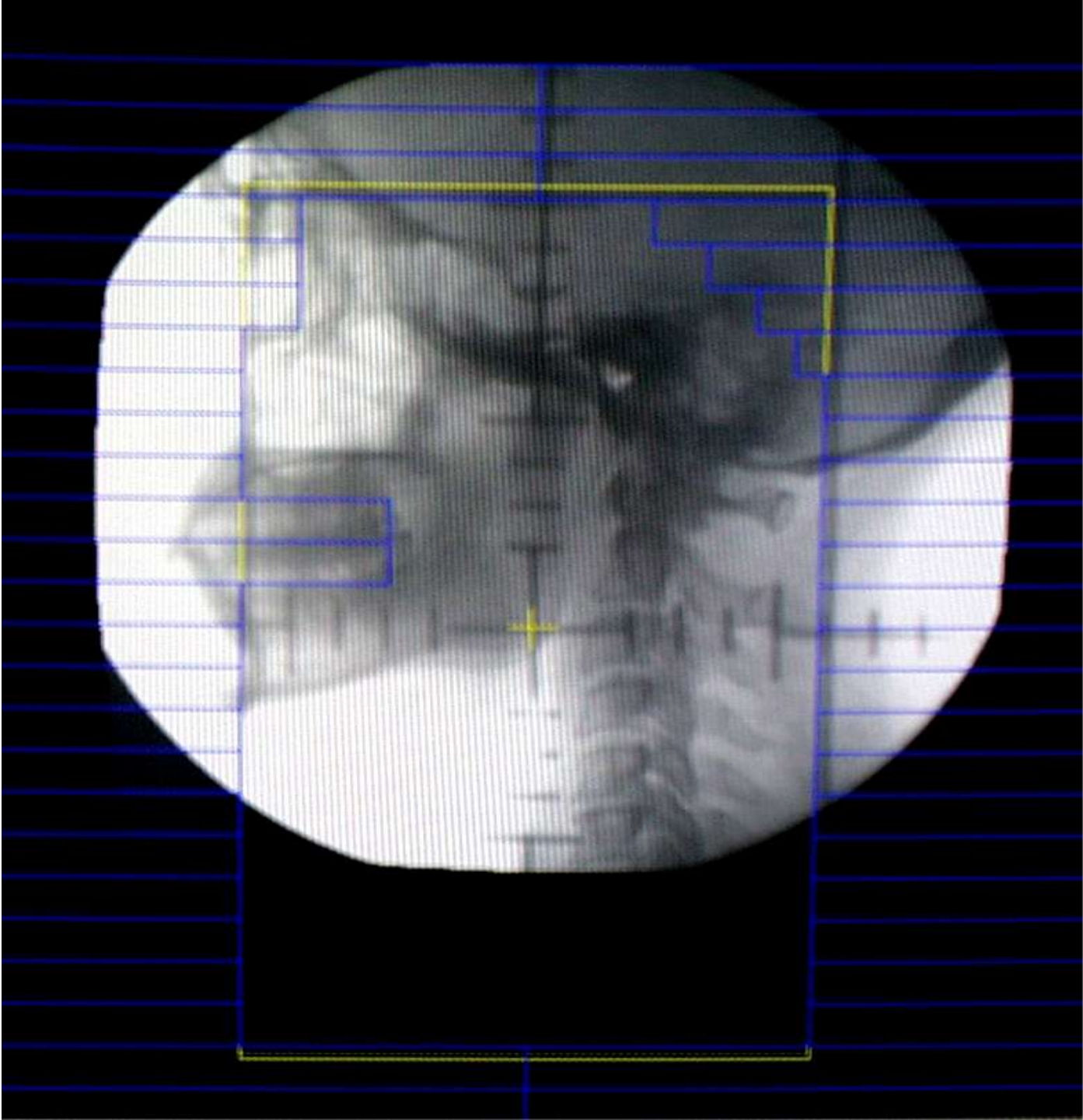
Dr. [Signature]



Tissue compensator



Conformal block




# ELECTRONIC PORTAL IMAGING

New Detector Technology, a-Si Detector A & B (PV a-Si) - Patient Viewing - PortaVision

