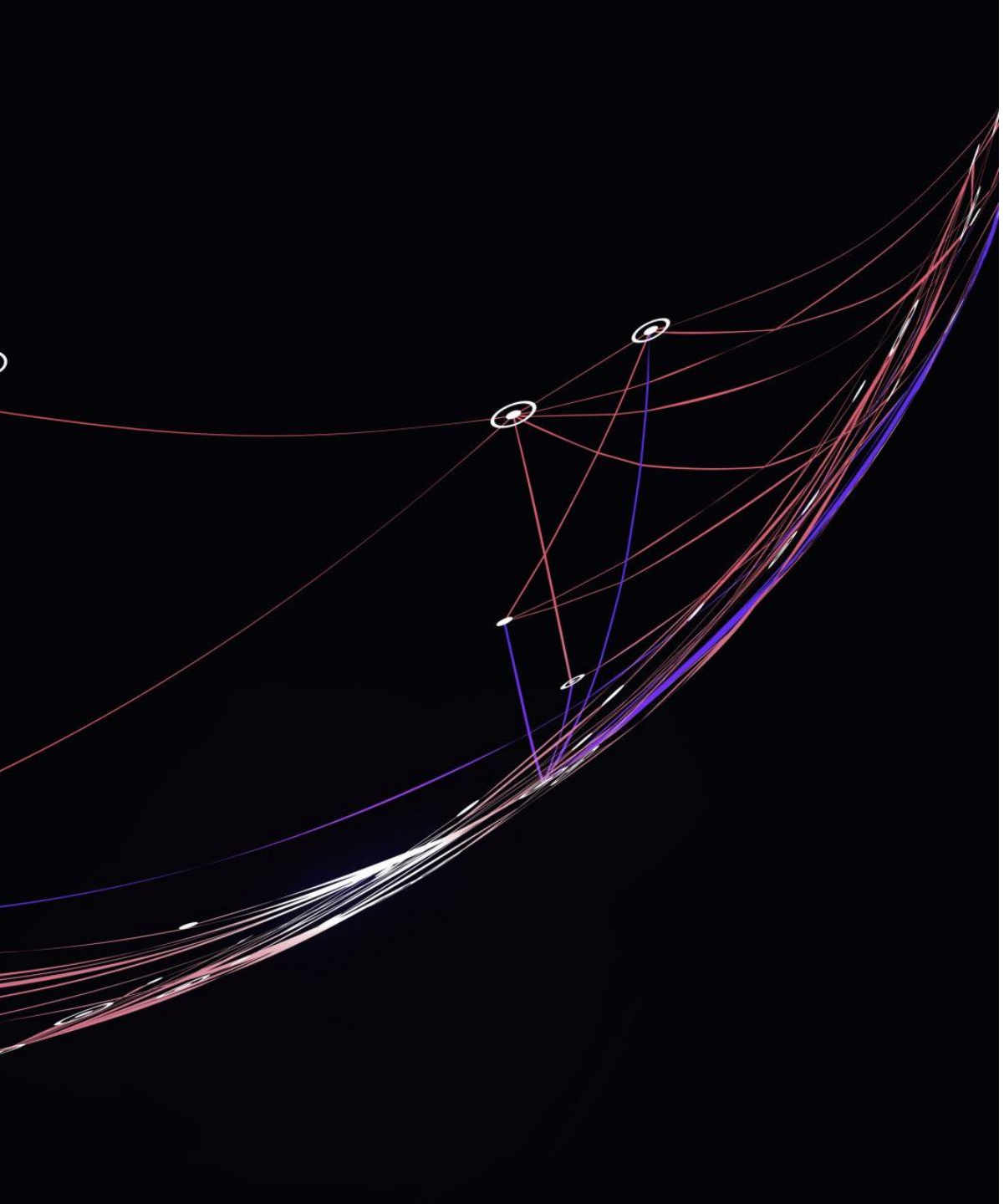


BRACHYTHERAPY APPLICATIONS

RT4220 – Lecture #17

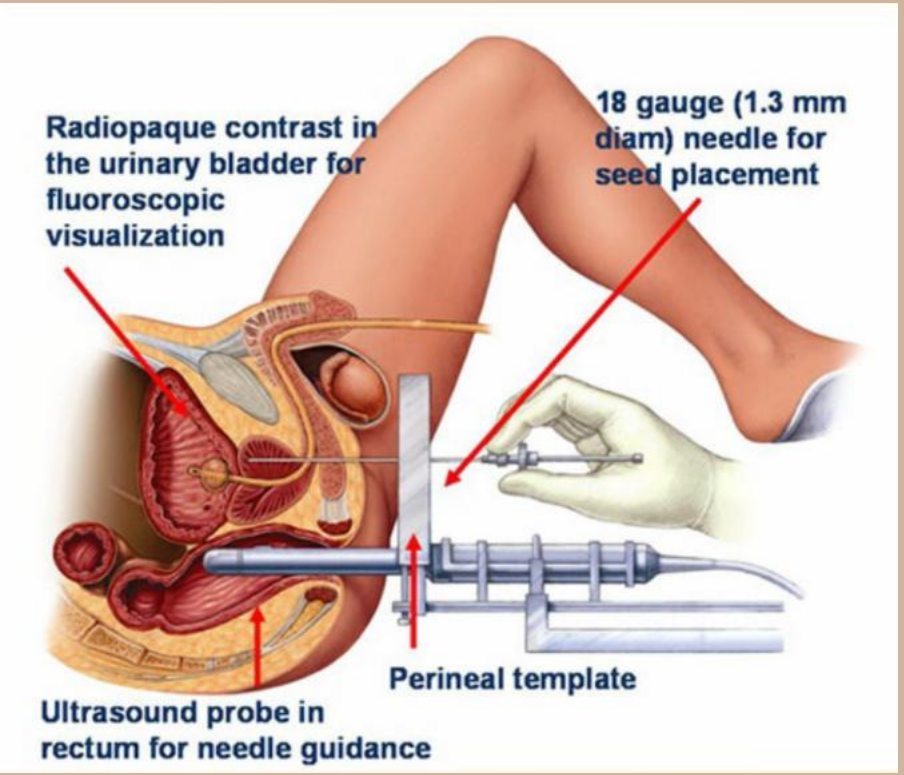
Kedree Proffitt

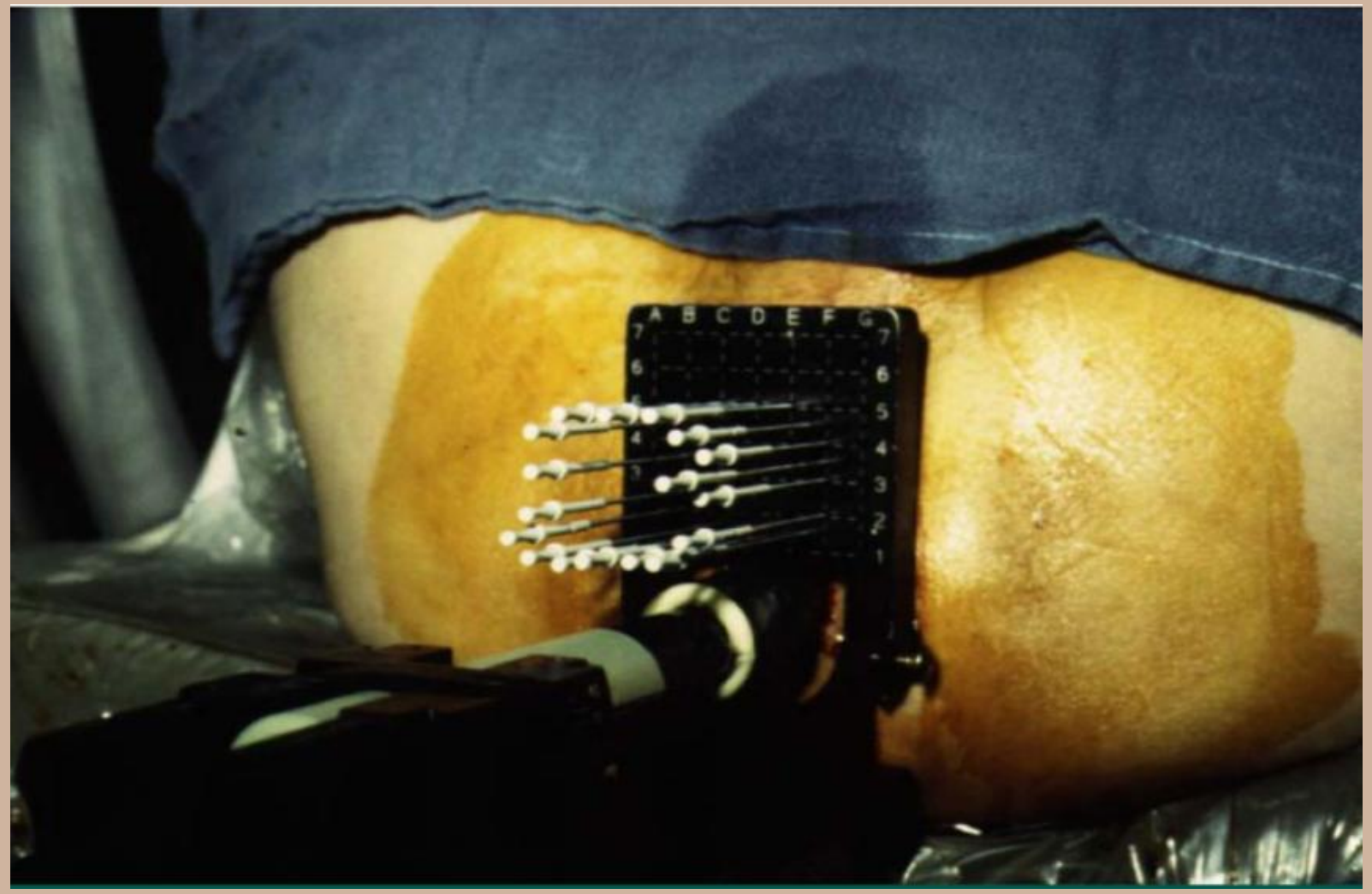
WSU

11/20/2025

PROSTATE

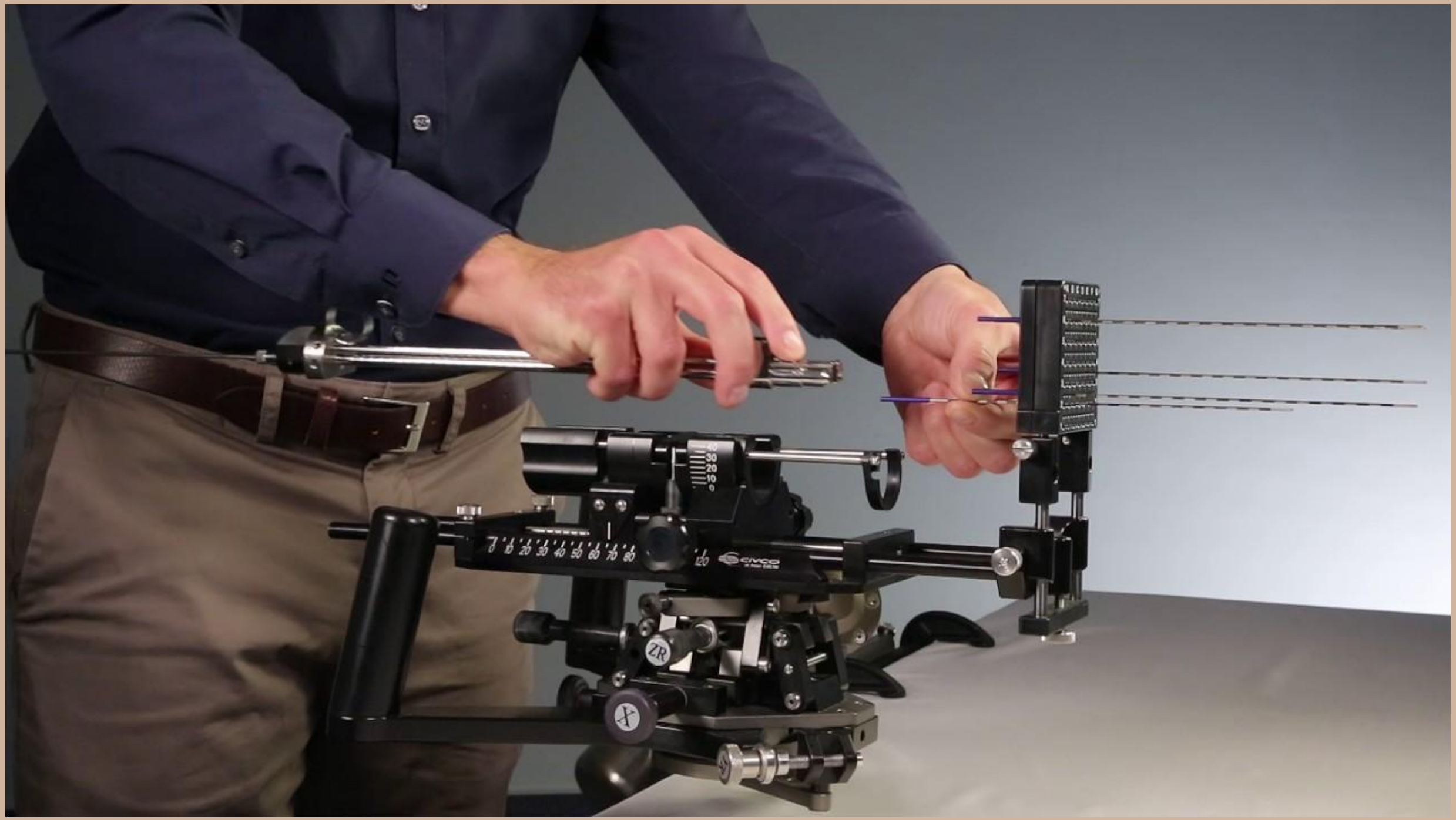
pro state?


