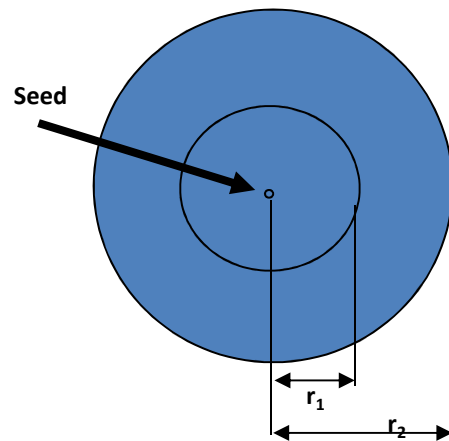


# BRACHYTHERAPY IN HEAD & NECK CANCERS

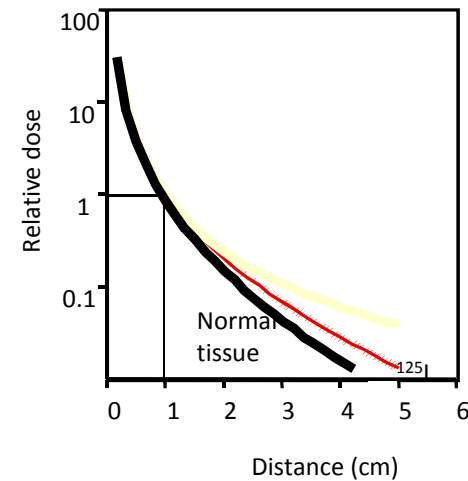
DR. GIRI G.V.

# BASICS

- High dose to tumor = local control
- Spare normal structures i.e. salivary gland, mandible and muscles of mastication.



Dose falls off with one upon the square of distance

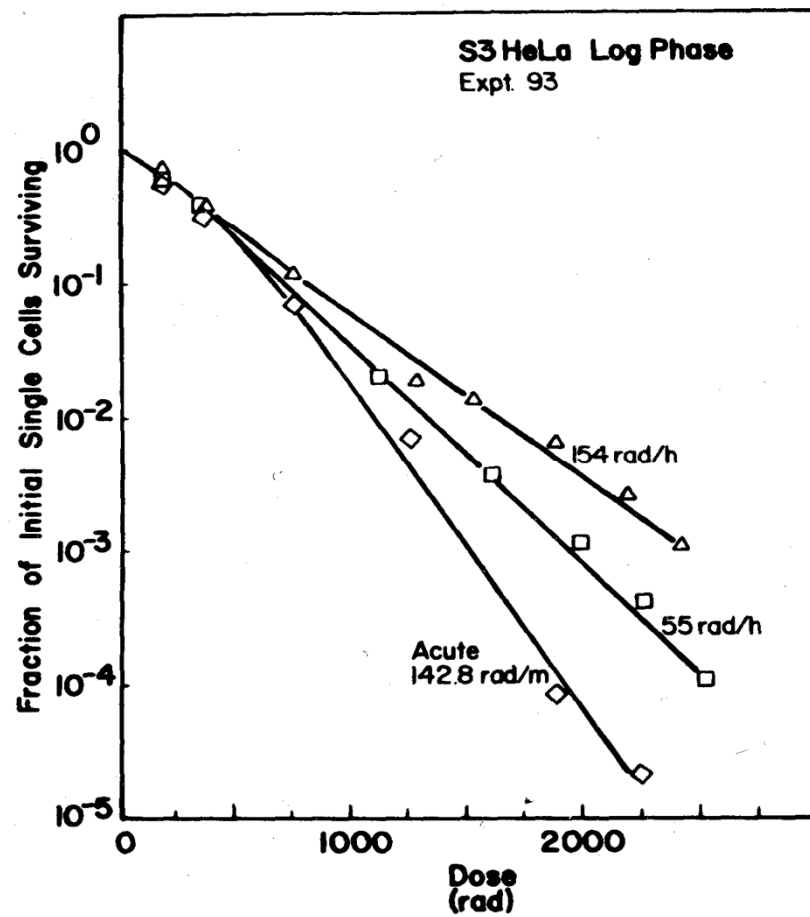
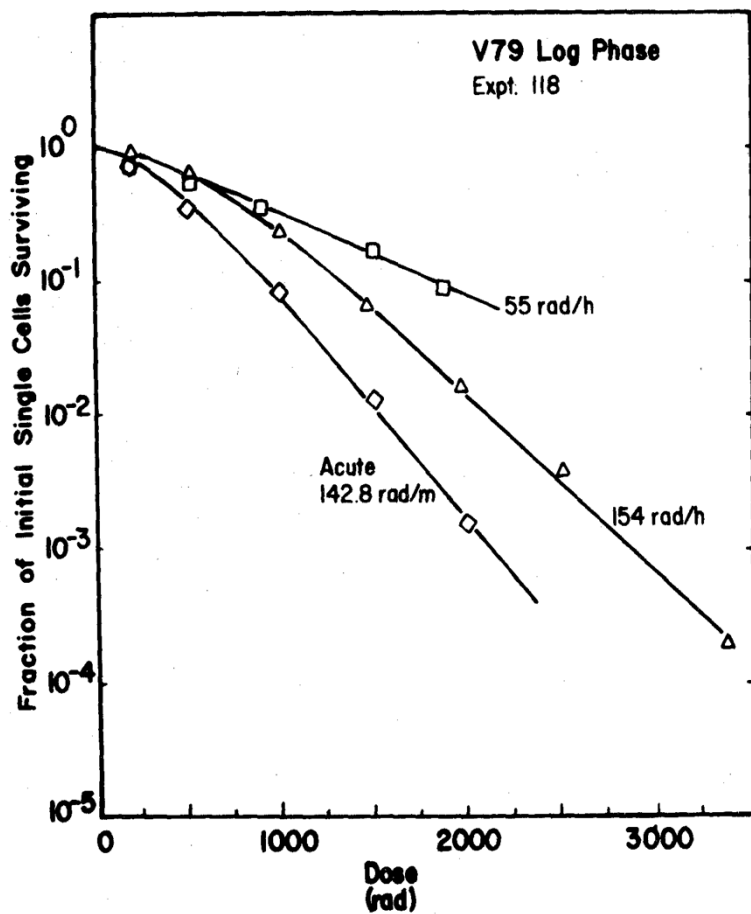


- Potential radiobiological advantages of brachytherapy include varying treatment times
- - Short treatment time could prevent tumor repopulation,
  - Longer could redistribute cells into sensitive cell cycle phases,
  - Longer could allow re-oxygenation with time after implantation.