File Edit View Insert Task Workspace Tools Window Help

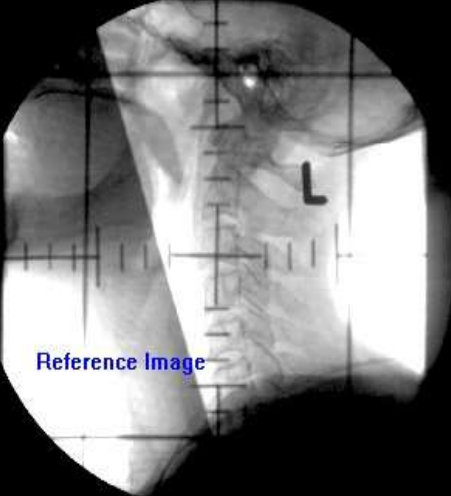
Filter & Feature

58066.zip - 6/21/1999 10:38 AM




PortalVision AS500 - Neck 6MV, Planned Field Image

57831.zip - 6/16/1999 11:05 AM



Reference Image

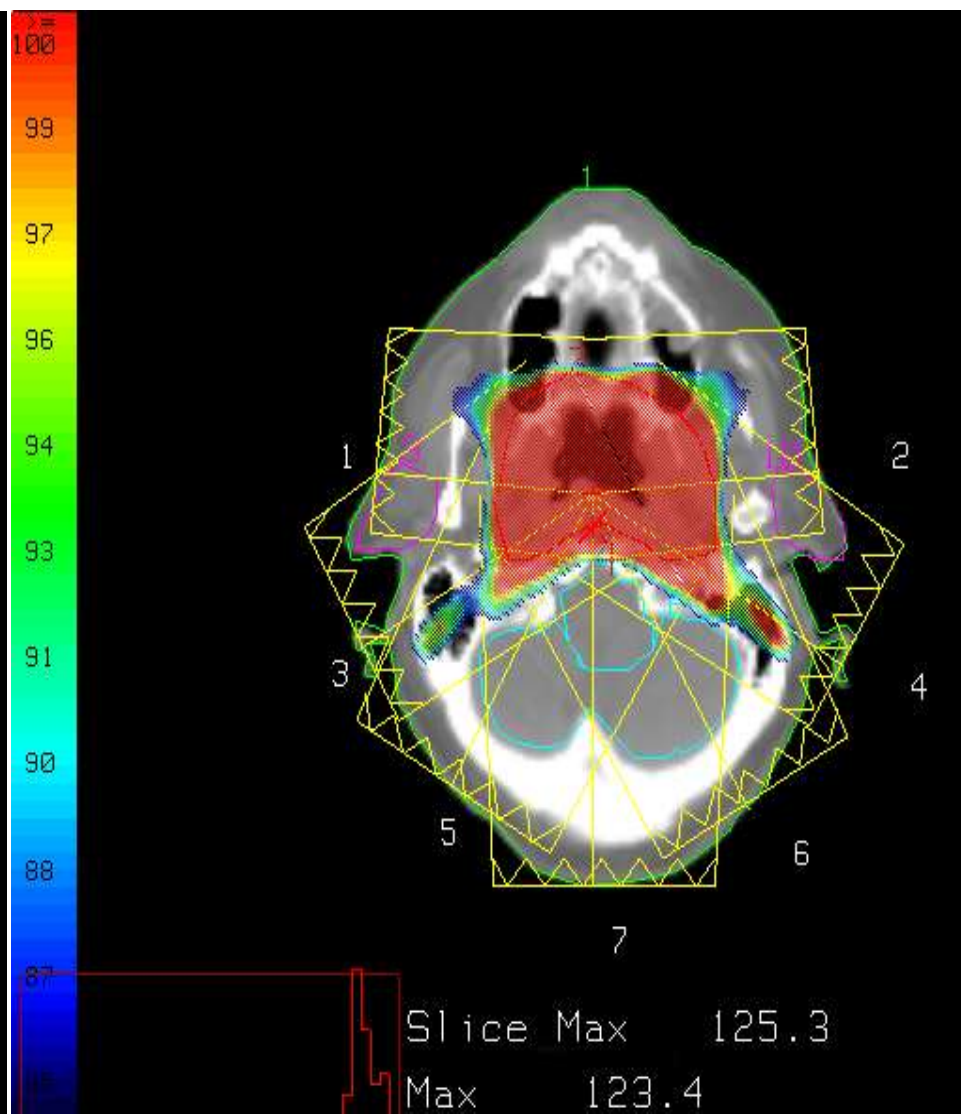
58065.zip - 6/21/1999 10:36 AM



PortalVision AS500 - Neck 6MV, Open Field Image

Ready Connection to Image Acquisition System established superuser AllRights NUM

Detailed description: The image shows a screenshot of the PortaVision software interface. At the top is a menu bar with 'File', 'Edit', 'View', 'Insert', 'Task', 'Workspace', 'Tools', 'Window', and 'Help'. Below the menu is a toolbar with various icons for image manipulation. The main area is divided into three panels. The left panel shows a large, irregularly shaped grayscale image of a neck, outlined in red, representing a planned radiation field. The top right panel shows a circular grayscale image of a neck with a grid overlay and a blue 'L' marker, labeled 'Reference Image'. The bottom right panel shows a smaller, rectangular grayscale image of a neck, labeled 'Open Field Image'. The status bar at the bottom indicates 'Ready', 'Connection to Image Acquisition System established', 'superuser', 'AllRights', and 'NUM'.



# Conventional fractionation

**1.8 - 2 Gy/ fr**  
**One fraction per day**  
**5 days a week**

# Altered Fractionation Schedules

## Biologic Rationale:

- a) the fraction size is the dominant factor in determining late effects, and the overall time has little influence
  
- b) by contrast, the fraction size and overall treatment time both determine the response of acutely responding tissues

# Accelerated treatment

- approx. conventional total dose
- conventional fraction number
- overall time is approx. halved (since two fractions are given)
- Intent- to reduce repopulation in rapidly proliferating tumours.

# Hyperfractionation

- to further separate the early and late effects
- overall treatment time 6-8 wks
- two fractions / per day
- number of fractions are doubled to 60-80
- dose per fraction - decreased
- Intent - further reduce late effects while achieving the same or better tumour control and the same or slightly increased early effects.