Radiopaque contrast in the urinary bladder for fluoroscopic visualization
18 gauge (1.3 mm diam) needle for seed placement
Perineal template
Ultrasound probe in rectum for needle guidance

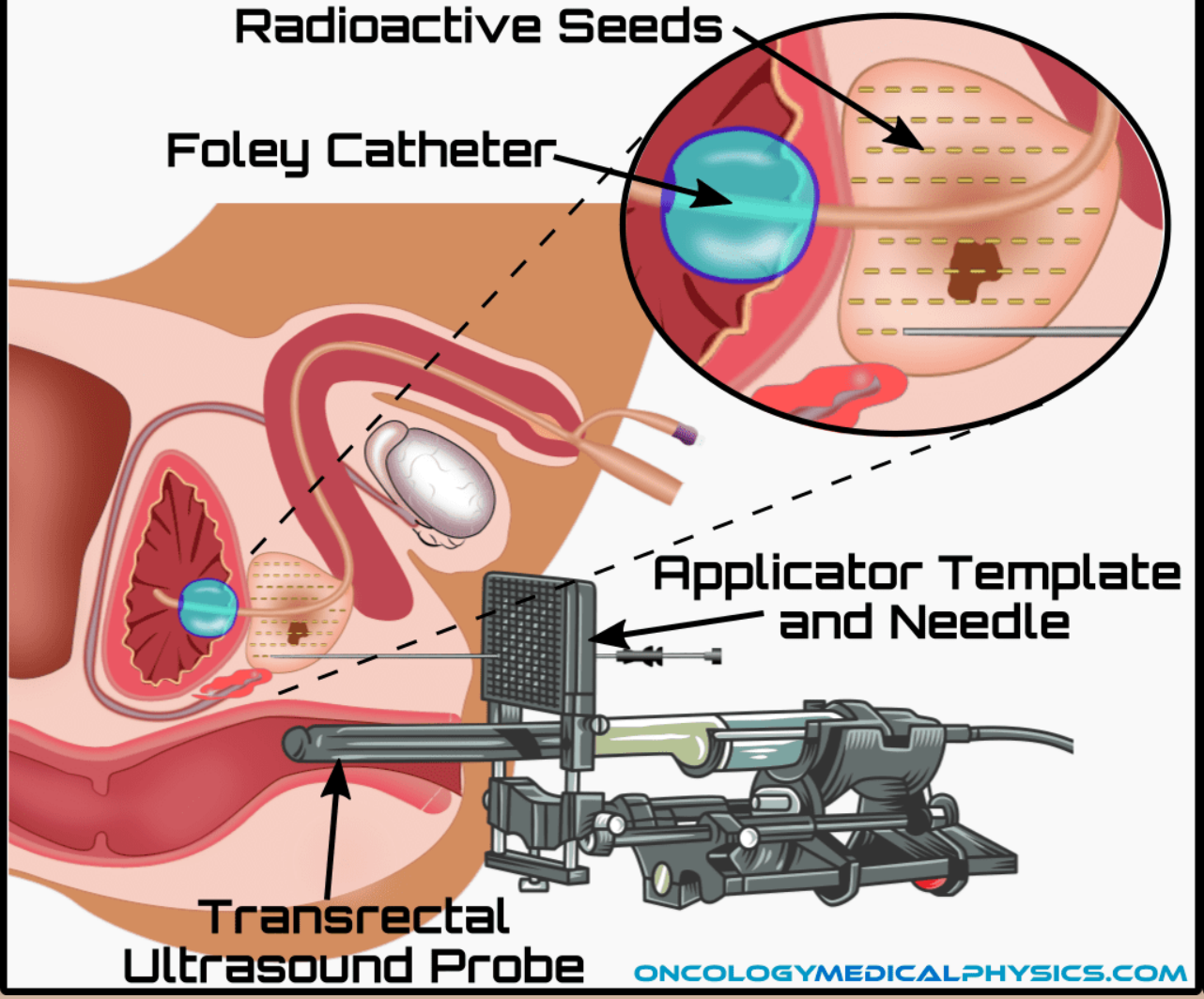

A B C D E F G

Treatment Process

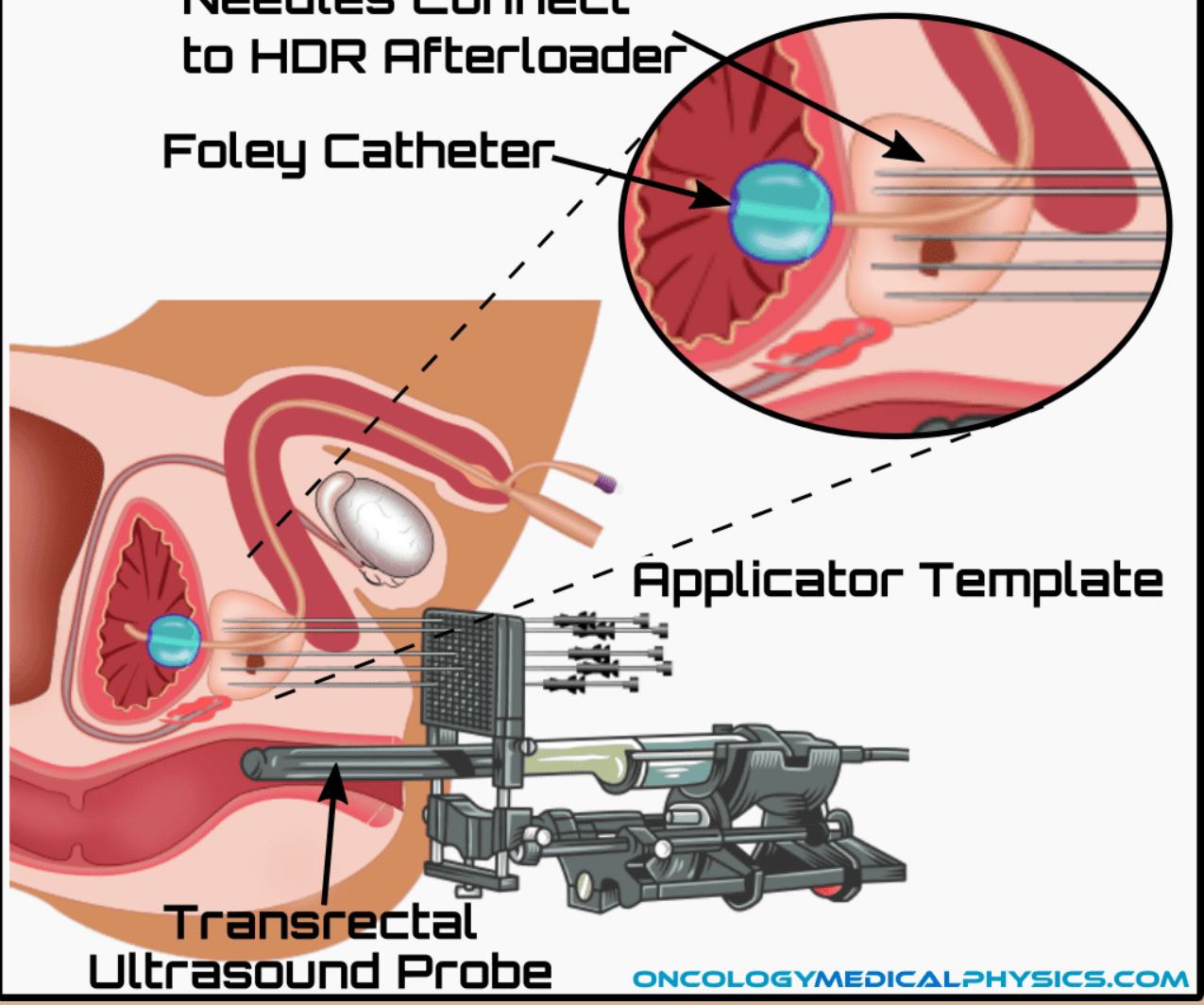
1. A volume study is conducted prior to treatment to assess the number of seeds required.
    - Volume commonly assessed via CT or transverse ultrasound imaging.
2. A treatment plan is generated either by computer or standard template.
    - Seed spacing ~1cm
    - 80-120 seeds are commonly used!
    - Sources
        - I-125 with an activity of around 0.3mCi
        - Pd-103 with an activity of around 1.7mCi
3. Implantation is performed under anesthesia and guided with a transrectal ultrasound probe.
    - A *Mick Applicator* is commonly used to place correctly spaced seeds.
        - Applicator uses a seed magazine and spacing indexer to simplify placing process.
    - 21cm long 18 gauge needles are used to place the seeds.
    - A template may be used to assist in uniform needle placement.
4. A cystroscopy is performed at the end of the procedure removing any seeds that may be been placed in the bladder of the urethra.

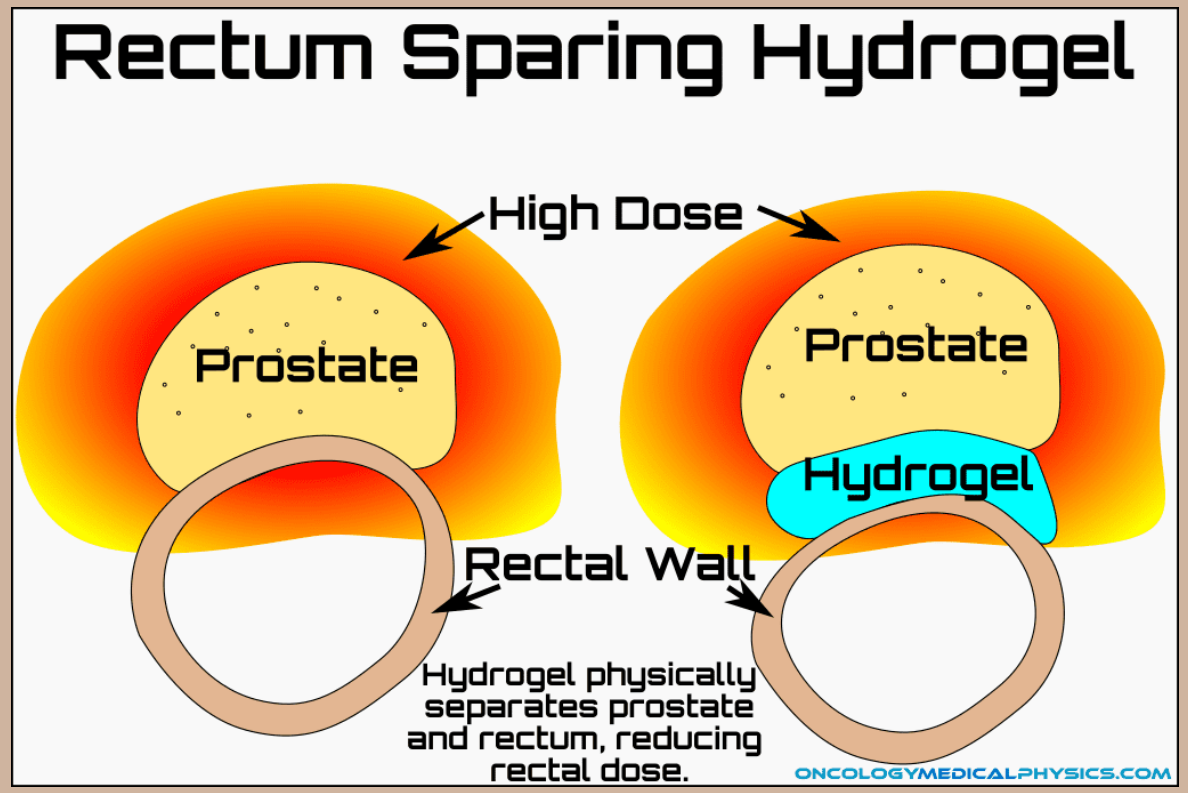

CMCO

Prostate
Low Dose Rate Brachytherapy



Prostate
High Dose Rate Brachytherapy




Rectum Sparing Hydrogel
High Dose
Prostate
Prostate
Hydrogel
Rectal Wall
Hydrogel physically separates prostate and rectum, reducing rectal dose.
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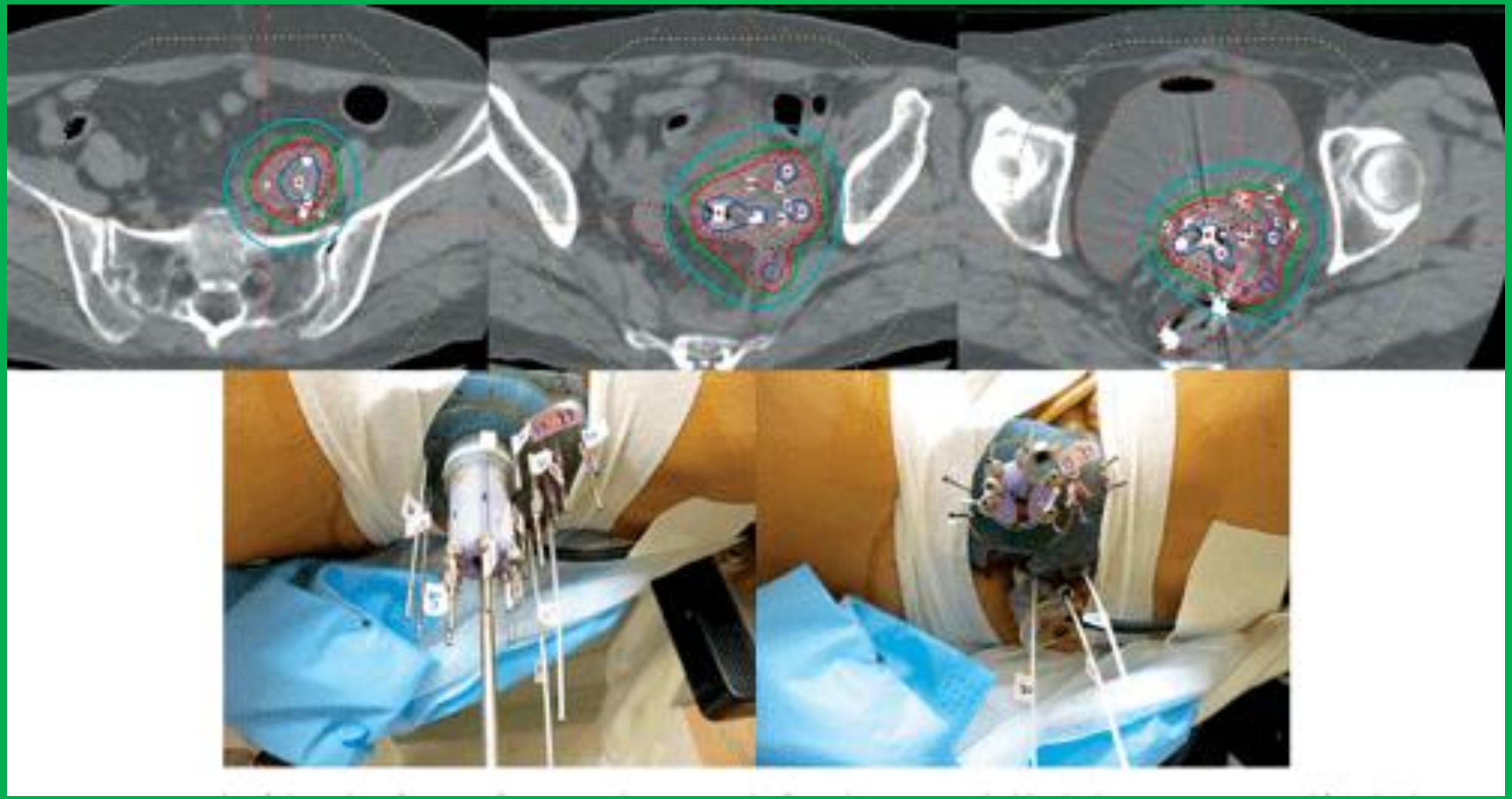
GYN

Gyno Eco-Logical



Typical GYN Procedures

- Cervix
  - Pre-operative or neo-adjuvant
    - Manchester system, **tandem and ovoids, ring and tandem**, tandem and cylinder
- Endometrium (corpus uterus)
  - Inoperable (also neo-adjuvant)
    - Heyman packing, Martinez applicator
  - Post-operative adjuvant
    - **Vaginal cylinder**, Wang applicator, dome applicator, vaginal ovoids

Treatment Regimen

Low Dose Rate: The Manchester System

LDR alone (Stages IA1-IB1): 50-70Gy prescribed to point A
LDR as boost for external beam (Stage IB1 – IV): 30-40Gy to point A for a total including external beam of 85-90Gy

High Dose Rate Prescriptions

Cervical Cancer

Early stage:

20-45Gy external beam therapy followed by 30-45Gy in 5 to 8 fractions of brachytherapy.