# EFFECT OF DOSE RATE

- In general decreasing dose rate decreases killing, however in some cases there is an inverse dose rate effect, which is thought to be due to redistribution and cells piling up in the radiosensitive G2 cell cycle check point.

# CONCEPT OF INVERSE DOSE RATE



Mitchell J.B. et al., Rad. Res. 79:552, 1979

# DOSE RATES

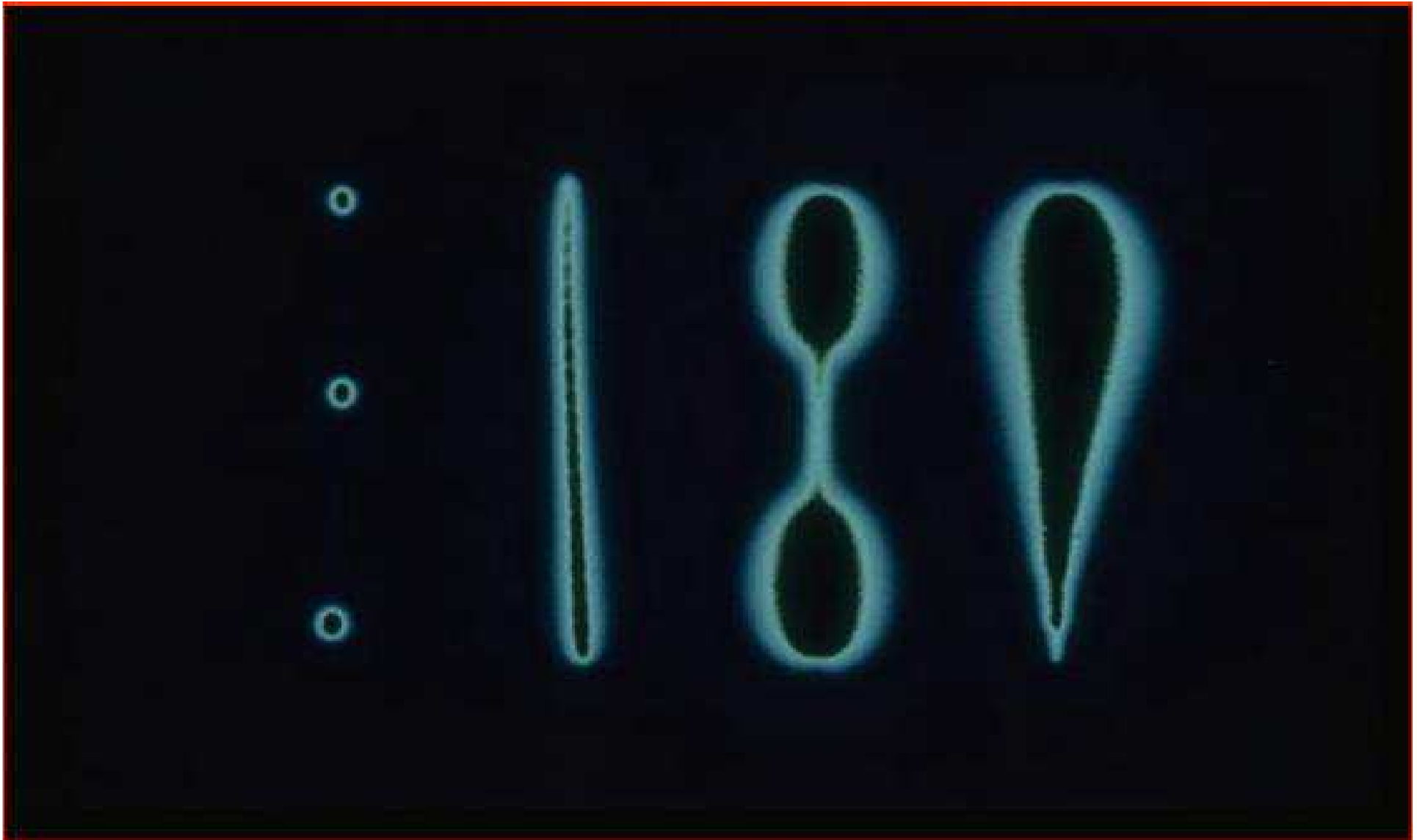
- LDR  $\rightarrow$  0.3 Gy – 0.6 Gy/hr ( high dose)
- PDR  $\rightarrow$  0.3 – 0.7Gy/hr, biological advantages of LDR but technological advantages of HDR
- HDR  $\rightarrow$   $> 2$  GY/min, decreased dose/ #, but increased number of #. (If 2X/day then 6hrs gap)

# DOSE OPTIMIZATION

Isodose volumes in tissue can be created by a combination of careful placement of the catheter and adjustment of the dwell times of the computerized stepping source. This process is usually called “dose optimization.”