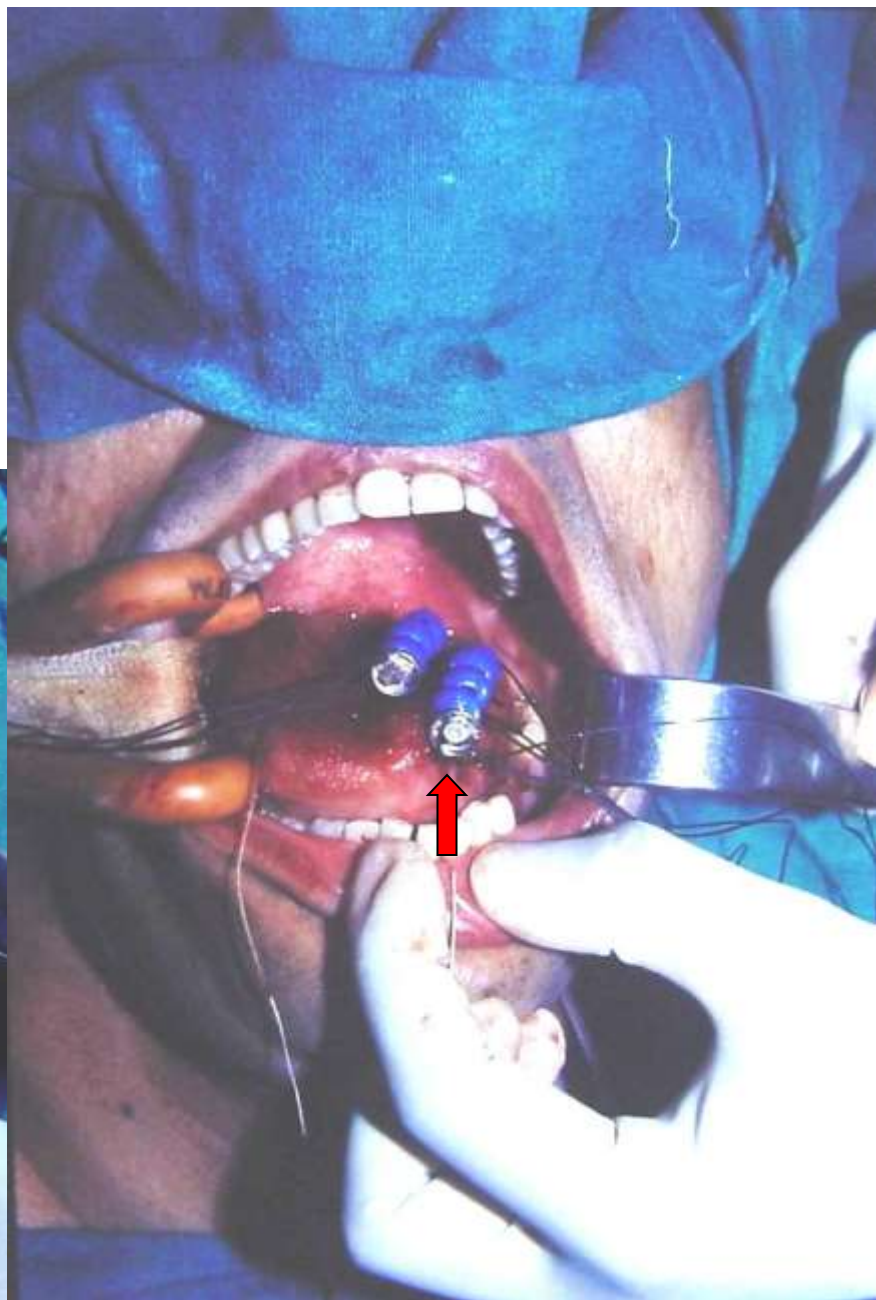
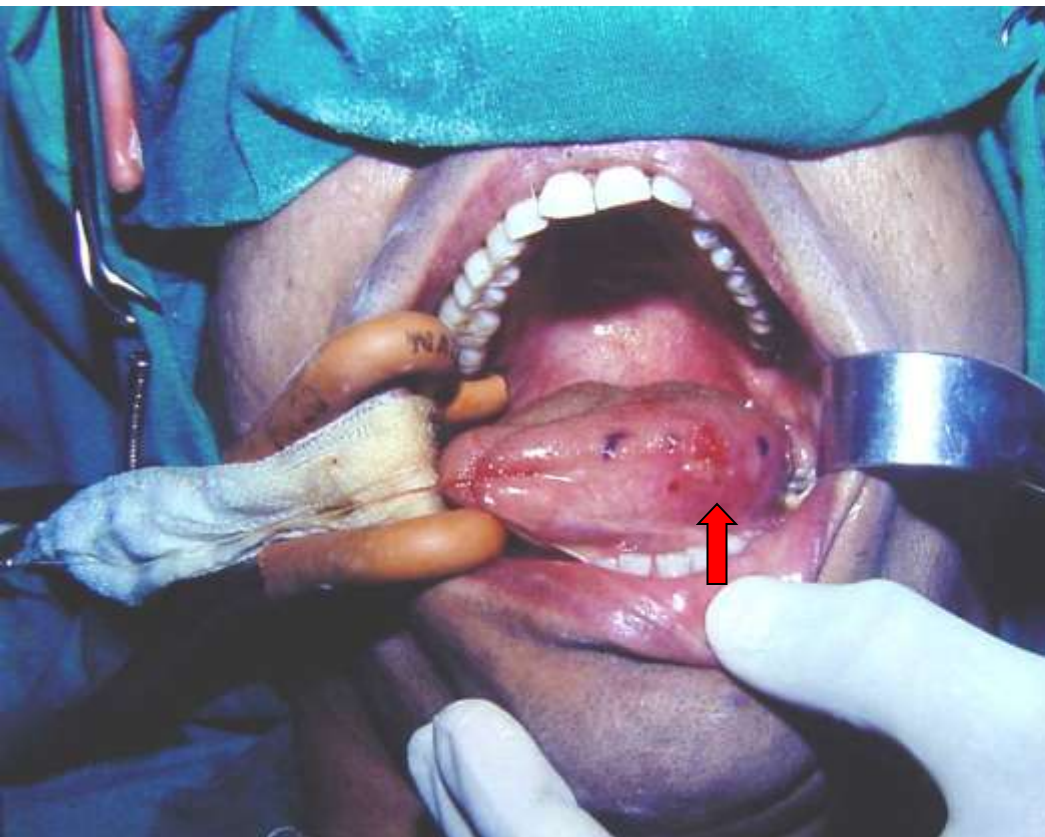
# Altered Fractionation- In conclusion

Modification of dose per fraction,  
total dose based on tumor  
kinetics in an attempt to increase  
therapeutic ratio