Late stage:

45-50.4Gy external beam therapy followed by 28-35Gy in 4 to 6 fractions of brachytherapy.

Uterine Cancer (Post Operative)

Brachytherapy Alone:

3 to 5 fractions of 7 to 4.7Gy prescribed to a depth of 5mm or 3 to 5 fractions of 10.5 to 7.5Gy prescribed to vaginal surface.

Brachytherapy following external beam:

2 fractions of 5.5Gy prescribed to a depth of 5mm or 2 fractions of 8Gy prescribed to vaginal surface.

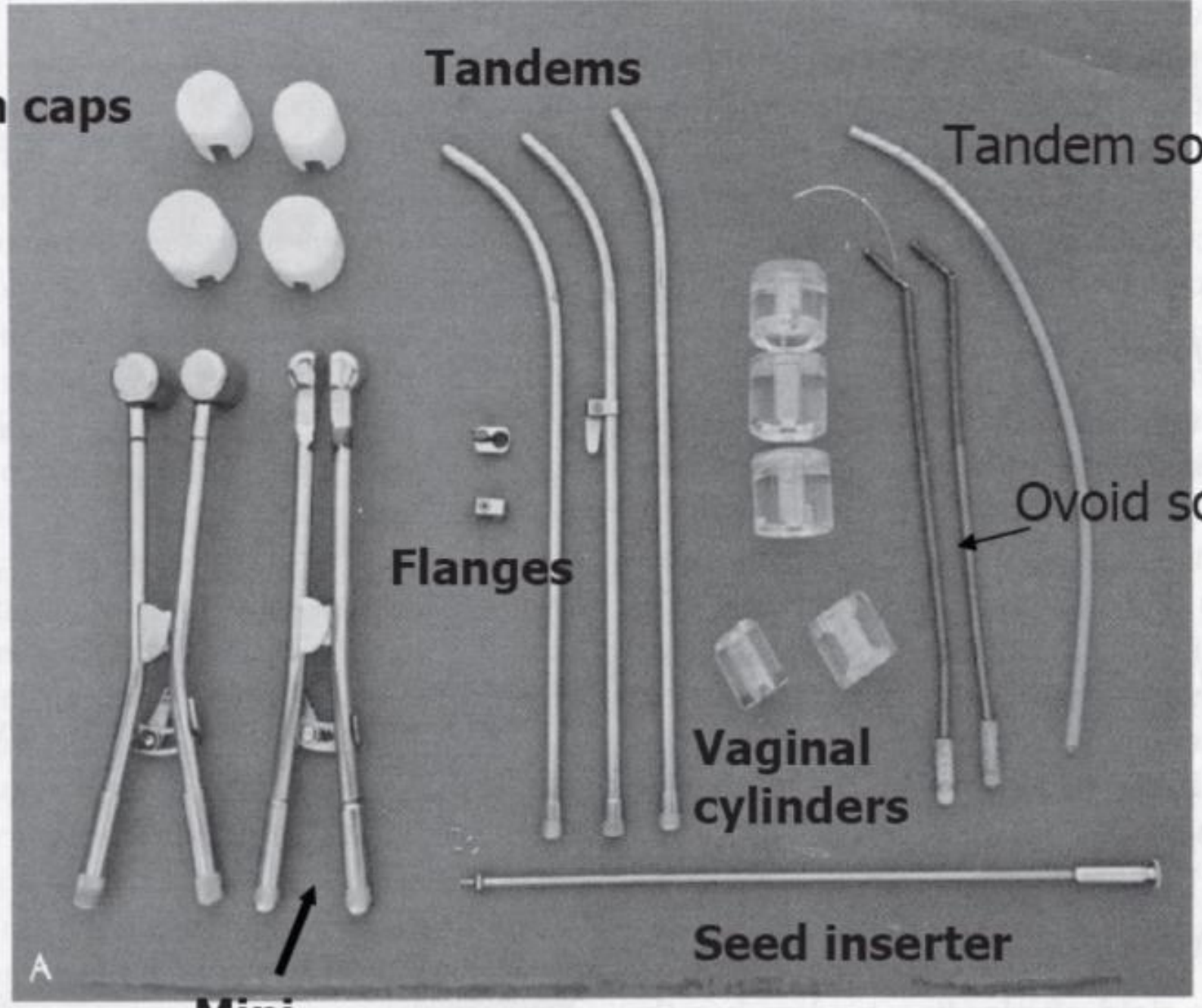
Uterine Cancer (Inoperable)

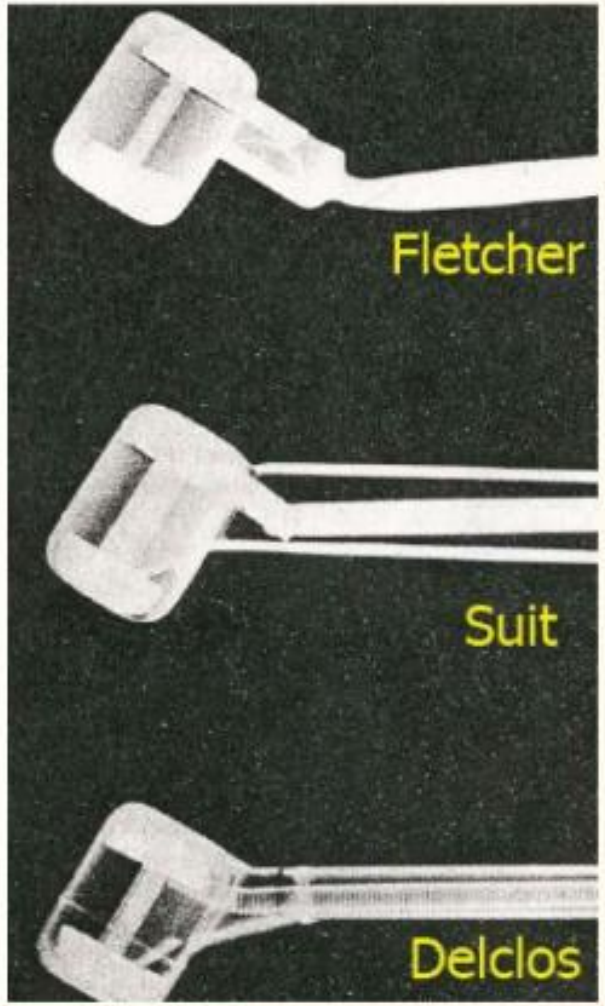
Brachytherapy Alone:

4 to 7 fractions of 8.5 to 5.7Gy prescribed to a depth of 2cm.

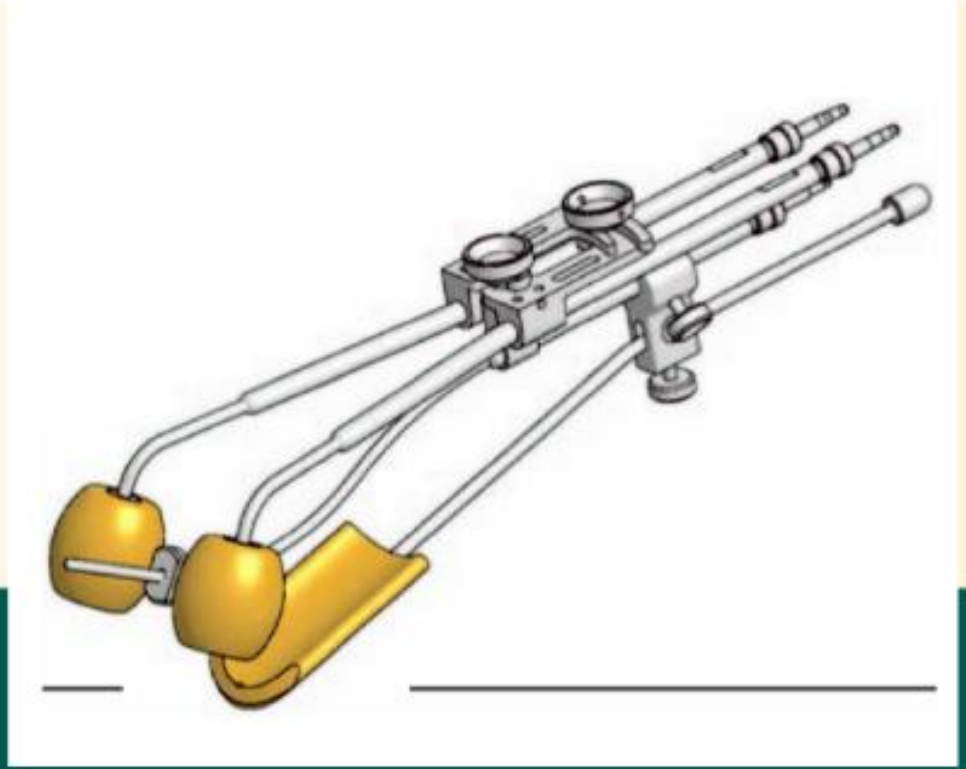
Brachytherapy following external beam:

45Gy external beam followed by 2 to 4 fractions of 8.5 to 5.2Gy brachytherapy prescribed to a depth of 2cm.


Medium caps
Tandems
Tandem source carrier
Large caps
Small ovoids
Ovoid source carriers
Flanges
Vaginal cylinders
Seed inserter
A
Mini ovoids