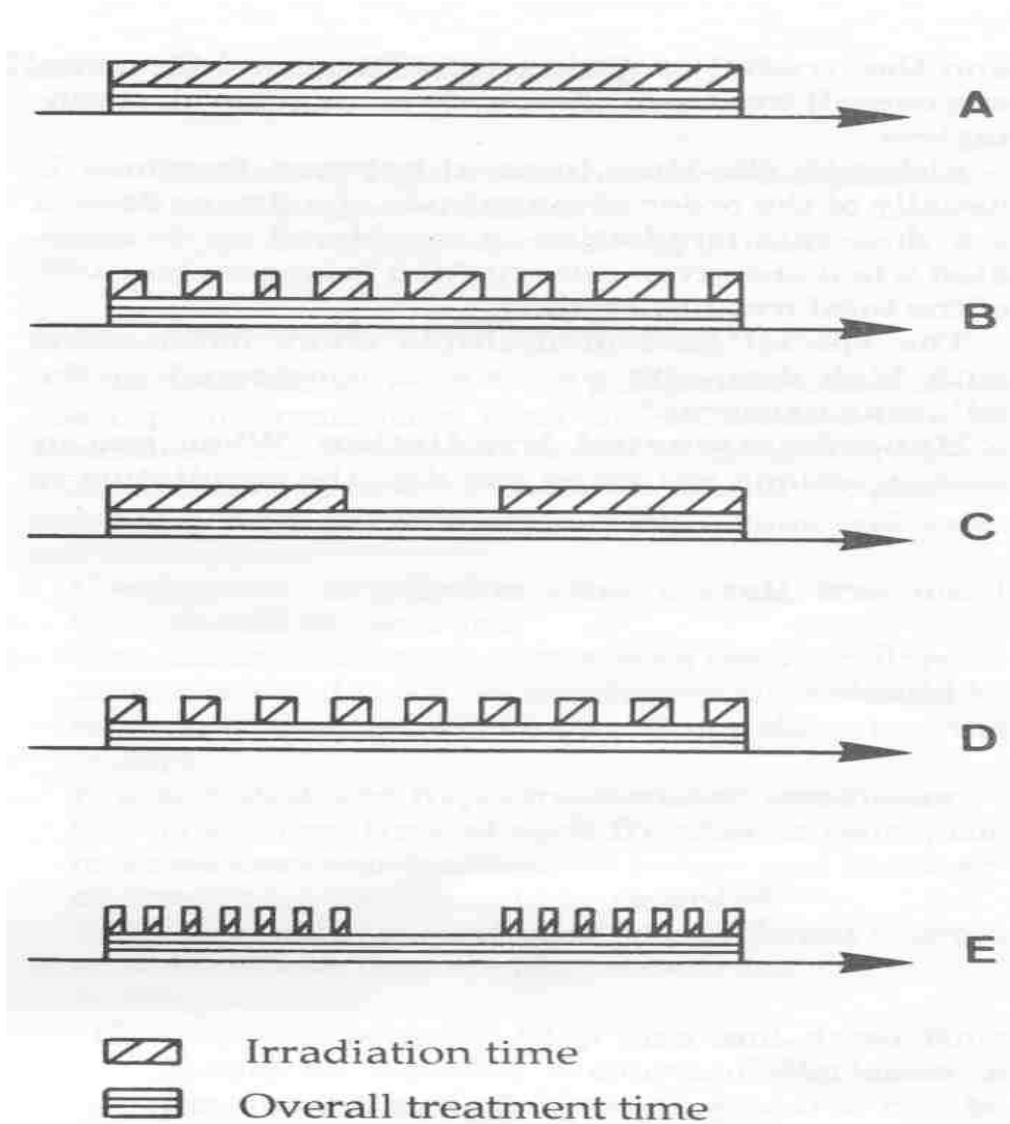
However, optimization should not be used as a substitute for poor-quality catheter implantation.

# OPTIMISATION





# PDR BRACHYTHERAPY



Different dose/time pattern possible  
Usually treatment about once per hour

Optimization possible

Emulates LDR

Nursing possible between the pulses

- To reproduce the biological effects of LDR-BT using PDR remote afterloading
- 1) the same total dose,
- 2) the same dose rate: typically about 0.5 Gy/hour,
- 3) pulse length of 10 minutes or more (or dose rate not exceeding 3 Gy/hour during the pulse),
- 4) each hour pulse repetition: typically 0.4-1.0 Gy/hour.
- If these conditions are met, the biological effects of PDR radiation therapy should be equivalent to those of LDR-BT for all tissues.

# Advantages/Disadvantages of HDR Vs LDR

*Advantages* : OPD procedure

- Optimization
- ? Better dosimetry
- No exposure to nursing staff
- No source preparation