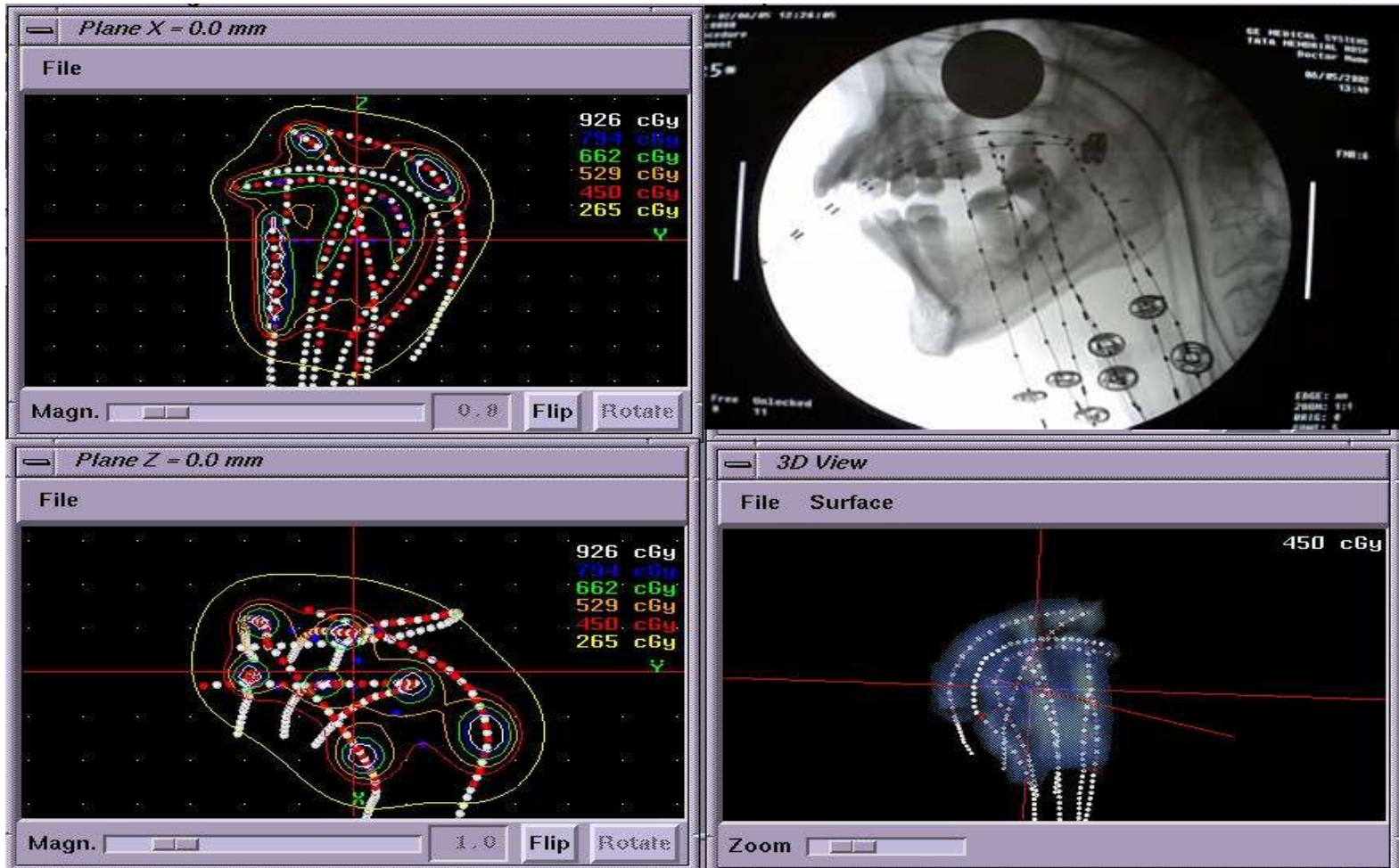
# Criteria for brachytherapy

- Accessible
- <3 cm in size
- Away from bone
- No nodal disease

# INTERSTITIAL BRACHYTHERAPY FOR CARCINOMA OF TONGUE



# DISTRIBUTION OF TONGUE IMPLANT



# Intraluminal brachytherapy for cancer nasopharynx



# Prophylaxis

## Pre-treatment

- Dental prophylaxis:
  - Extraction
  - Scaling
- Application of fluoride gel

# Adjuvant Radiotherapy

## Indications

**T3,T4 primary**

**High grade**

**Infiltration of soft tissues/ muscle/ bone**

**Perineural invasion**

**Lymphovascular emboli**

**Cut margin positive/ close**

**Thickness**

**Recurrent disease**

**Multiple nodes**

**Perinodal extension**

# Adjuvant Radiotherapy

## Volume

**Primary + one station beyond involved nodes**

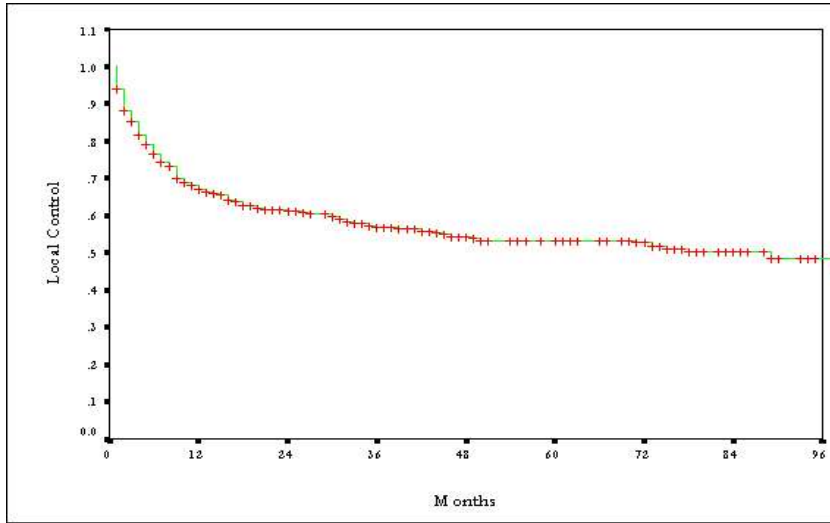
## Dose

**56 - 60 Gy/ 28 - 30 fr/ 5-6 weeks**

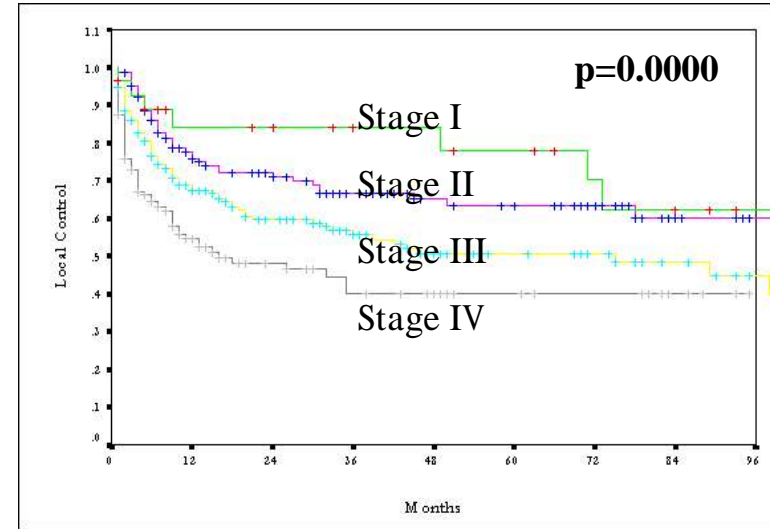


2002	
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3	4
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29	30
31	

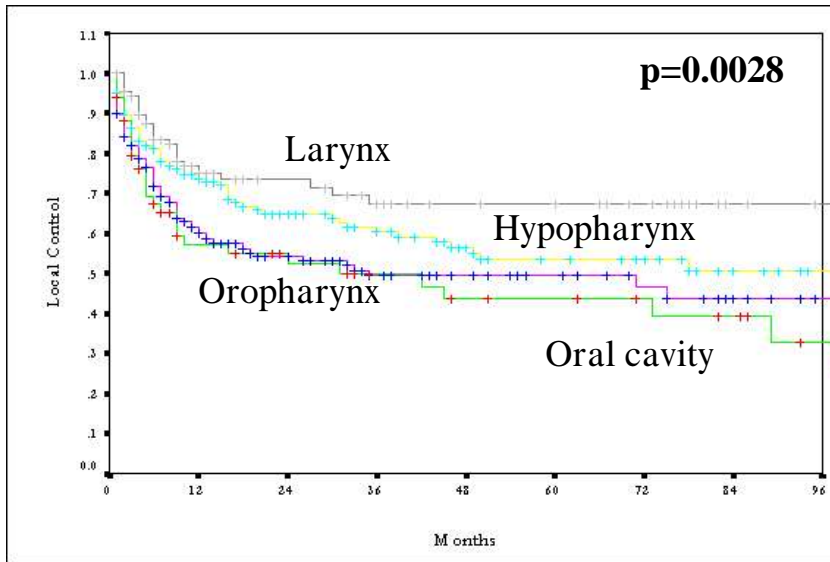
# Radical RT (TMH): 568 PTS. *Clin Oncol 2006*