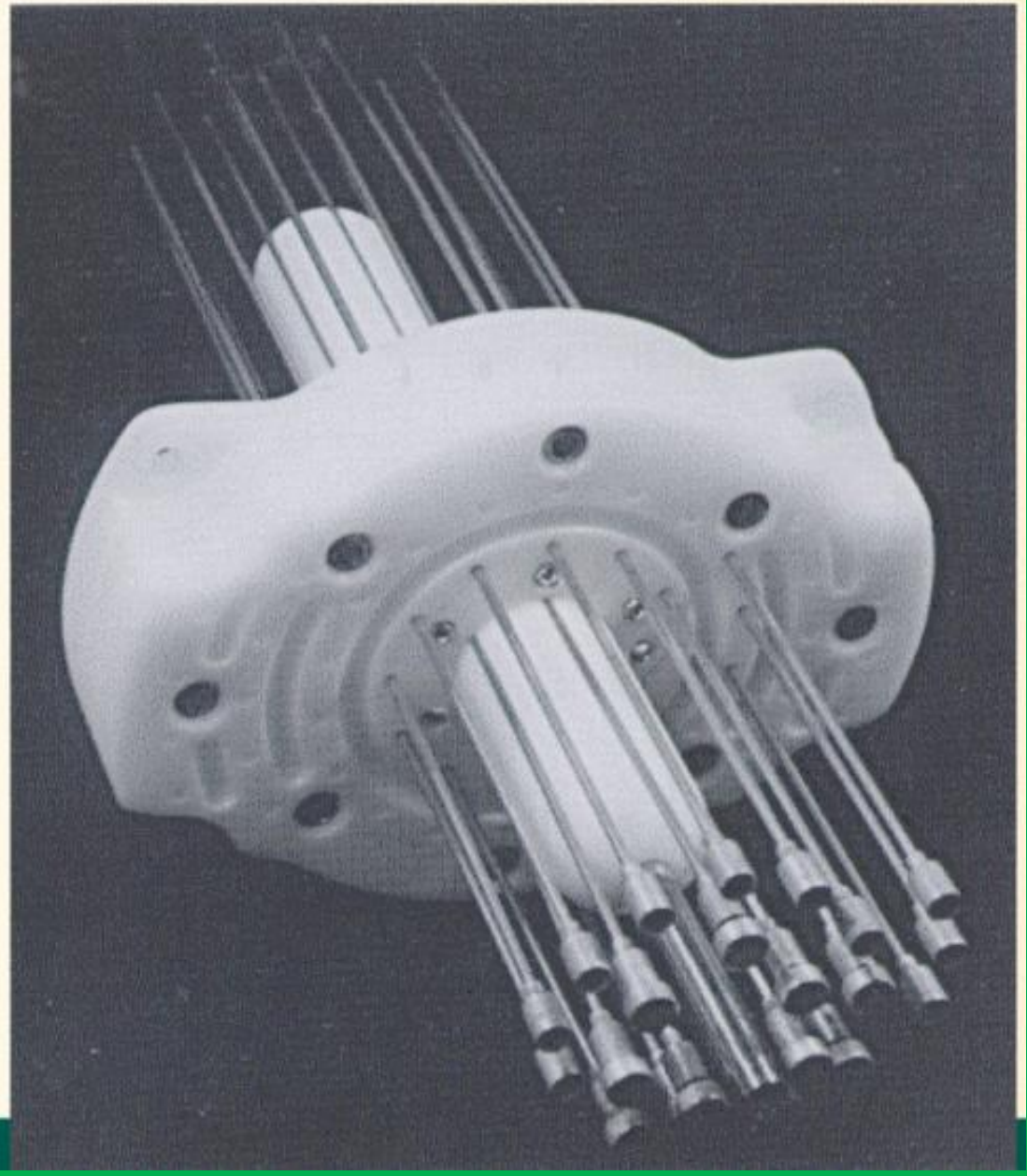

Fletcher
Suit
Delclos

Henchke



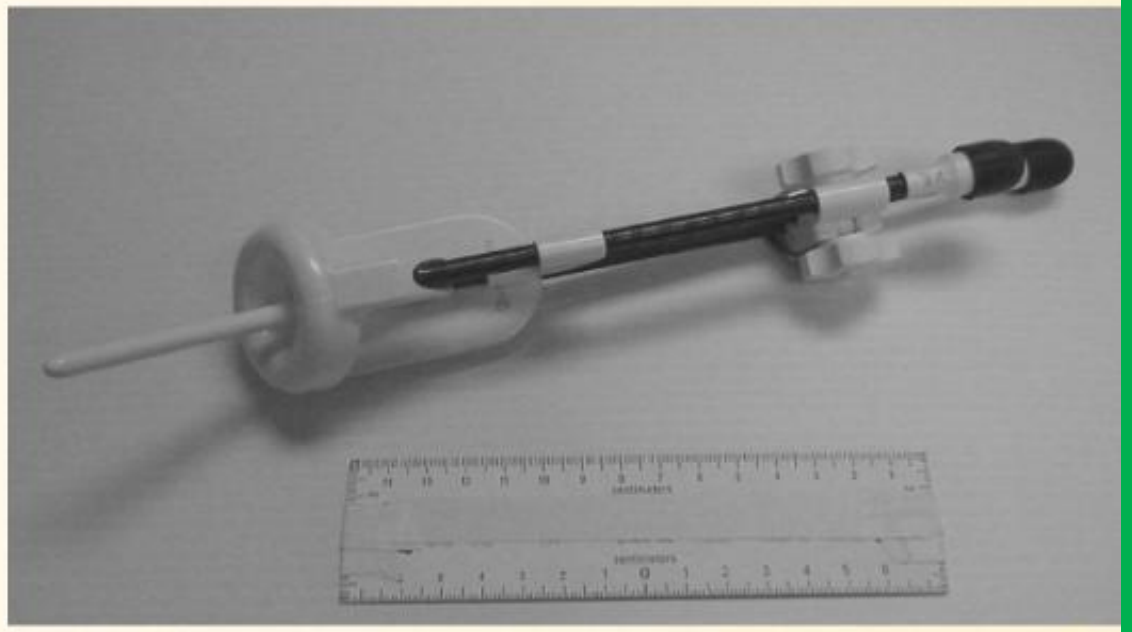
Syed Applicator

- Used when more extensive disease requires greater interstitial dose



3D Volumetric HDR

- CT and MRI compatible applicators
- Plastic or carbon fiber applicators
- Ring and Tandem
- Vaginal cylinders
- Needles

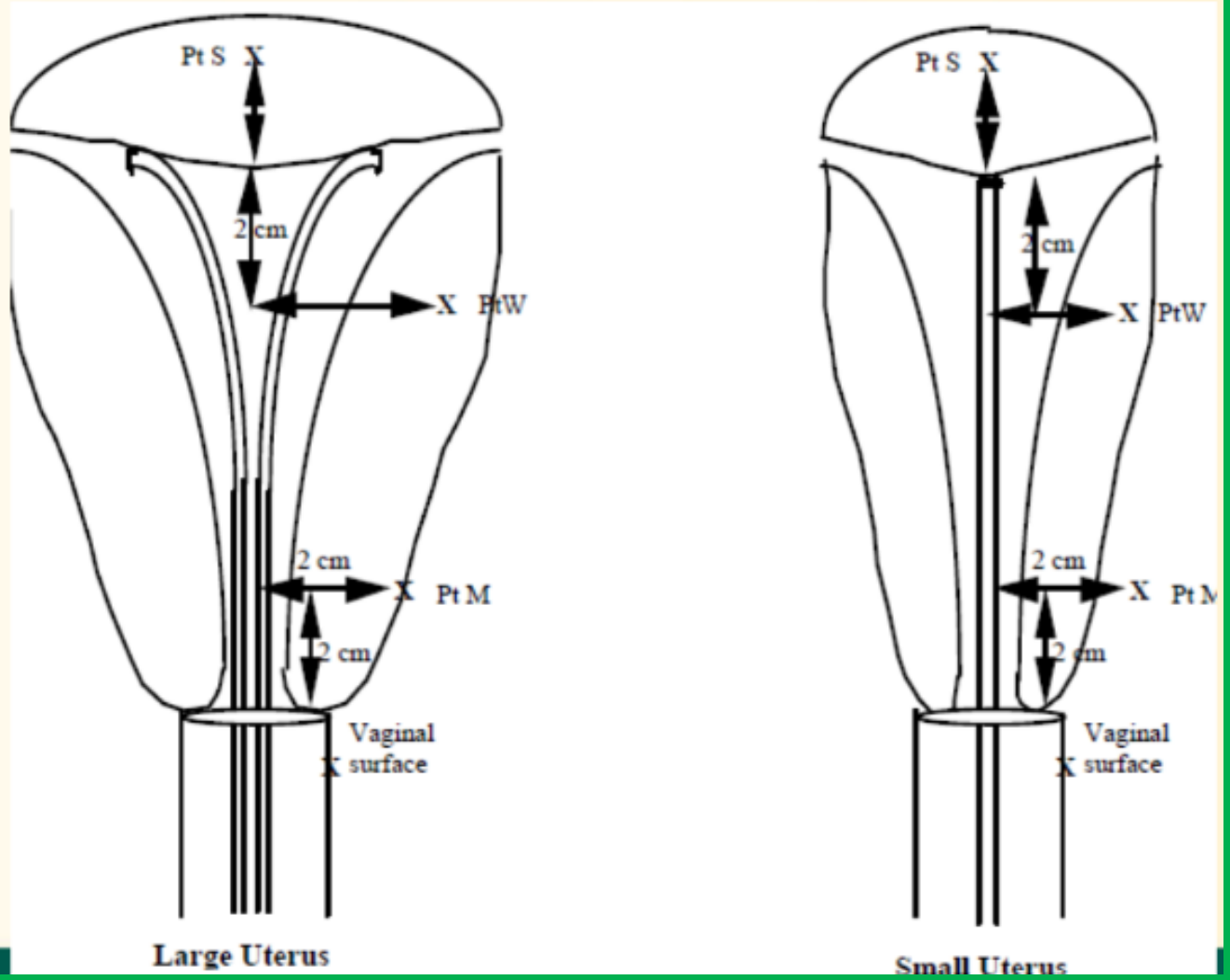


Heyman Packing

- Many capsules are packed into uterus to try to give uniform dose to wall

Madison Endometrial Treatment

- Point S - In the fundus
- Points W - In the superior myometrium
- Points M - At the Paracervical triangle
- Vaginal surface – at the lateral aspect of the ovoids

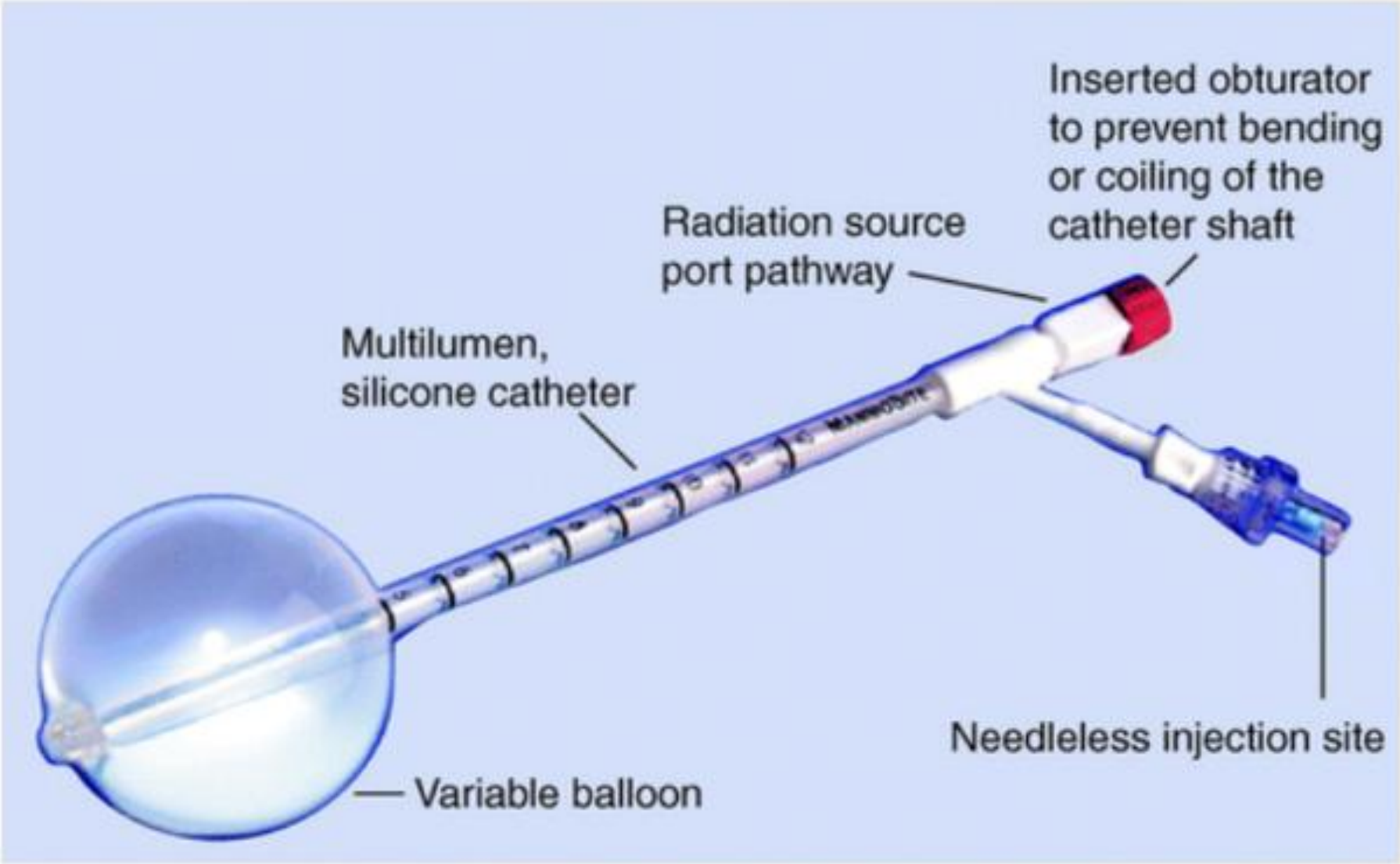


BREAST

BREASTS

Interstitial Brachytherapy

Mammosite


Inserted obturator to prevent bending or coiling of the catheter shaft
Radiation source port pathway
Multilumen, silicone catheter
Needleless injection site
Variable balloon

Interstitial

- LDR
  - Ir-192 or I-125, 45 to 50 Gy in 4 to 5 days
- HDR
  - 3.4 Gy X 10 or 4 Gy X 8
- Catheters can be inserted prone or supine

Supine/Ultrasound Technique	Prone/Digital Mammogram Technique
Placement of catheter is radiation oncologist dependent	Template-guided makes it radiation oncologist independent
Less number of catheters	More number of catheters
Irradiation time same since planning target volume (PTV) is the same	Irradiation time is the same
Since less catheters, simulation/planning time is less	More catheters, hence more simulation/planning time
Total treatment time is less since less catheters and hence less time in check cable runs	More treatment time with more catheters and more check cable runs

Breast Brachytherapy

- Interstitial
  - Age > 40 yrs
  - Tumor < 4.0 cm
  - Negative surgical margins of 2 mm
  - No skin involvement
- Mammosite
  - Age > 45 yrs
  - Tumor < 3 cm
  - Negative margins
  - Lumpectomy cavity > 3.0 cm

HEPATIC

You liver some, you loser some

Overview

Ytterium-90 microspheres are used for the treatment of Hepatocelular Carcinoma and metastatic tumors of the liver.

^{90}Y incorparated into glass or resin sphere approximately 20-60µm in diameter. The spheres are injected into the hepatic artery, often accessed through the femoral artery. This approach to delivery is very effective because the hepatic artery supplies 80-100% of the blood flow to these tumors. In contrast, the unaffected liver will only receive 20-30% of its blood from the hepatic artery and the remaining 70-80% from the portal vein. The use of Y-90 microspheres allows for greater tumor dosing compared to external beam which may be limited by tissue toxicity to non-tumor destroying levels.

There are currently two types of Yttrium-90 microspheres available in the US. SIR-Spheres uses a resin based material and is available in 3GBq vials. TheraSphere uses a glass based material and is available in 3, 5, 7, 10, 15, and 20GBq vials. Theraspheres are slightly denser (3.29 vs 1.6 g/cm^3) and has a higher activity per sphere (2500 vs 50 Bq).