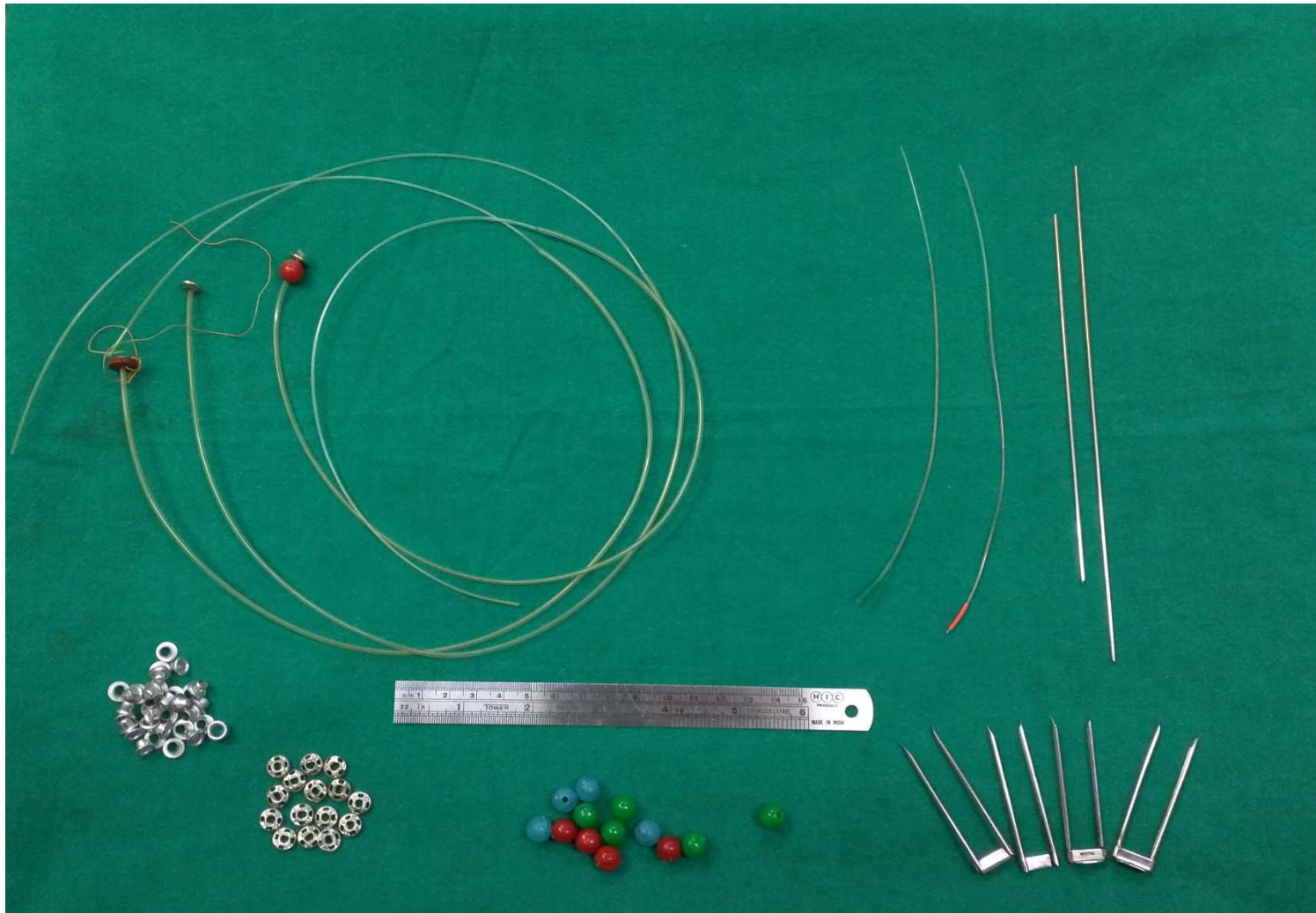
*Disadvantages*:

- LDR differentially spares late responding tissue compared to early responding tissue and tumors
- Fractionation
- More shielding
- No time to intervene if machine failure
- More sophisticated and expensive

# RADIONUCLITIDES

ISOTOPE	½ LIFE	ENERGY
CESIUM 131	9.7 Days	30.4 Kev
CESIUM 137	30.17 yrs	0.662 Mev
COBALT 60	5.26 yrs	1.17, 1.33 Mev
IRIDIUM 192	73.8 days	0.38 Mev
IODINE 125	59.6 days	27.4, 31.47 & 35.5 Kev
PALLIDIUM 103	17 days	21 Kev
RUTHENIUM 106	1.02 yrs	3.54 Mev
RADIUM 226	1599 yrs	1 Mev

# Brachytherapy equipment



# SITES SUITABLE FOR BRACHYTHERAPY IN THE HEAD AND NECK

- Ant 2/3 tongue
- Lip
- Buccal mucosa
- Floor of mouth
- Soft palate.
- Base of tongue as boost.
- Tonsil
- Nasopharynx

- Primary implant
- Combination with EBRT
- Post Operative setting

The aim being to preserve organ function & cosmesis or as a boost in larger tumors.

- Recurrences

# Patient selection & pre procedure work up

*Solitary lesions and relatively accessible lesions*

- Complete H&N examination including a pan endoscopy ( to rule out a 2<sup>nd</sup> primary)
- EUA
- CAT SCAN/MRI
- OPG
- Oral Hygiene
- Shielding with 2 mm lead to reduce < 50% dose to gums & mandible
- Suitability for Anesthesia



# Treatment strategy

- Original tumor volume must always be implanted ( need for radiopaque markers or tatoos)
- Concurrent chemotherapy with brachythrerapy not recommended
- OTT – 7/8 wks
- Interval between EBRT and implant  $\leq$  2wks

# Target definition

- GTV – Defined by clinical examination and imaging
- CTV – GTV with a safety margin, never less than 5 mm ( 5mm – 1cm)
- No PTV
- Treated volume – the minimal isodose line that encompasses the CTV
- Skin should not be included in the CTV and always calculate the skin dose.

# IMPLANT TECHNIQUE

- Should be done under GA
- Based on the classical systems of either Paris/Manchester– distribution rules, method of dose calculations and prescription system
- Catheters should be placed 1 – 1.5 cm equidistant
- Parallel placed catheters with increased dwell times more at the top acceptable if loops cannot be made

# ICRU 58/62

- Homogeneity Index (HI):  $MCD \times 100 / MTD$
- High dose vol (  $V_{150}$  ) & low dose vol (  $V_{90}$  )
- Coverage Index (CI) :  $TV_{ref} \times 100 / PTV$
- Conformity Index (ICRU 62) :  $PTV \times 100 / TV$
- DNR :  $V_{150} / V_{ref}$
- CDVH.
- ODR.
- Conformity number (CN).