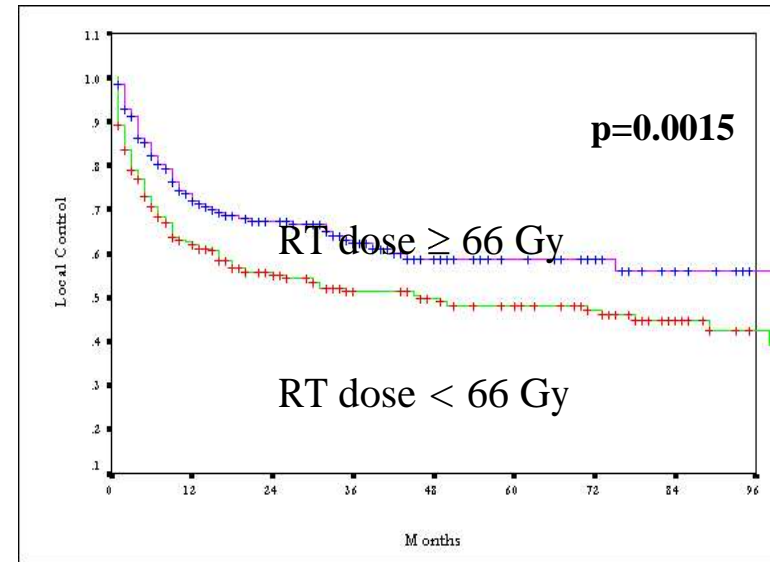
5-yr Local Control: 53%



Local Control vs stage

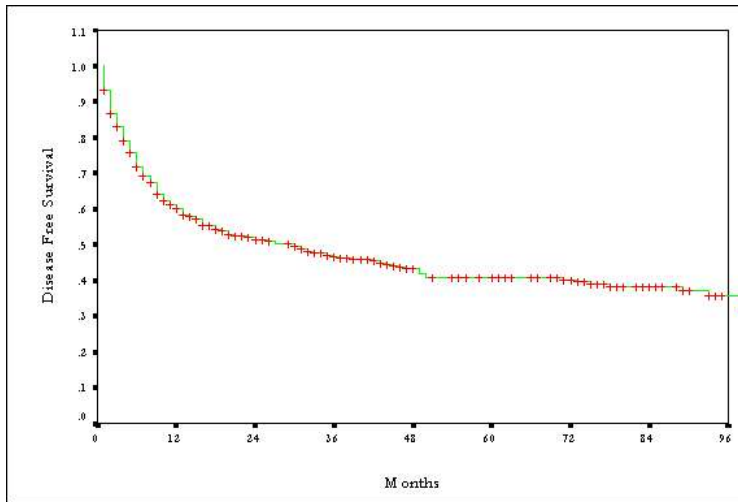


Local Control vs primary site

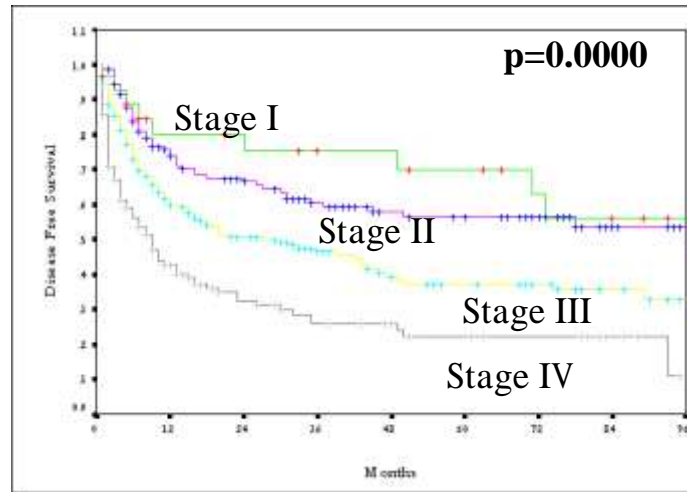


Local Control vs RT dose

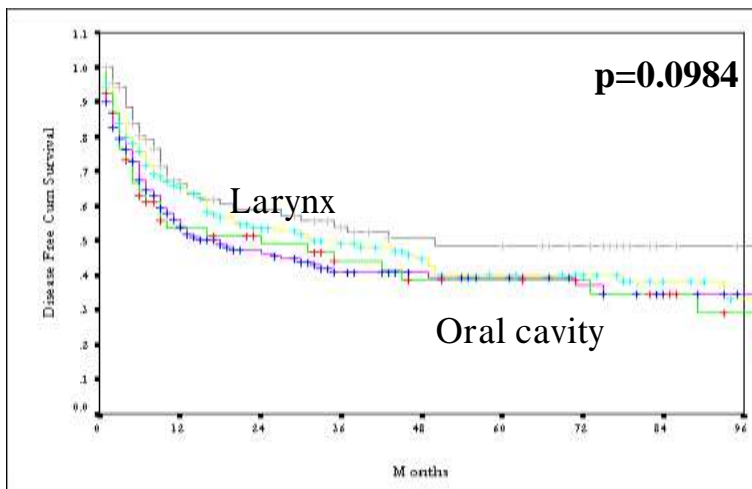
# Radical RT (TMH): 568 PTS. *Clin Oncol 2006*