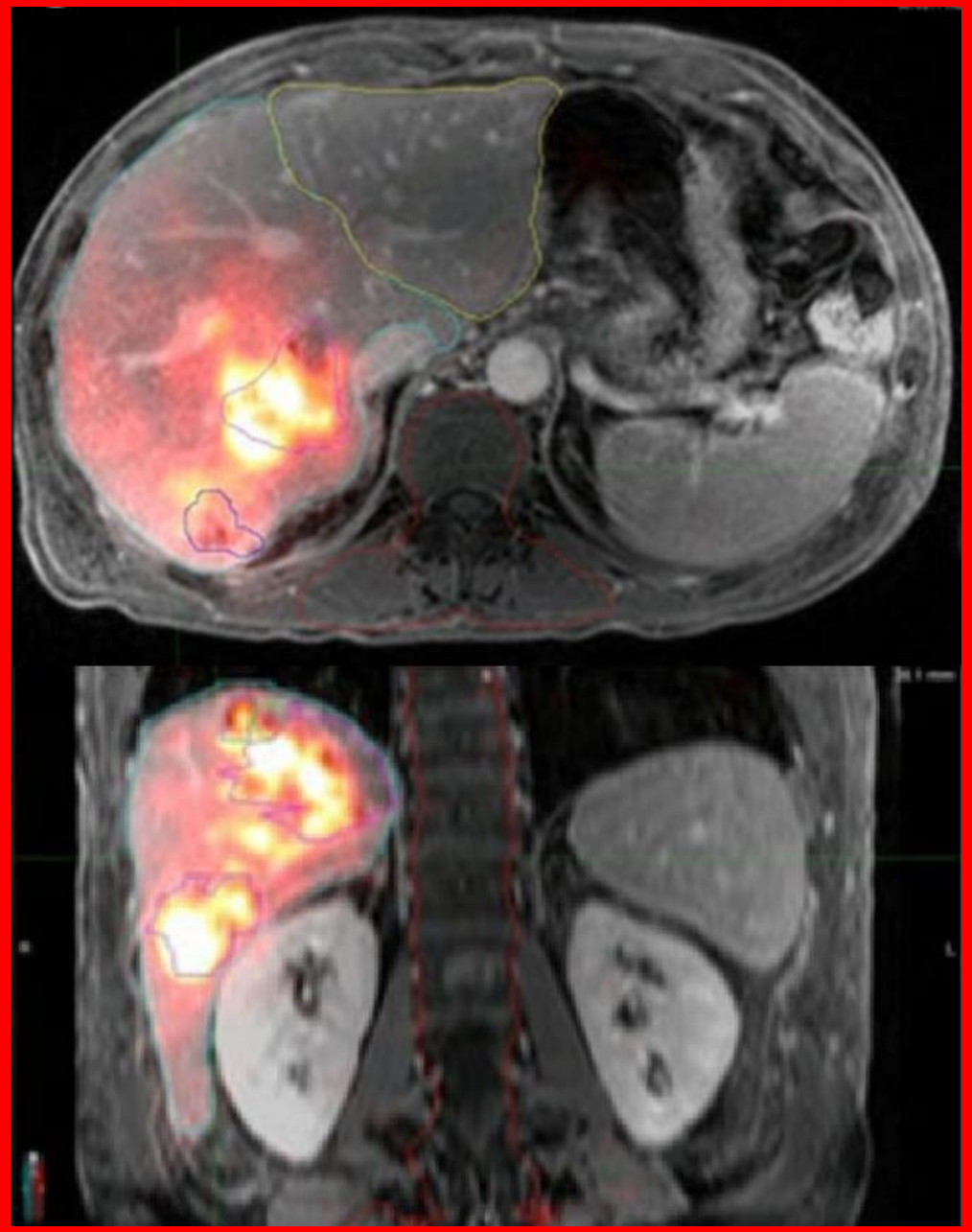
Prescriptions

Prescriptions may be written either in either terms of administered activity or mean dose to the target liver lobes. Mean target lobe doses are commonly in the range of 120-150Gy!

Indications and Contraindications

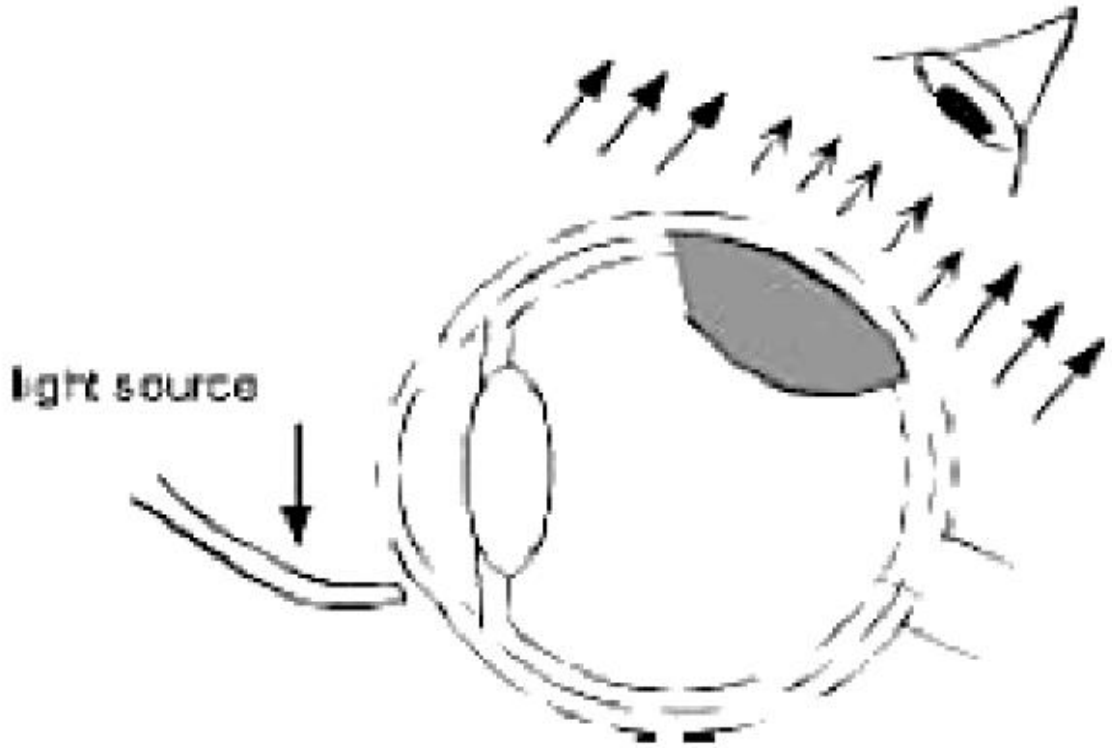
Data from Table II TG-144

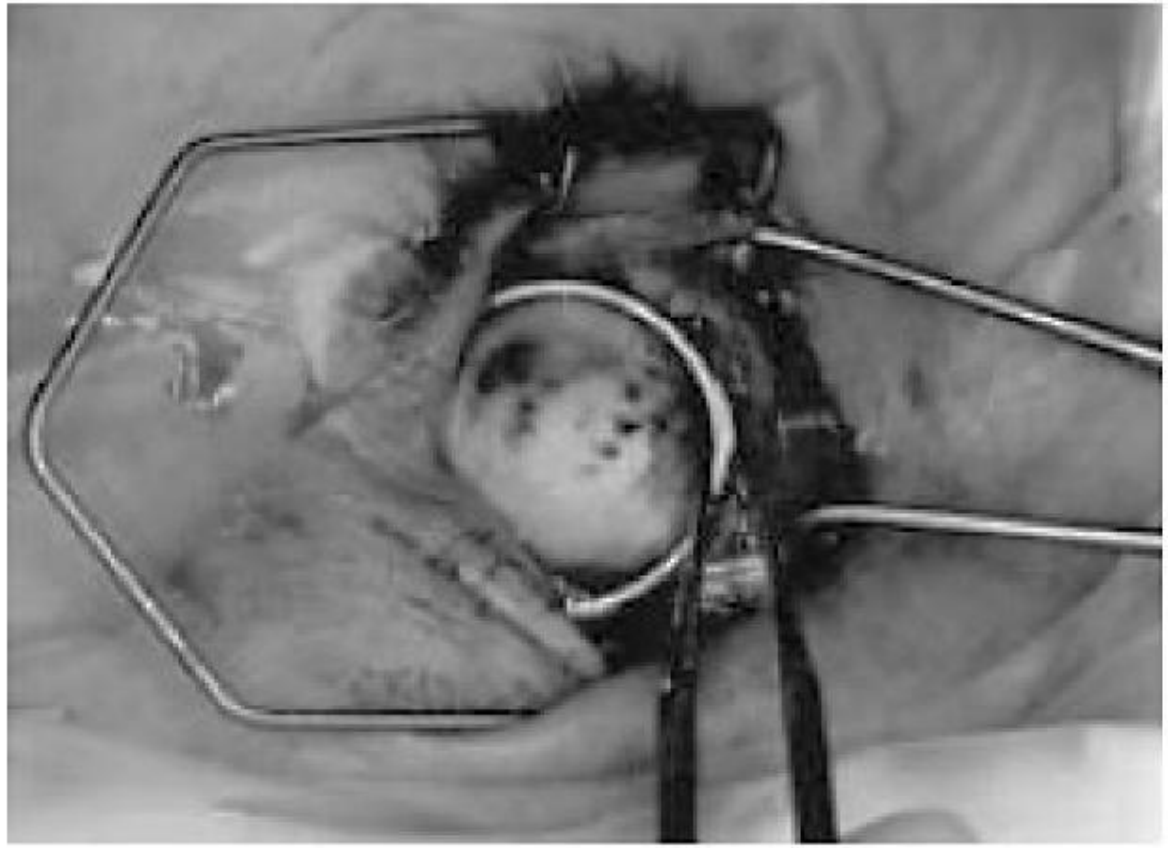
Indications	Contraindications
Unresectable hepatic primary or metastatic disease	Limited hepatic reserve
Liver dominant tumor	Estimated lung dose greater than 30Gy
Life expectancy greater than 3 months	Uncorrectable extrahepatic deposition



OCULAR

YEOWCH


light source



Treatment Regimen

Disease: Ocular Melanoma

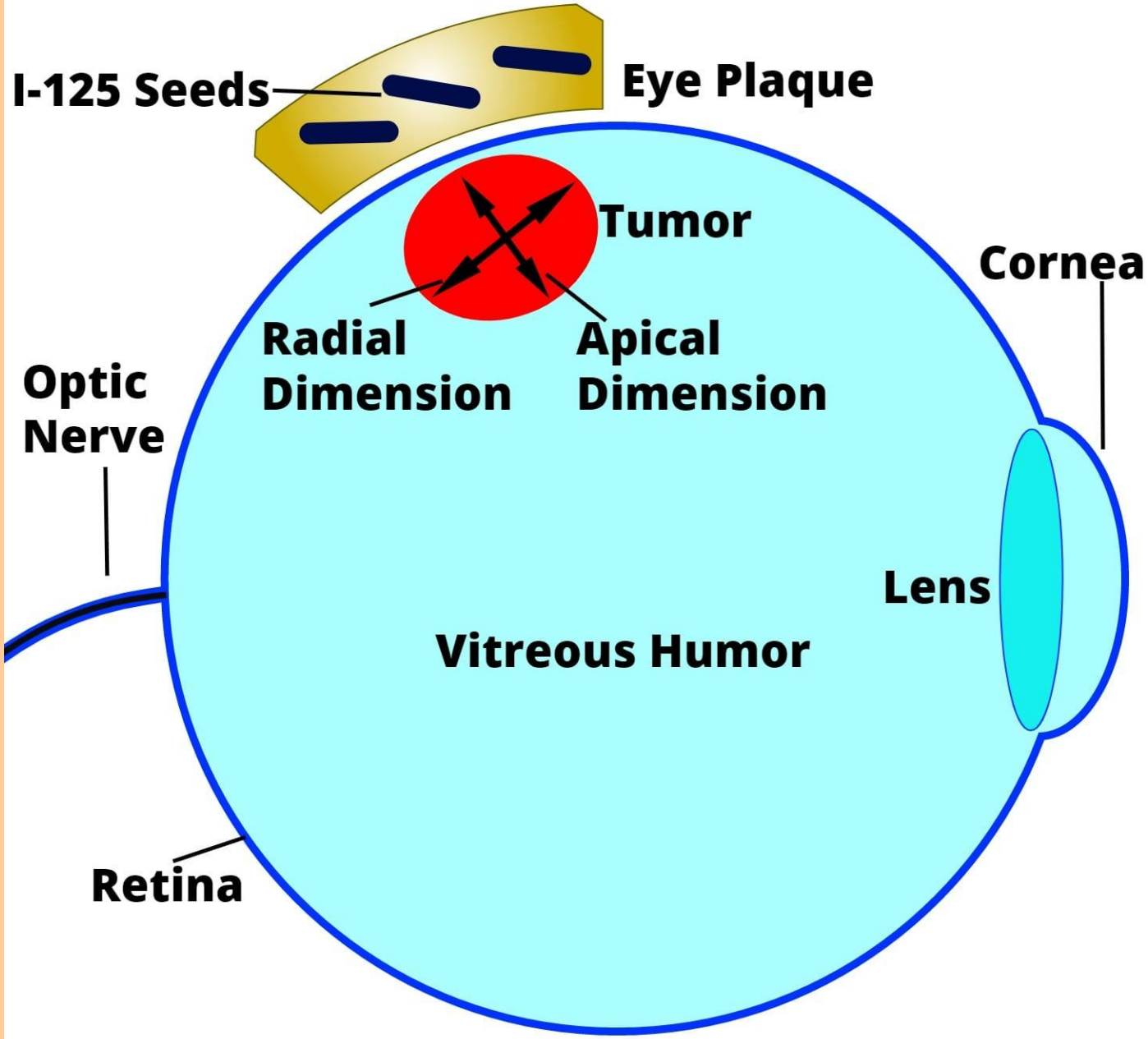
Prescriptions

- COMS: 85Gy to water at a depth of 5mm (for tumors with apex height of 5mm or less) or to apex depth (if apex is greater than 5mm).
  - Max dose is may be as much as 10 times greater than prescription dose (1000Gy)!
- **Implant duration:** 5-12 days
- **Radionuclide:** ^{125}I, ^{103}Pd
- **Seed activity:** 0.5 – 5 mCi
- **Dose rate:** 0.5 – 1.25 Gy/hr
- **Plaque size**
  - Chosen to cover radial extent of tumor with 2-3mm margin.
  - Available plaque sizes: 10mm to 22mm in 2mm increments

Alternative Treatments

- External beam proton therapy.
- Enucleation (removal of eye).