# TREATMENT MOINITIRING

- Catheter displacement or sources
- Antibiotics
- Analgesics
- Mouth washes
- NG tube
- At time of catheter removal to watch for arterial bleeding – bimanual compression
- Reactions start ~ 1wk after implant and peaks by 3<sup>rd</sup> wk and disappears by 6wk

# POST TREATMENT AND FU

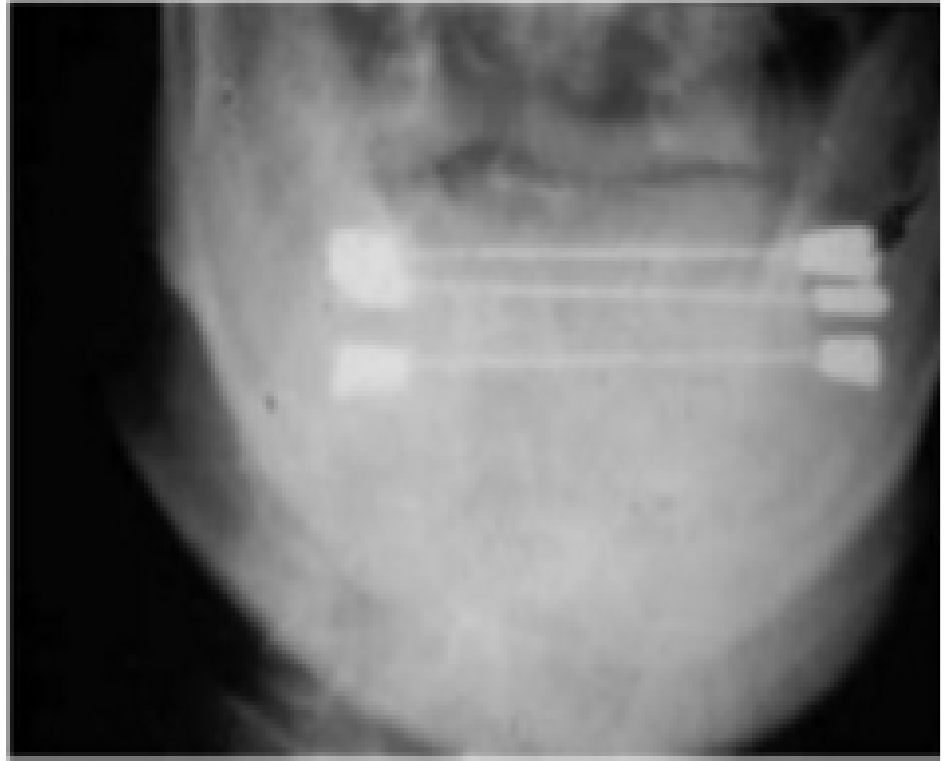
- at 4wk, 3mts for 3 yrs & 6mts till 5 yrs and yearly
- Soft tissue necrosis & osteoradionecrosis → antibiotics, analgesics, steroids & hyperbaric oxygen
- Bx avoided unless progression
- EUA → wide excision if medical treatment fails

# LIP CANCER

- < 5 cm brachytherapy alone, larger lesions combination of EBRT with Brachytherapy.

[Mandibular involvement – surgery]

- Rigid needles with a template recommended in treating lower lip and a plastic tube for upper lip and commissure
- A protector device is mandatory for the mandible and the upper lip.
- Unless superficial & very small(wedge resection ), brachy. better cosmesis and functional result
- A (LDR/PDR) dose of 60–65 Gy for T1, 65–70 Gy for T2, and 70– 75 Gy or even higher doses for T3 lesions





# MANDIBULAR SHIELD





# BUCCAL MUCOSA

- Brachytherapy alone if < 4 cm and <1.5cm thick.  
{contraindicated in RMT/GB sulcus involvement}
- Single plane or a double plane plastic tube implant.
- A total dose of 65–70 Gy (LDR/PDR) delivered exclusively by brachytherapy yields the best results. If brachytherapy is given as a boost after 45–50 Gy of external beam irradiation, the dose is 25–30 Gy (LDR/PDR).

# Ant 2/3 tongue cancer

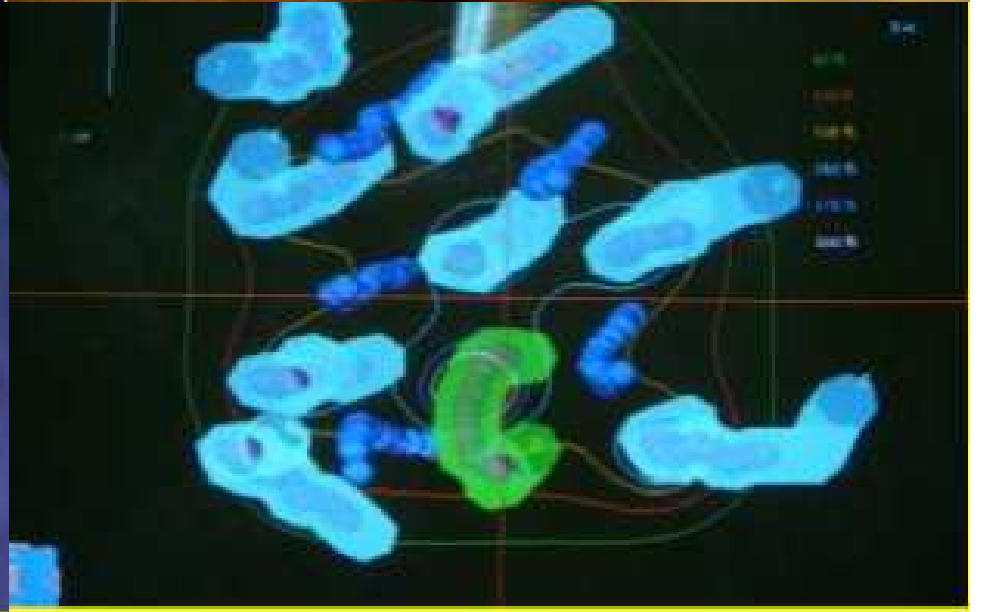
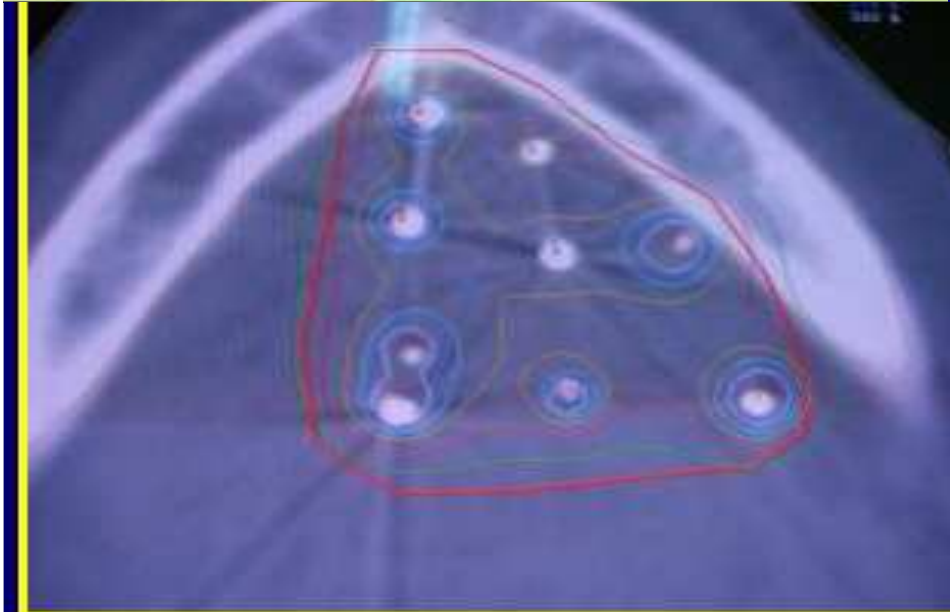
- T1, T2 N0 → Brachy.Rx alone recommended
- T3 N1 → may be used as a boost after EBRT, however surgery preferred. Post Op. brachytherapy if margins are close or positive.
- Guide gutter technique may be used in very small lesions or in elderly under Local anesthesia. Most common plastic tube technique with or without loops