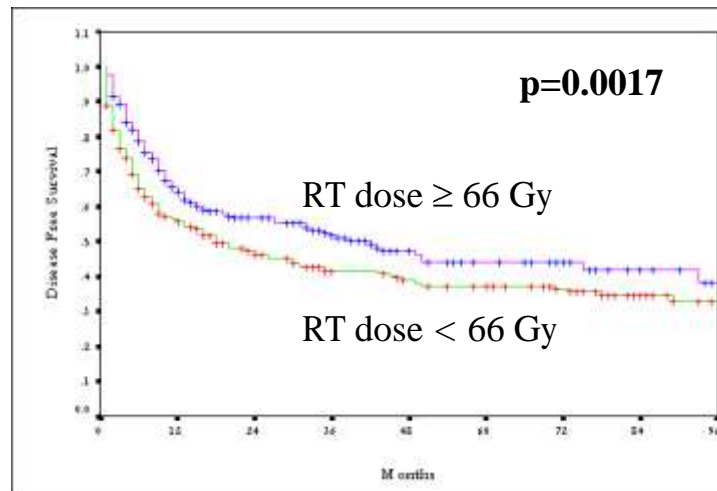
5-yr DFS: 41%



DFS vs stage



DFS vs primary site



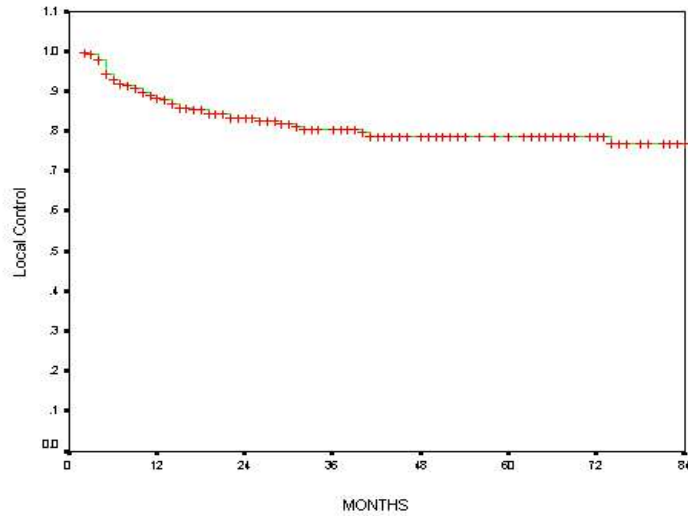
DFS vs RT dose

# Post-operative Radiotherapy

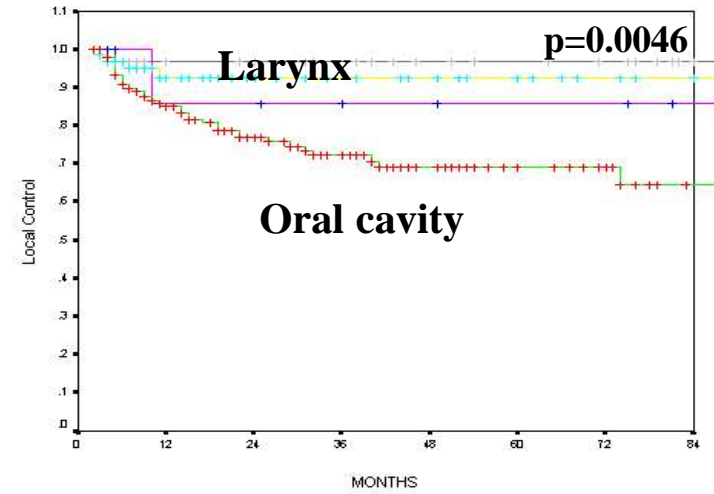
## Indications:

- T3/4 STAGE
- HIGH GR HISTOLOGY
- CUT MARGIN + OR CLOSE
- LVI/PNI
  
- NODE POSITIVE
- PNE

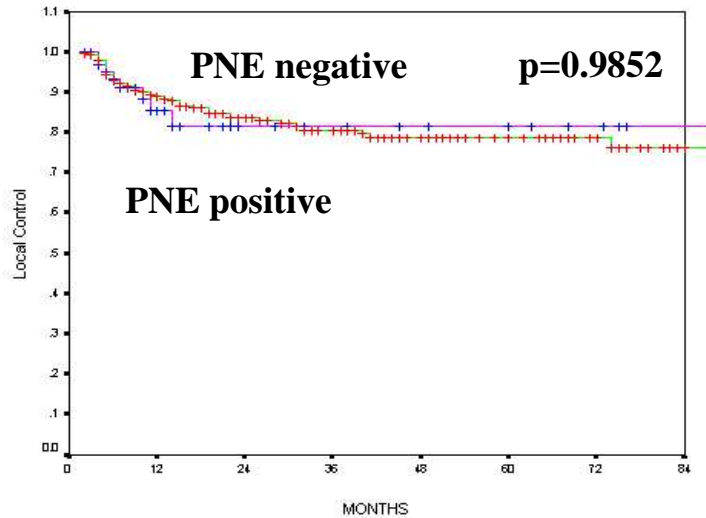
# Post-op RT (TMH) 368 Pts.: *J. Surg Oncol* 2005