Eye Plaque Brachytherapy (COMS)



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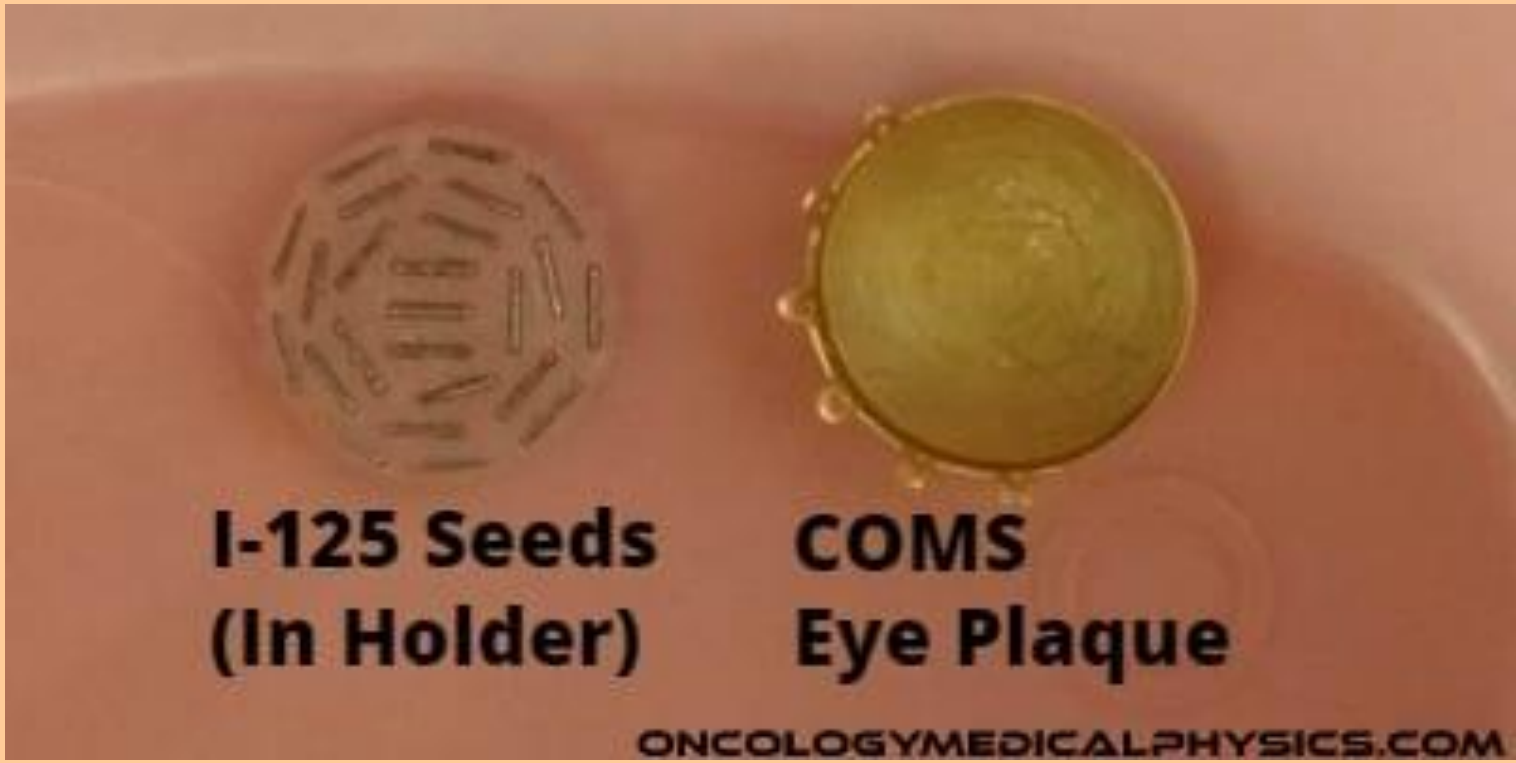

I-125 Seeds
(In Holder)
COMS
Eye Plaque
ONCOLOGYMEDICALPHYSICS.COM

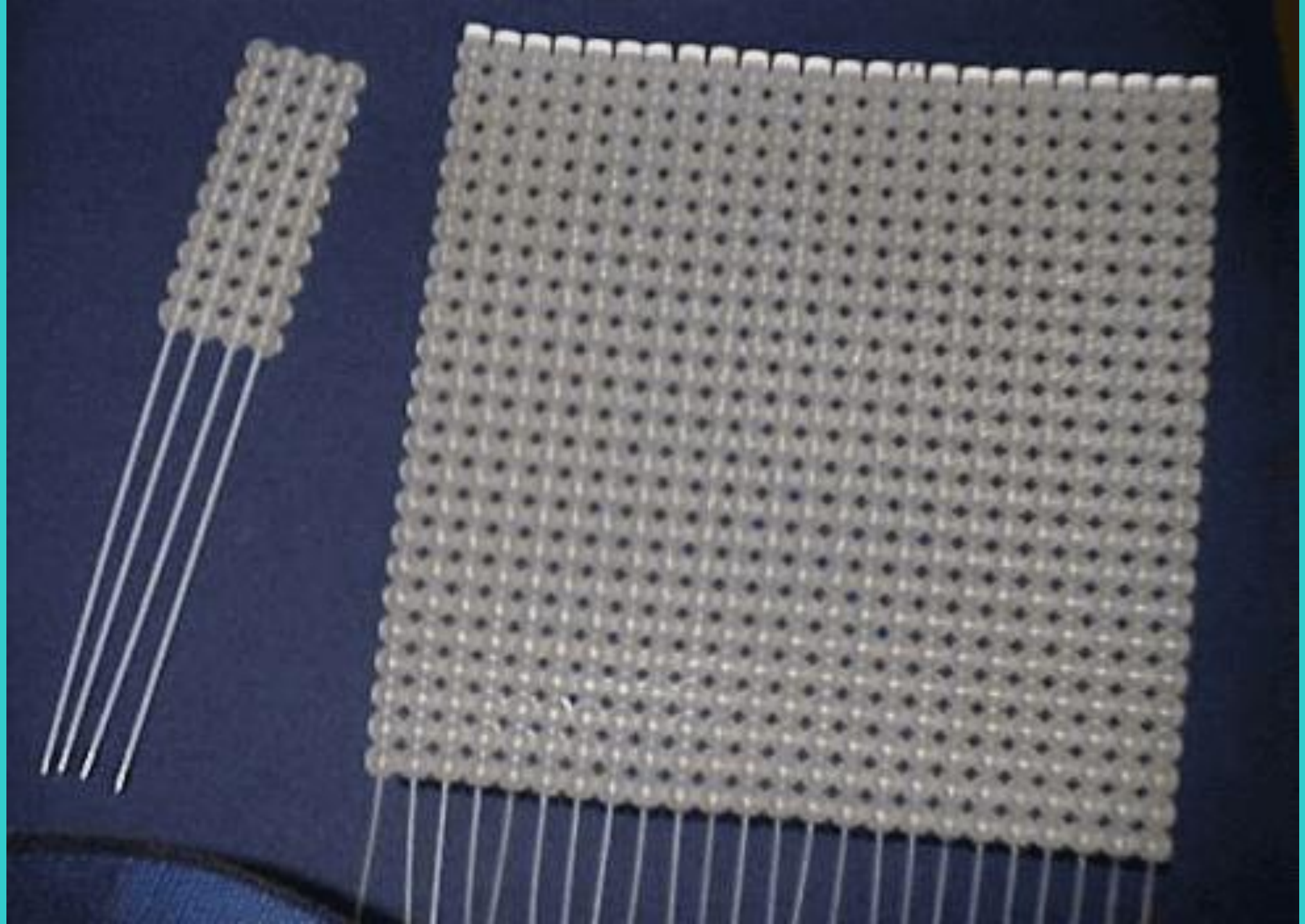
SUPERFICIAL

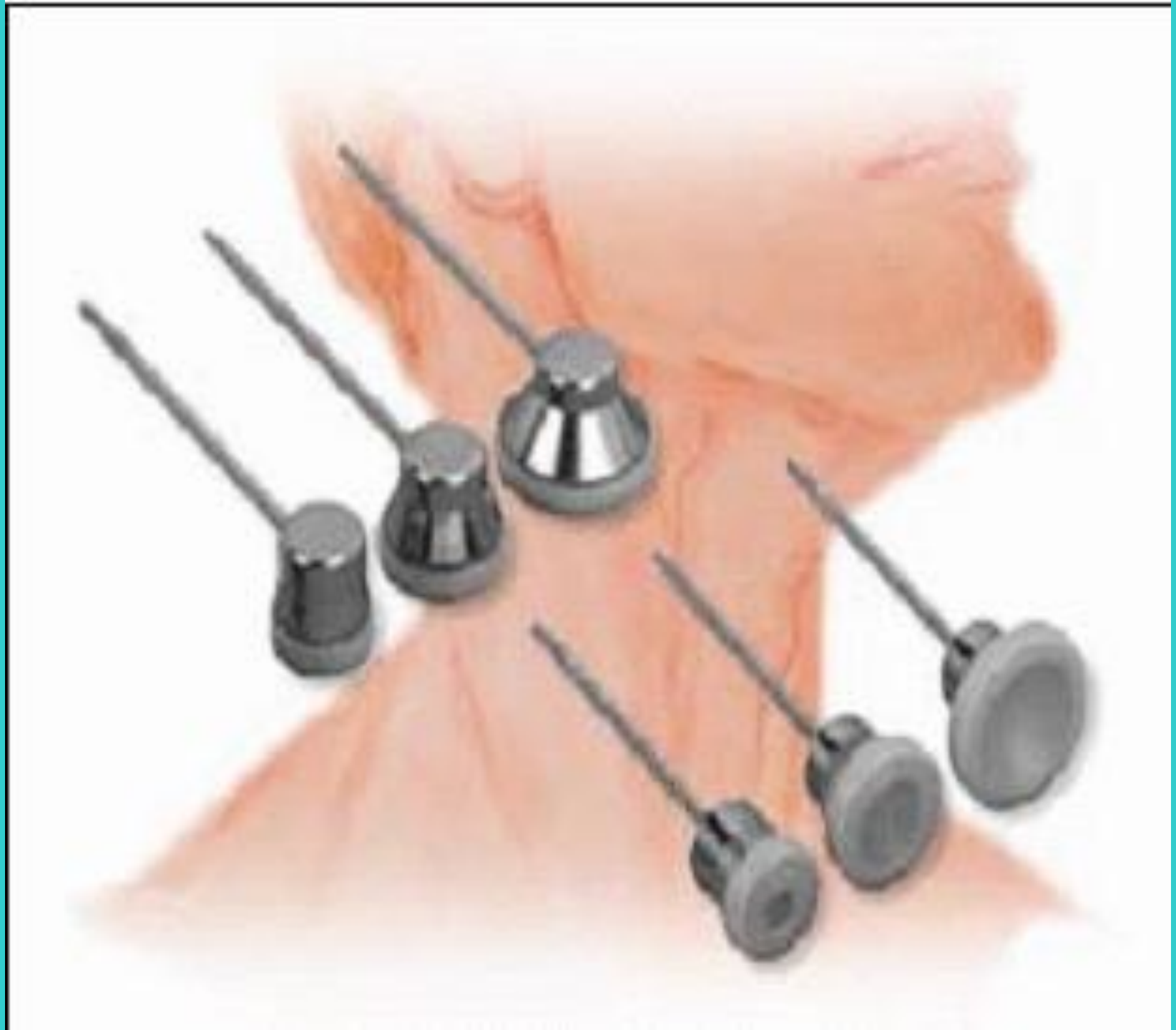
Califragilistic

Treatment Regimen

Skin Cancer is typically treated with 40Gy in 10 fractions (4Gy/fx) every other day prescribed to a depth of 1cm.

Skin keloid (tissue overgrowth) is treated with 12Gy in 3 fractions (4Gy/fx) prescribed to a depth of 0.5cm.

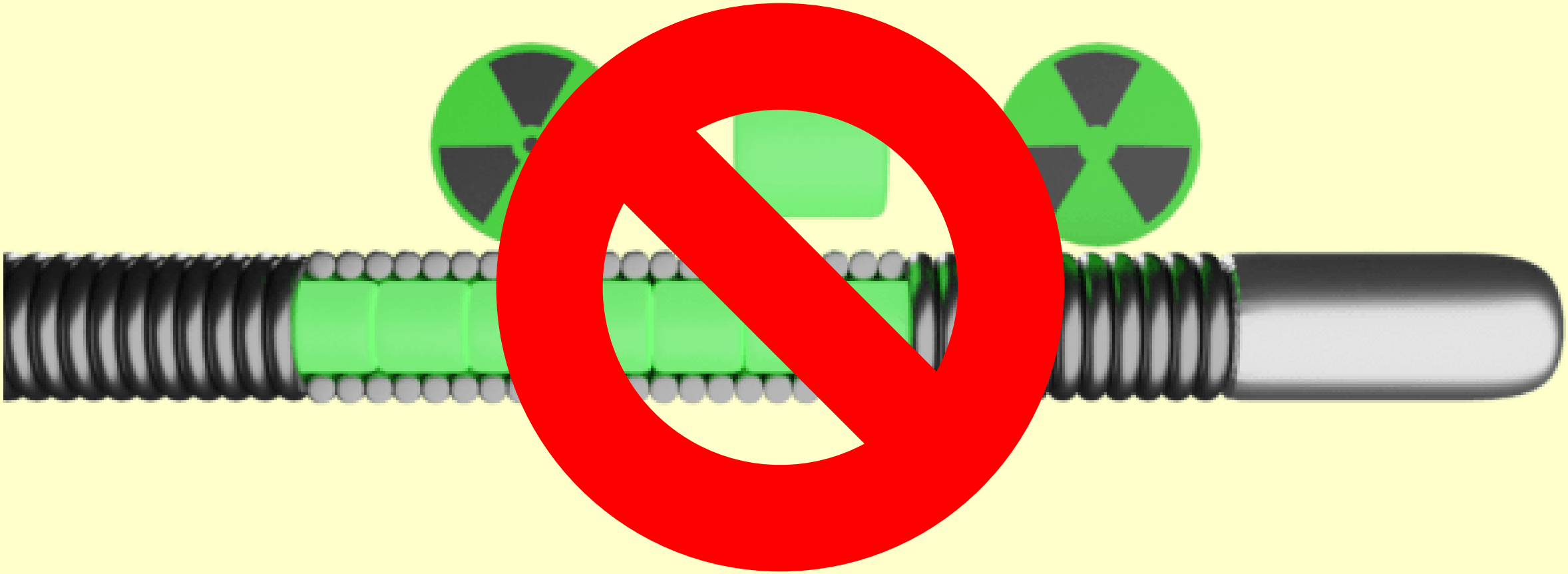




INTRAVASCULAR

See: spaghetti

?????????