## Ant 2/3 tongue

- Recommended dose (LDR-PDR) is 65–75 Gy for the treatment with definitive brachytherapy and 25–30 Gy after 40–45 Gy of external beam radiotherapy.
- postoperatively, these doses are reduced to 50–60 Gy and 10–24 Gy, respectively
- For salvage implants in a previously irradiated territory, a dose of 60 Gy is adequate.
- The recommended dose rate/pulse dose is .03–.07 Gy/h/24 h

EUA





# FLOOR OF MOUTH

- Proximity to mandible makes patient selection important.
- $< 4$  cm lesions  $> 5$  mm from mandible suitable for Brachytherapy {  $> 4$  cm,  $< 5$  mm from mandible  $\rightarrow$  surgery }
- Post operative setting brachytherapy may be delivered if -- c/m +ev, LVSI + or DOI  $> 5$  mm provided N0
- Plastic tube or guide gutter technique may be used.
- Not more than 2 wires in close to mandible



- The recommended dose (LDR-PDR) is 65 Gy in case of definitive brachytherapy and 15–25 Gy after 46–50 Gy of external beam radiotherapy
- postoperatively, these doses are reduced to 50–65 Gy and 10–25 Gy, respectively.
- For salvage implants dose of 60–65 Gy is adequate

# OROPHARYNX

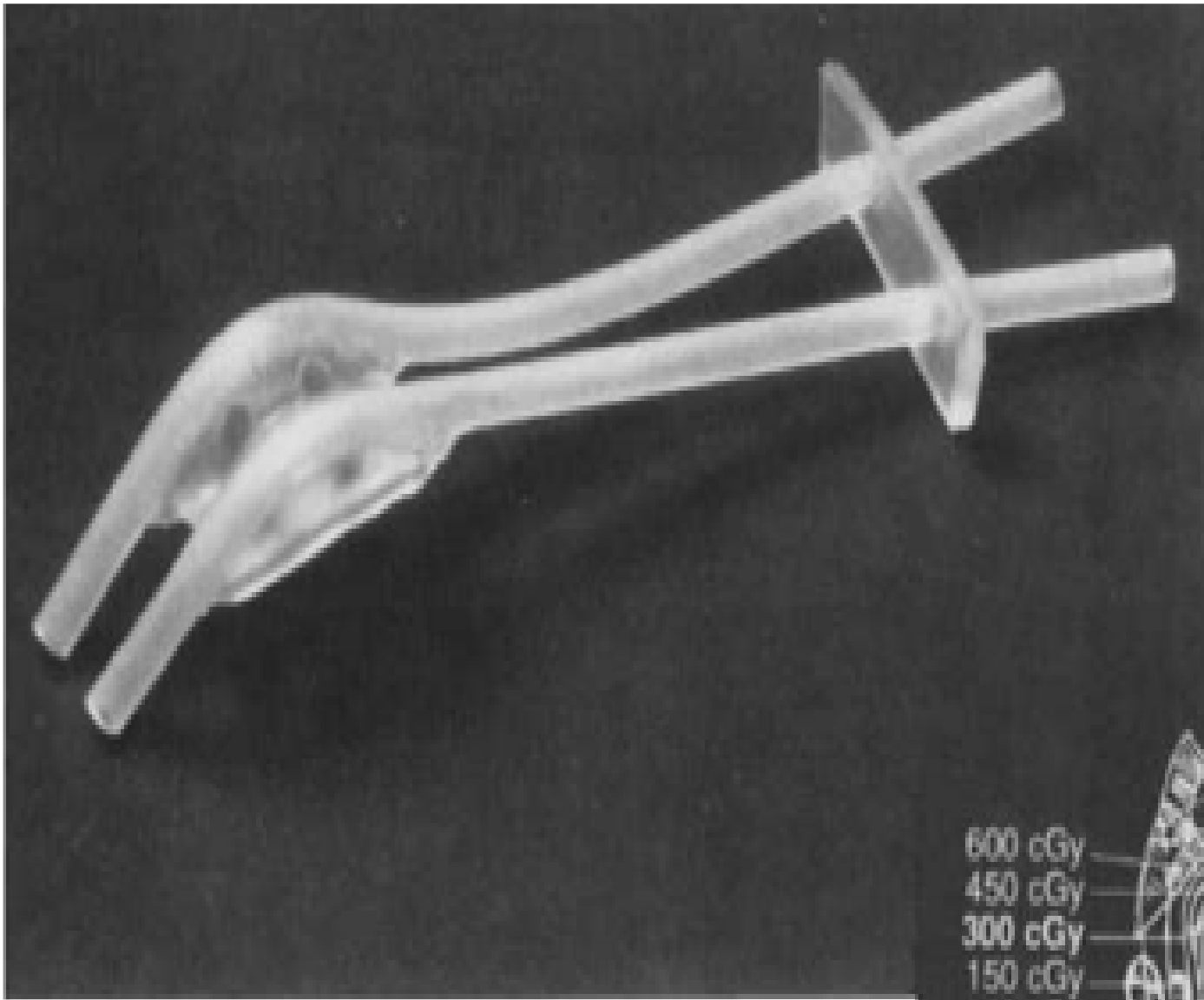
- $\leq 5$  cm lesions in BOT, Soft palate, tonsil or vallecula may be implanted
- Primary implant in lesions  $< 1$ cm or exophytic lesions
- Used in conjunction with EBRT after 40-50 Gy to primary and the nodes
- Recurrent lesions or new lesions in previously irradiated regions
- Plastic tube technique with a nasal intubation or a temporary tracheostomy