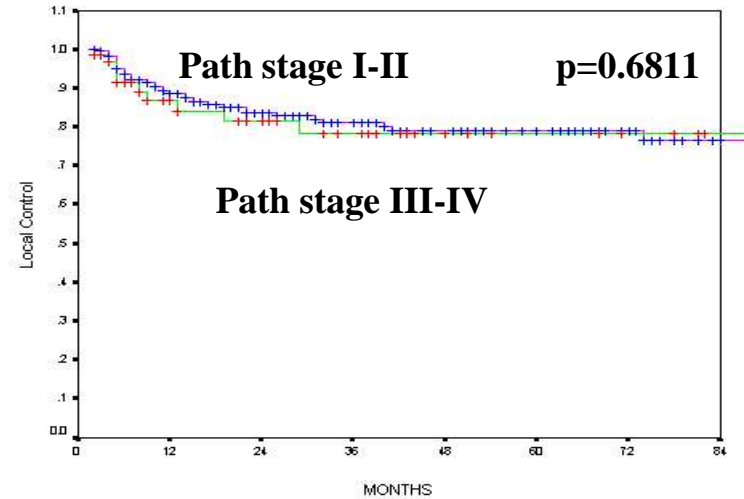
**5-yr Local control: 79%**



**Local control vs Primary site**

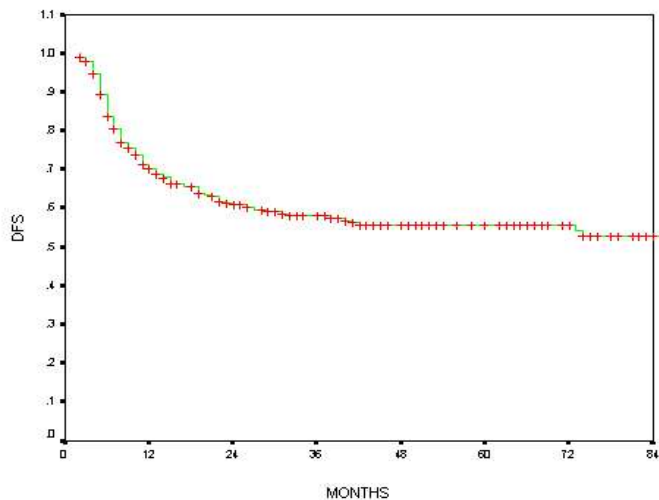


**Local control vs PNE**

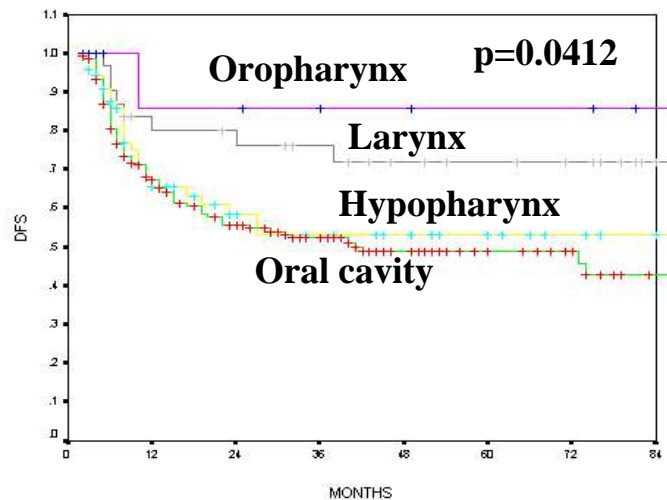


**Local control vs stage**

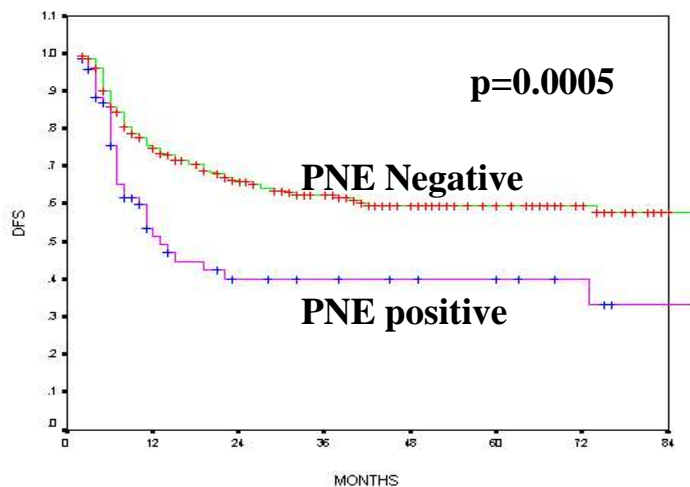
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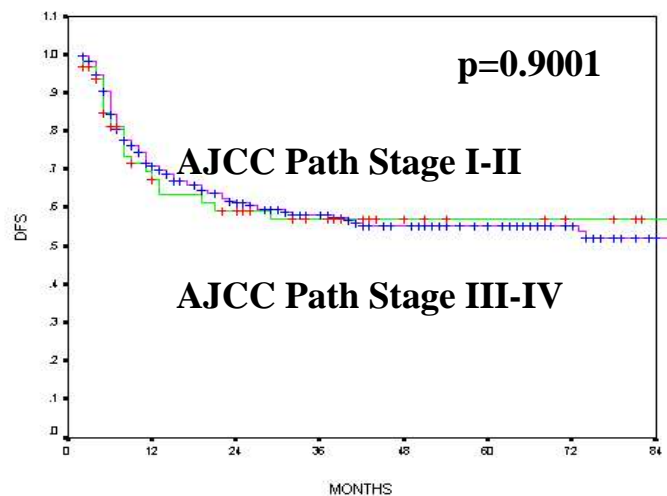
**5-yr DFS: 56%**



**DFS vs primary site**



**DFS vs PNE**



**DFS vs Path stage**

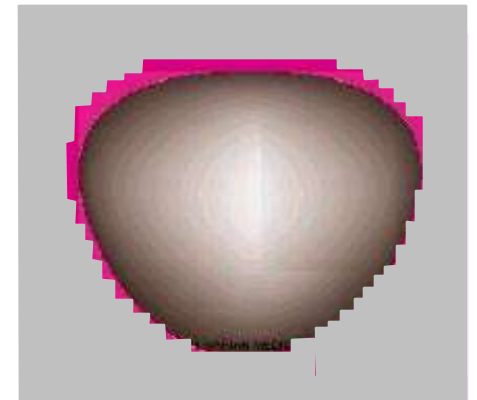
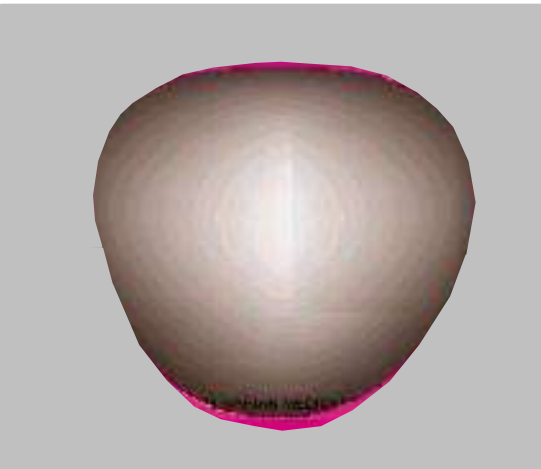
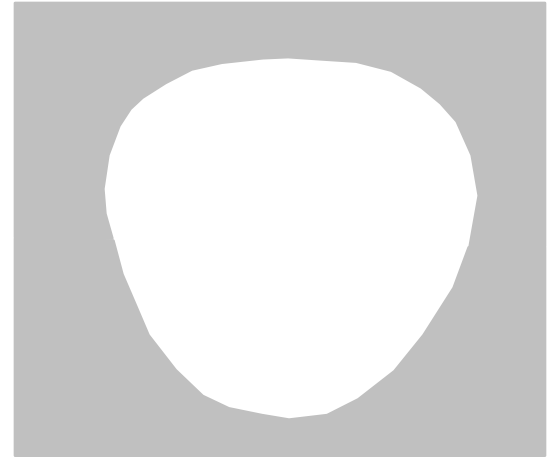
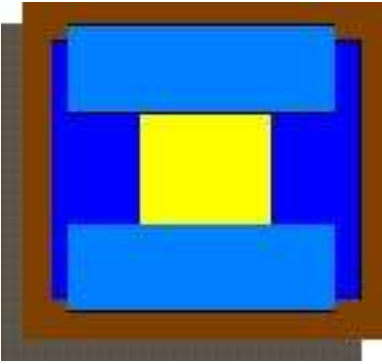
# CONFORMAL RADIOTHERAPY