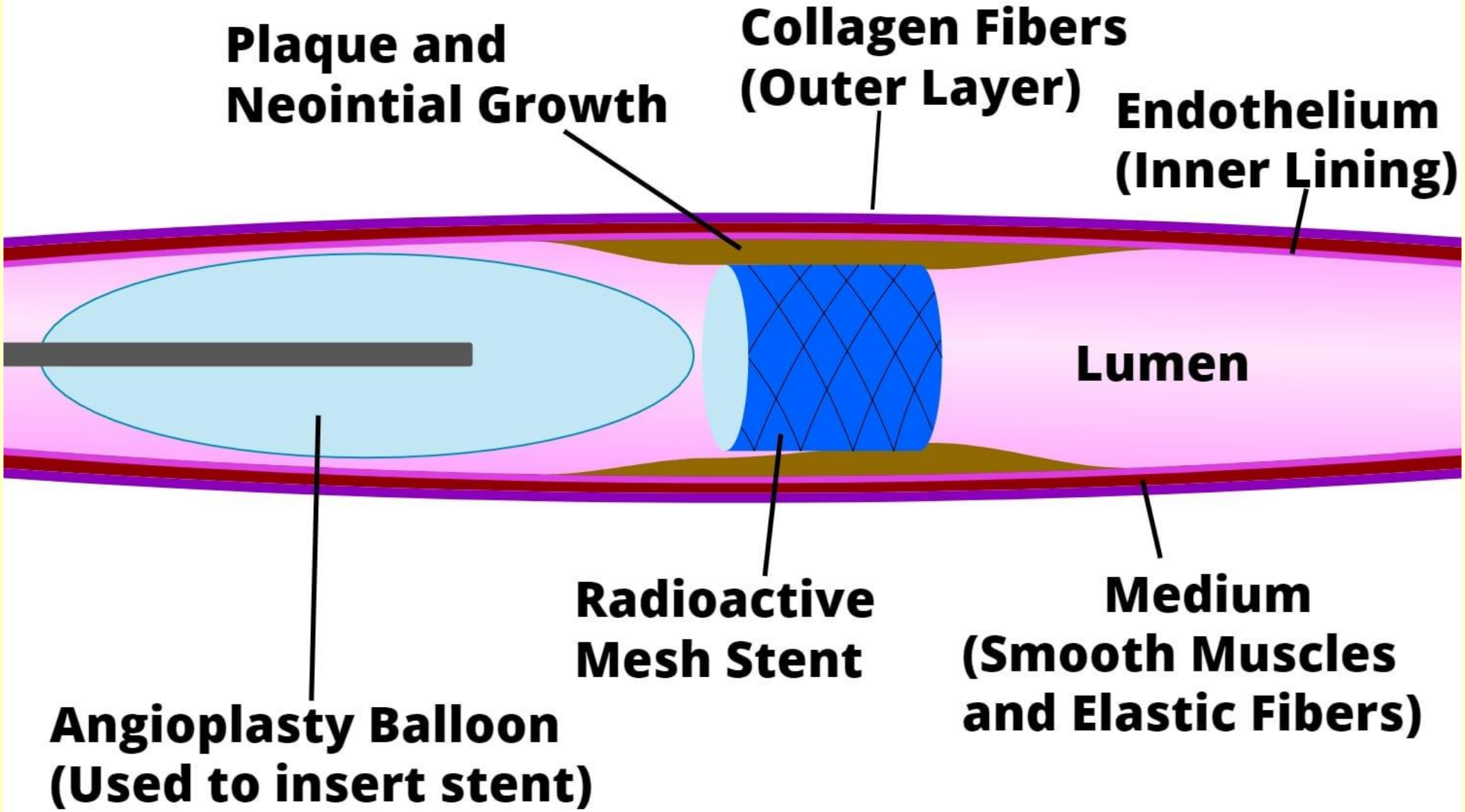
Overview

Intravascular brachytherapy is used as a treatment for restenosis and recurrent arterial blockage following angioplasty or stenting of a blocked artery. This technique is effective for blockages that are resistant to drug infuse stents or anti-coagulant (anti-clotting) drugs.

Treatment Regimen

- Prescription: 15-20Gy typically prescribed at 2mm from the source (intracoronary) or 2mm beyond lumen radius (peripheral arteries).
- Treated volume: a 2-5cm length of artery to a depth of between 0.5 and 2mm beyond the lumen.
- Dose rate:
  - 1-5cGy/hour for radioactive stents
  - >5Gy/minute for HDR afterloader type deliveries

Radioactive Stent Placement



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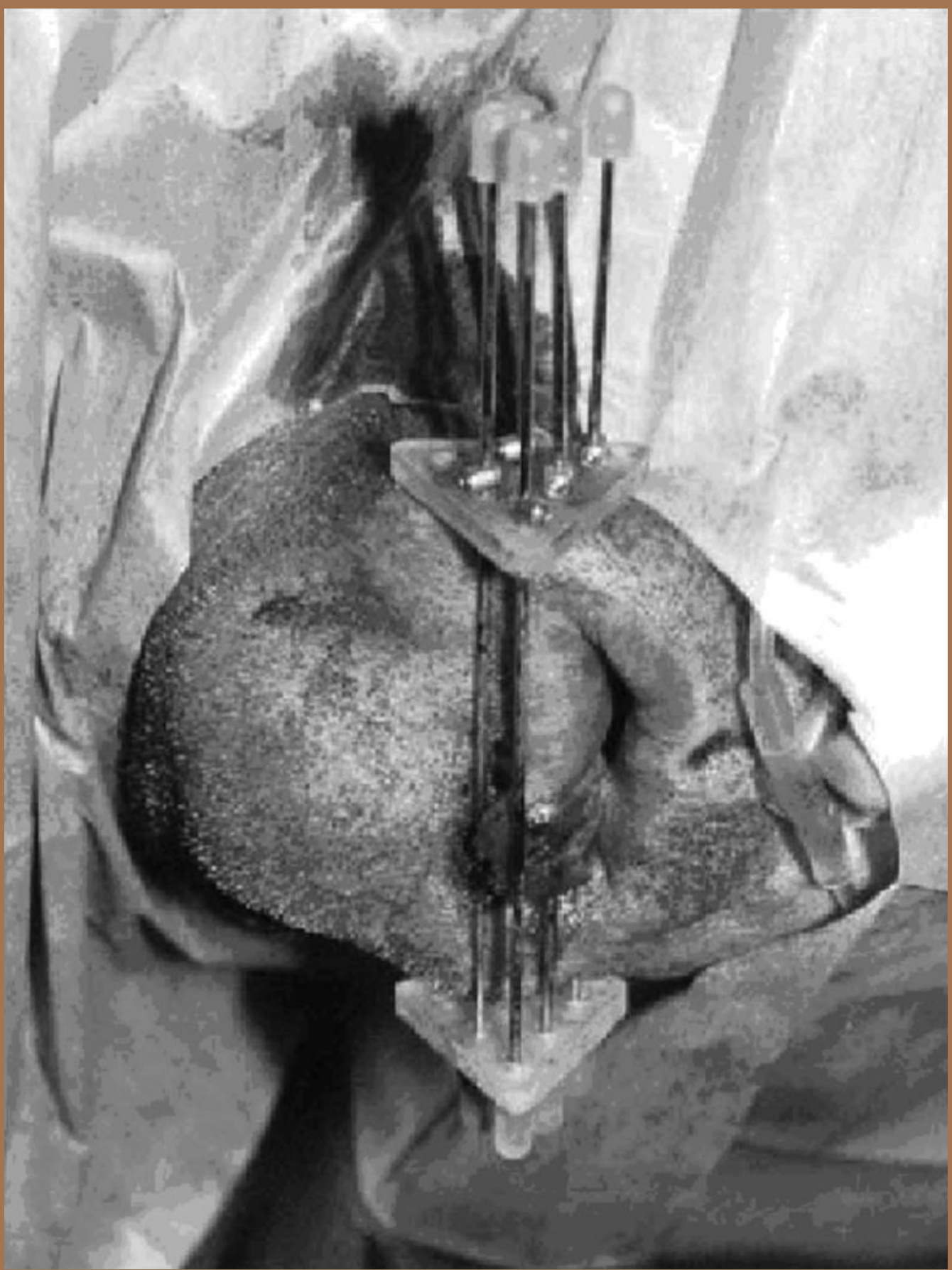
My neck, my back, my… head

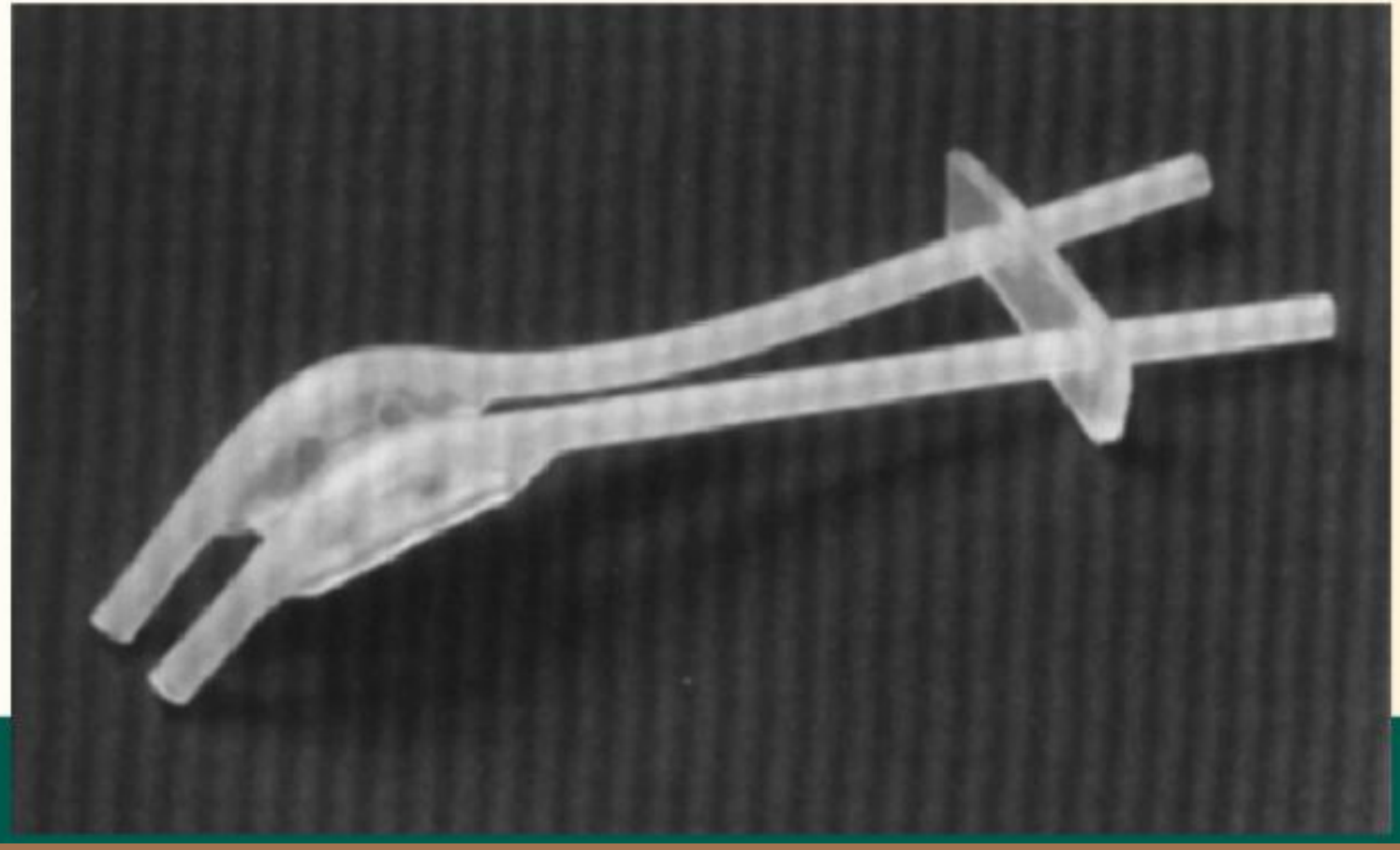
H&N



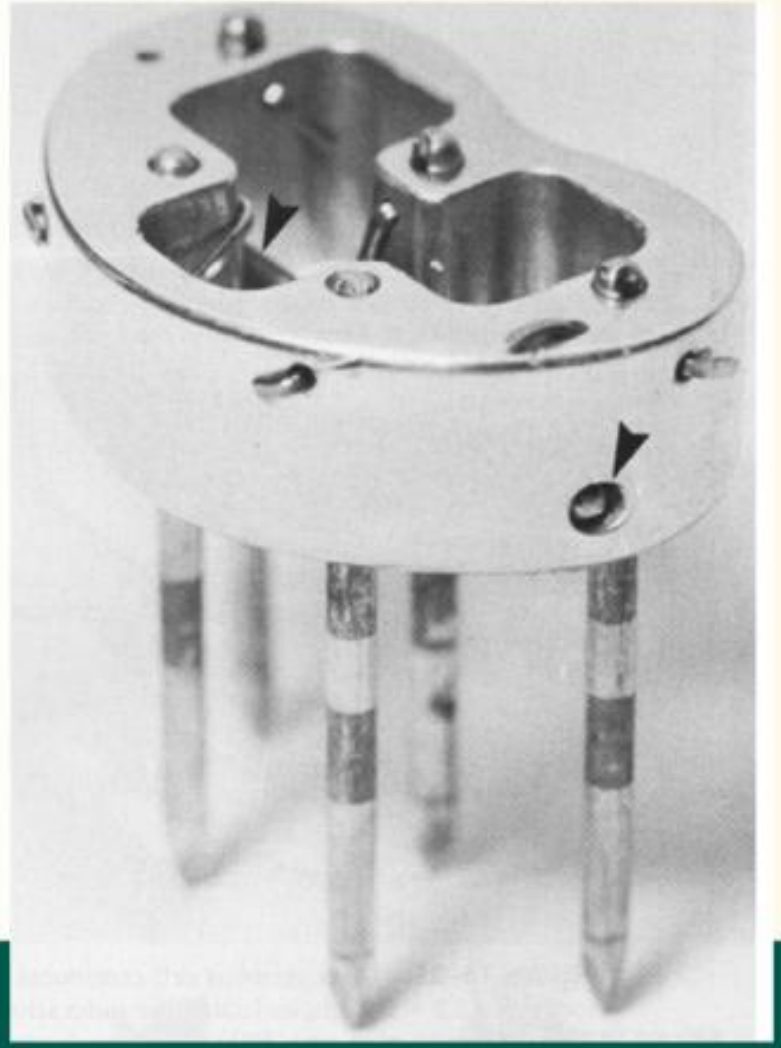
Technique	Subsites
Interstitial	Oral cavity: – lip – buccal mucosa – oral tongue – floor of mouth Oropharynx: – base of tongue/vallecula – soft palate – tonsil – epiglottis
Intraluminal	Nasopharynx/external auditory canal (EAC)
Surface mould (SM)	External ear Nasal vestibule Hard palate Skin of face (BCC/SCC)
SM + interstitial	Hard palate + soft palate Tumors of nasal vestibule