# OROPHARYNX

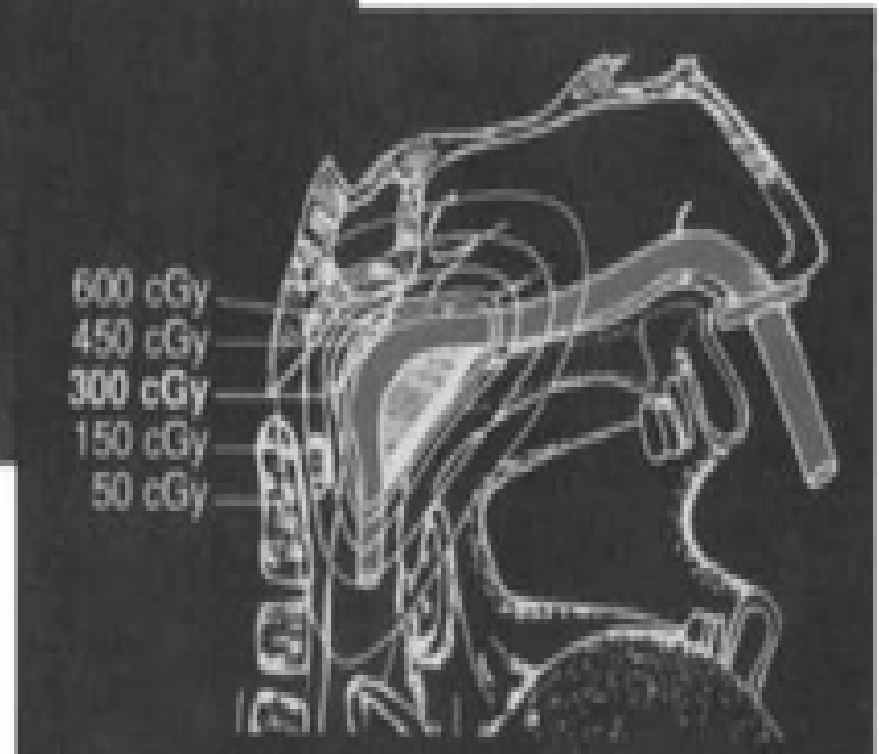
- Large safety margins and complete organ may have to be encompassed with BOT of tongue lesions. ( poor tumor delineation)
- combined 45–50 Gy of external beam irradiation, an additional dose of 25–30 Gy of (LDR-PDR) brachytherapy, tonsil lesions
- 30–35 Gy for BOT as boost.
- With HDR # size not higher than 4.5 Gy/# {3-4 Gy}
- BT - Important role in a post RT salvage setting ( 5yr LC 57%-69%)

# NASOPHARYNX

- Surrounded by bone, nerves and vessels
- Only endocavitary brachytherapy possible
- Restricted to boost minimal residual disease post EBRT/CCRT or well circumscribed recurrent lesions
- Contraindicated with involvement of bone, nasal cavity or oropharyngeal extension
- Doses of 18Gy/3# [EBRT 60 Gy/30#]—T1
- 12Gy/4#[EBRT 70Gy/35#]—T2-T4 lesions
- Recurrent disease – 60 Gy/ 6 days ~ 50% LC