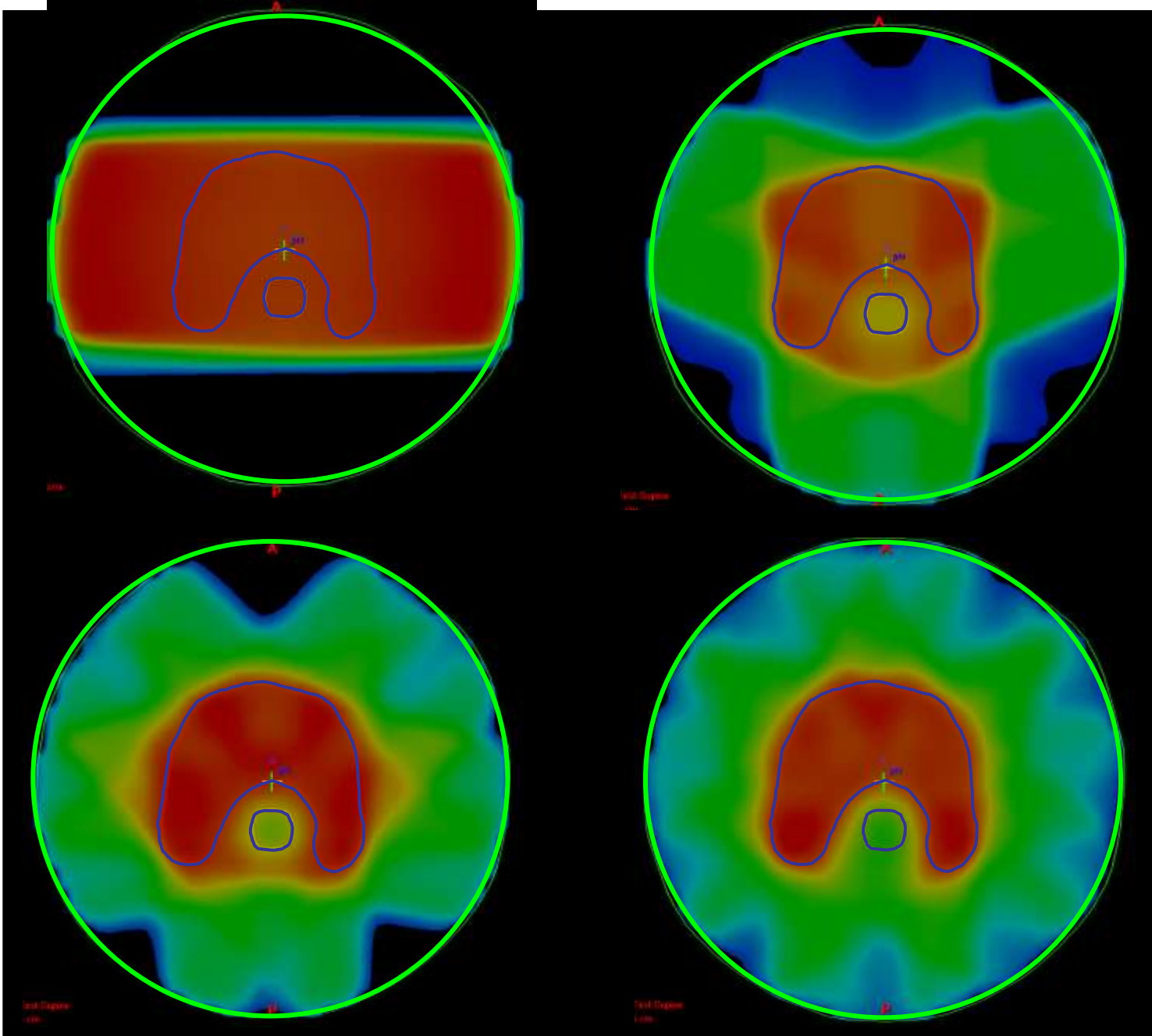
- Enhanced conformation allows for greater dosages of radiation to reach the target volume (*conformal shaping*)
- While minimizing the dose delivery to surrounding normal tissues (*conformal avoidance*)

# Improving Efficacy of Irradiation

- **Physical Dose Escalation**
  - Better target definition/delineation
  - Better radiation delivery
  
- **Biological Dose Escalation**
  - Altered Fractionation Schemes
  - Radiation and Chemotherapy
  - Selective Tumor Radiosensitization
  - Bio reductive drugs Tirapazamine
  - EGFR Inhibitors

# technology





# META-ANALYSES OF CHEMORADIOOTHERAPY

Investi- gators	No. of Trials Period	No. of pts.	Relative Risk of Death (RT / CT + RT)			Absolute Benefit	
			Neo	Con.	Overall	Conc.	Overall
Stell (1992)	28 (before 1991)	4292	1.09 (NS)	0.71 p=0.02	0.92 (NS)	7.0	2.8
Munro (1995)	54 (1963- 1993)	7828	0.83 p=0.01	0.56 p<0.001	0.73 p<0.001	12.1	6.5
El Sayed (1996)	42 (1963- 1993)	5079	0.95 (NS)	0.78 p<0.005	0.89 p<0.001	8.0	4.0
MACH NC (1998)	63 (1965- 1993)	10741	0.95 (NS)	0.81 p<0.001	0.89 p<0.001	8.0	4.0
Browman (2001)	18 (1970- 2000)	3192		0.83 p<0.0001		11	

# Meta-analyses

- 6 Meta-analyses addressing the status of chemotherapy in HNC
- Only 1 is IPD based (MACH-NC)
- 5 favour the addition of chemotherapy
- Concomitant Platinum based chemotherapy appears most beneficial WHILE neo-adjuvant and adjuvant chemotherapy provide no advantage
- Concomitant chemoradiotherapy increases survival
- Morbidity not yet quantified

# Head and Neck Intergroup Trial R91-11

- **Abstract ASCO 2002**
- **576 patients**
- **RT alone VS Three-weekly Platinum VS NACT (Platinum + 5FU)**
- **No Survival Difference =76% (5 yr)**
- **Larynx preserved in 66% of concurrent arm VS 58% in NACT arm VS 52% in RT arm**

# Points to Ponder

- **Chemoradiotherapy and Altered fractionation (concomittant boost and hyperfractionation) may provide improvement in control and ?survival -**
- **Are they feasible?**
- **Which is better ?**
- **What is the optimum combination and sequencing?**

# Factors

- Type of radiation
- Dose per fraction
- Time between fractions
- Total dose delivered
- Irradiated volume
- Anatomic structures exposed

# Effects of Radiotherapy

- Skin
- Mucosa
- Salivary glands
- Spinal cord
- Teeth

# Palliative radiotherapy

## Symptoms:

Bleeding

Fungation

Pain

## Volume:

Gross disease with min margins

## Dose:

8Gy/1fr or 20Gy/5 fr or 40Gy/16 fr