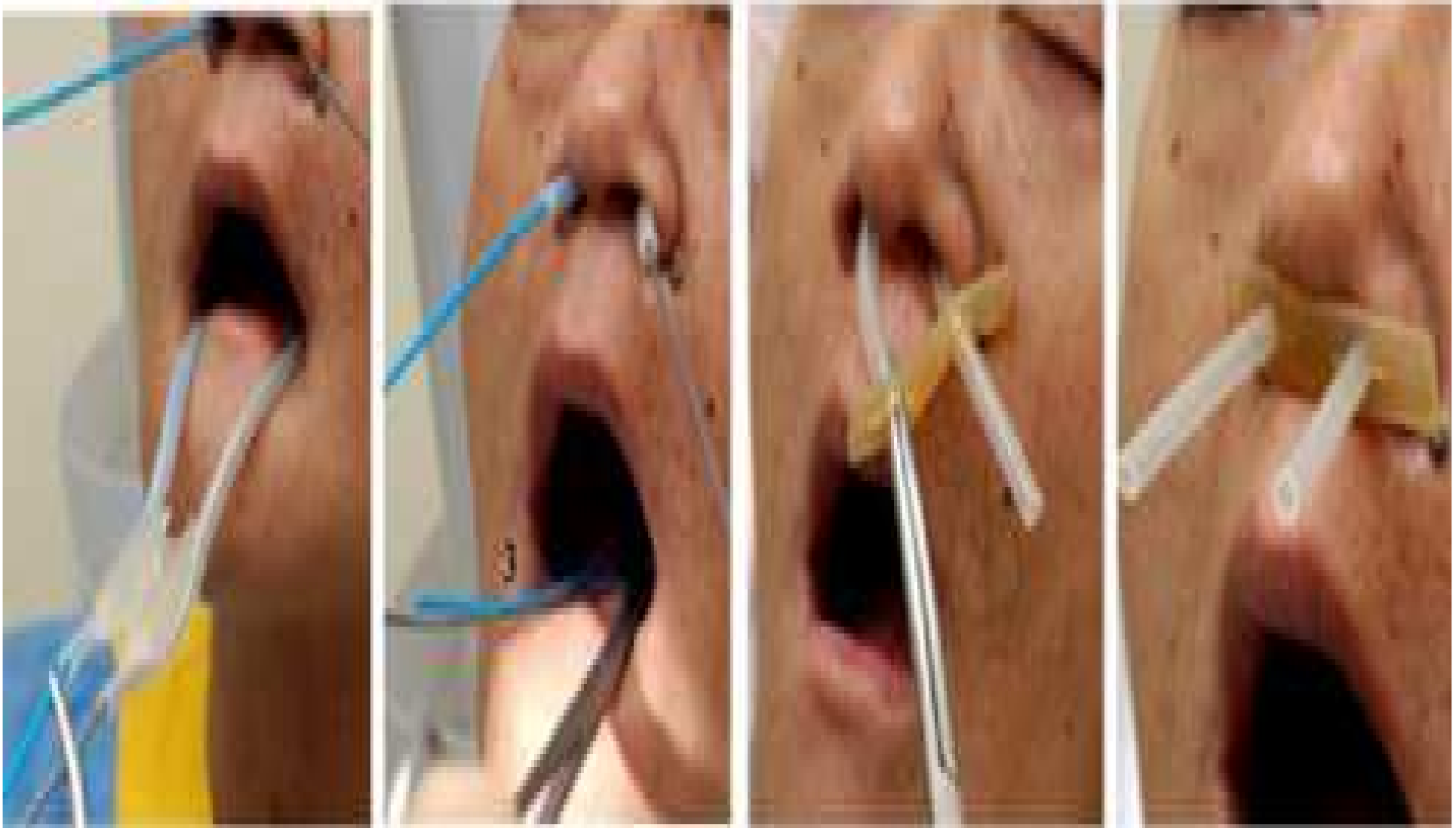


Silicone RNA  
applicators  
With isodose  
lines  
With HDR



J.Clinical oncology, 16,2213-2220, 1998

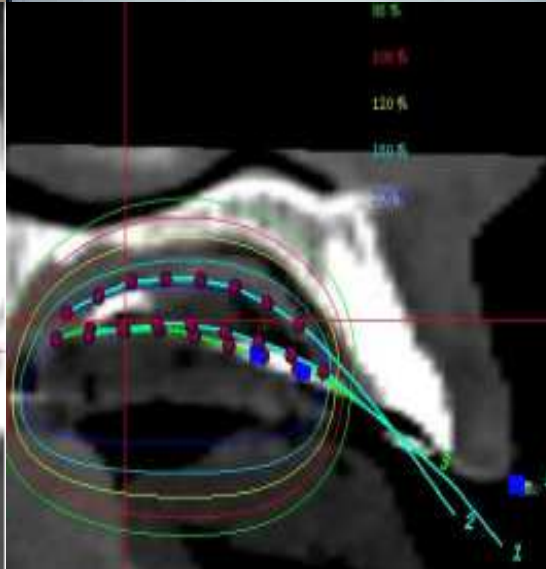
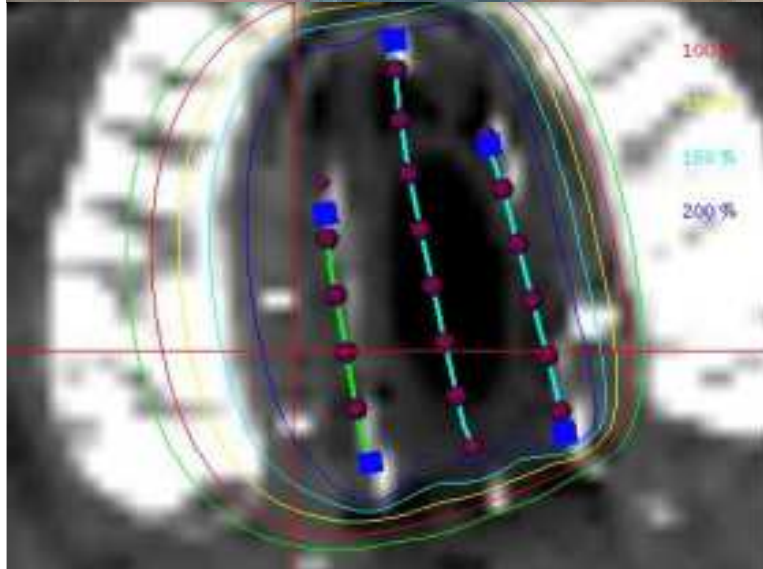
# APPLICATOR TECHNIQUE



# Nasopharynx Brachytherapy Dose distribution 6 x 3 Gy (optimization)



# HARD PALATE SURFACE MOULD





SITE	PT SELECTION	TECNIQUE	MARGIN	DOSE	RESULTS
LIP	T1-3	RN	5-10mm	65-70 Gy LDR-PDR	LC 90-95% N: 2-10%
BUCCAL MUCOSA	<4cm	PT	5-10mm	65-70Gy 25-30 + 45/50	LC 80-90% N: <10%
ANT.2/3 TONGUE	T1-3	PT	5mm	65-70 Gy 25-30 + 45/50	LC > 90% N:10-20%
FOM	T1-2N0	RN / PT	> 5mm	65 Gy 10-25 + 45/50	LC>90% N:10-30%
OROPHARYNX	<5 cm	PT	>10mm	25-30+ 45/50 21-30 /3-4 # + 45/50 Gy	BOT: T1-2-(80-90%) T3/4-(65-80%) LC N:25%  TONSIL:T1/2-(90%),T3-67% N:20%