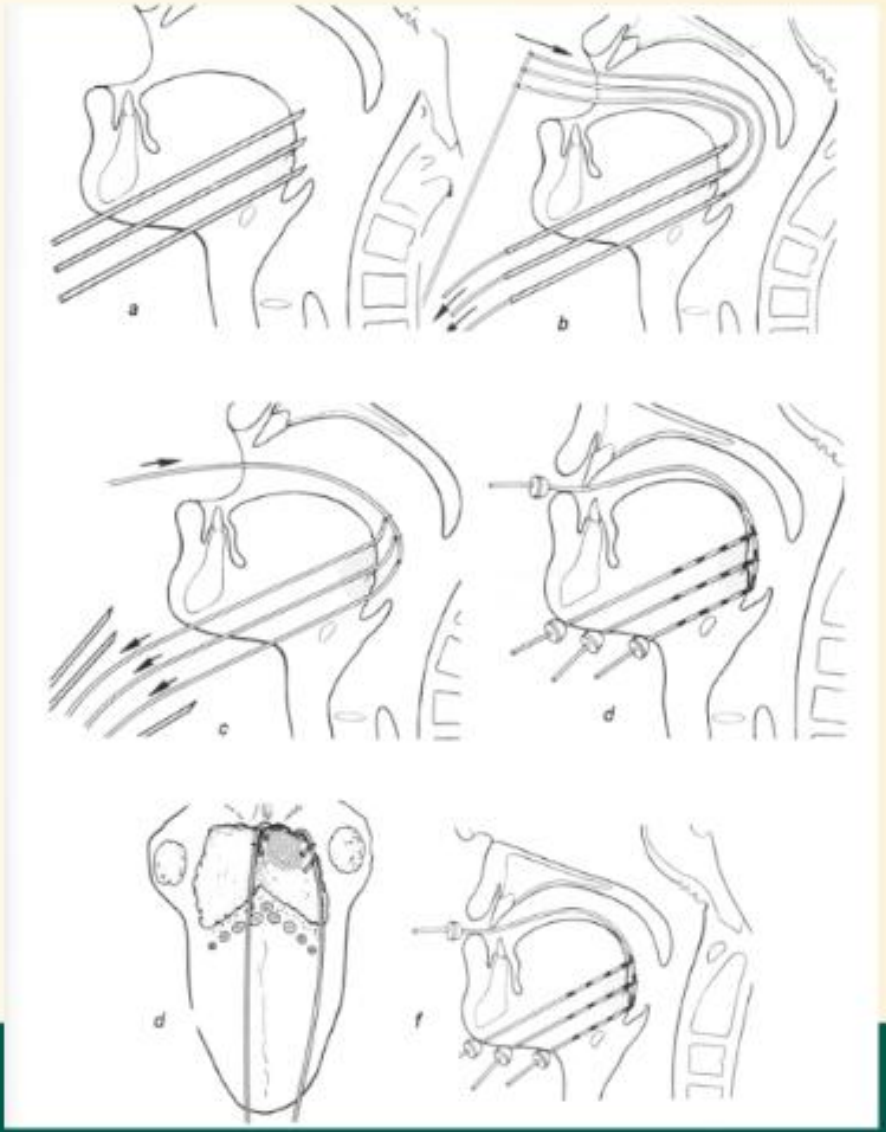
Nasopharynx

- 3Gy/fx BID for 4 fractions after 70 Gy EBRT

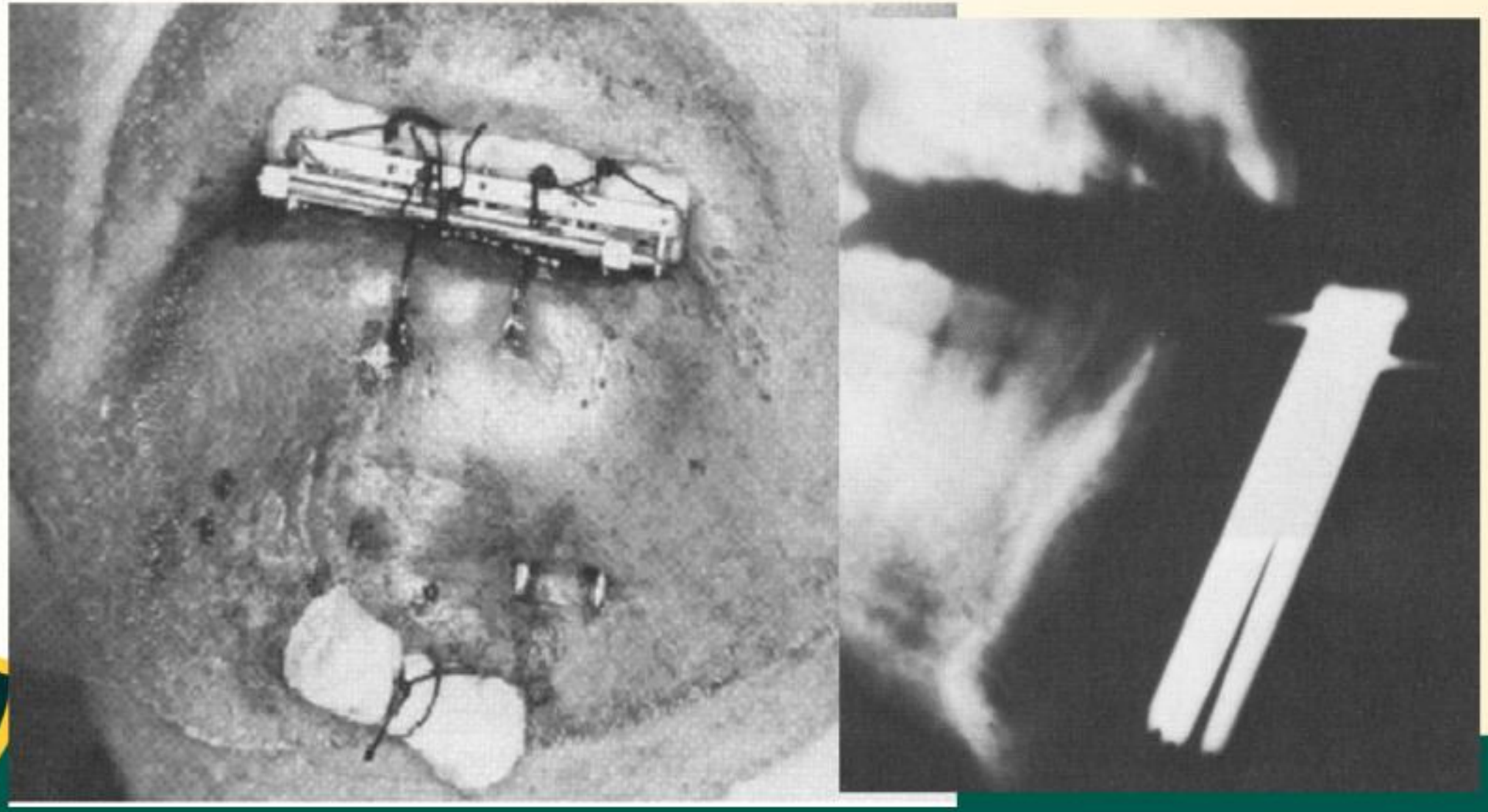


Oral Cavity



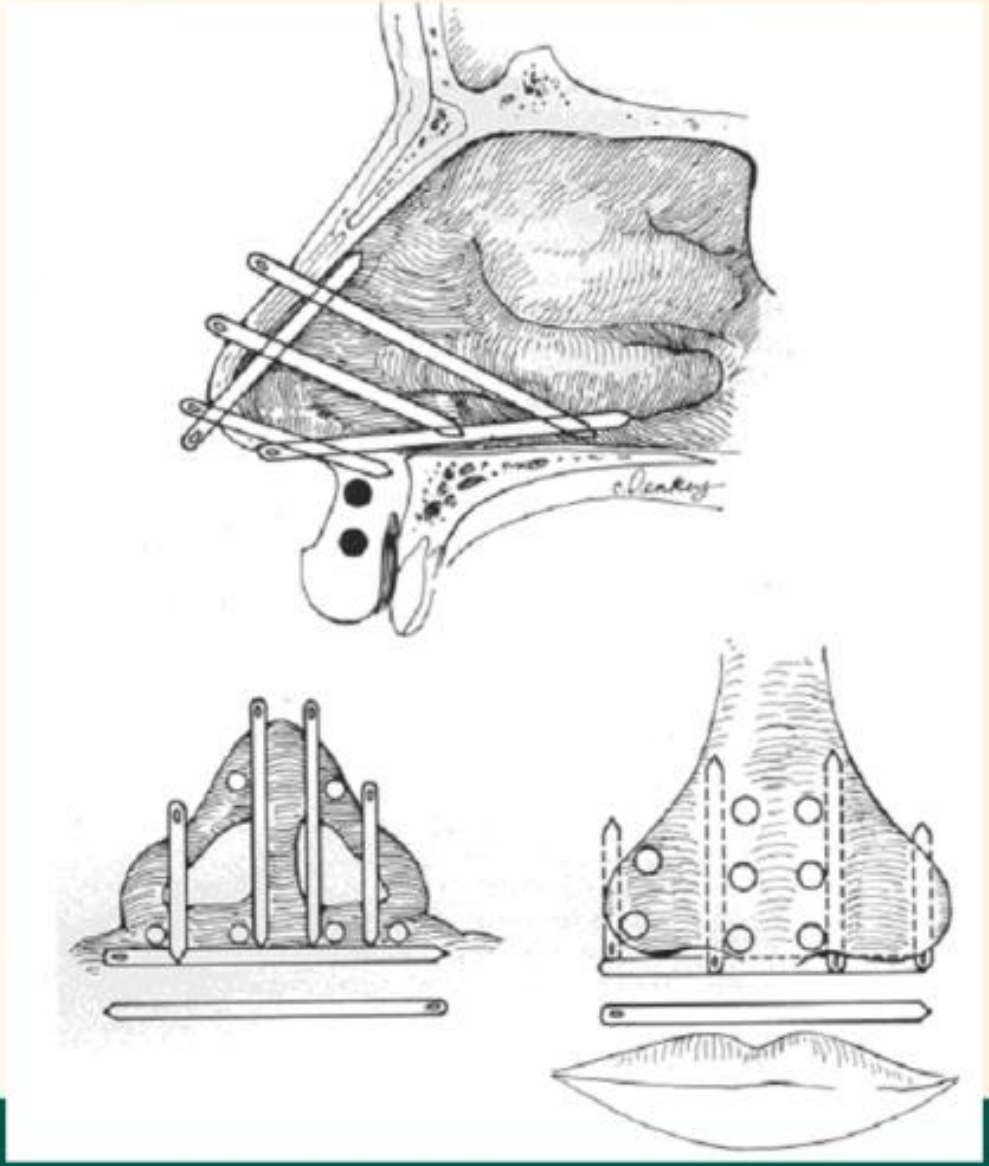


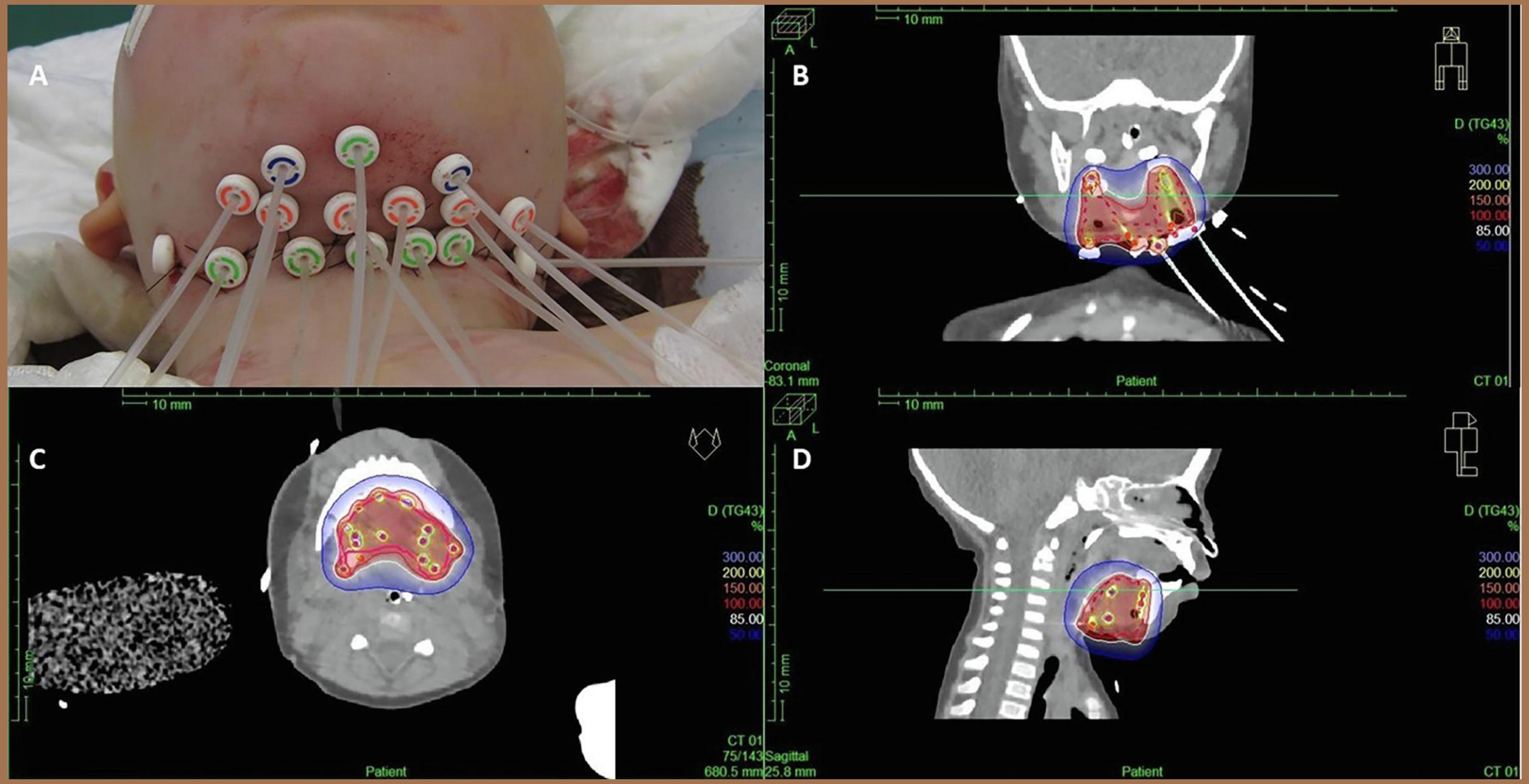
Lip



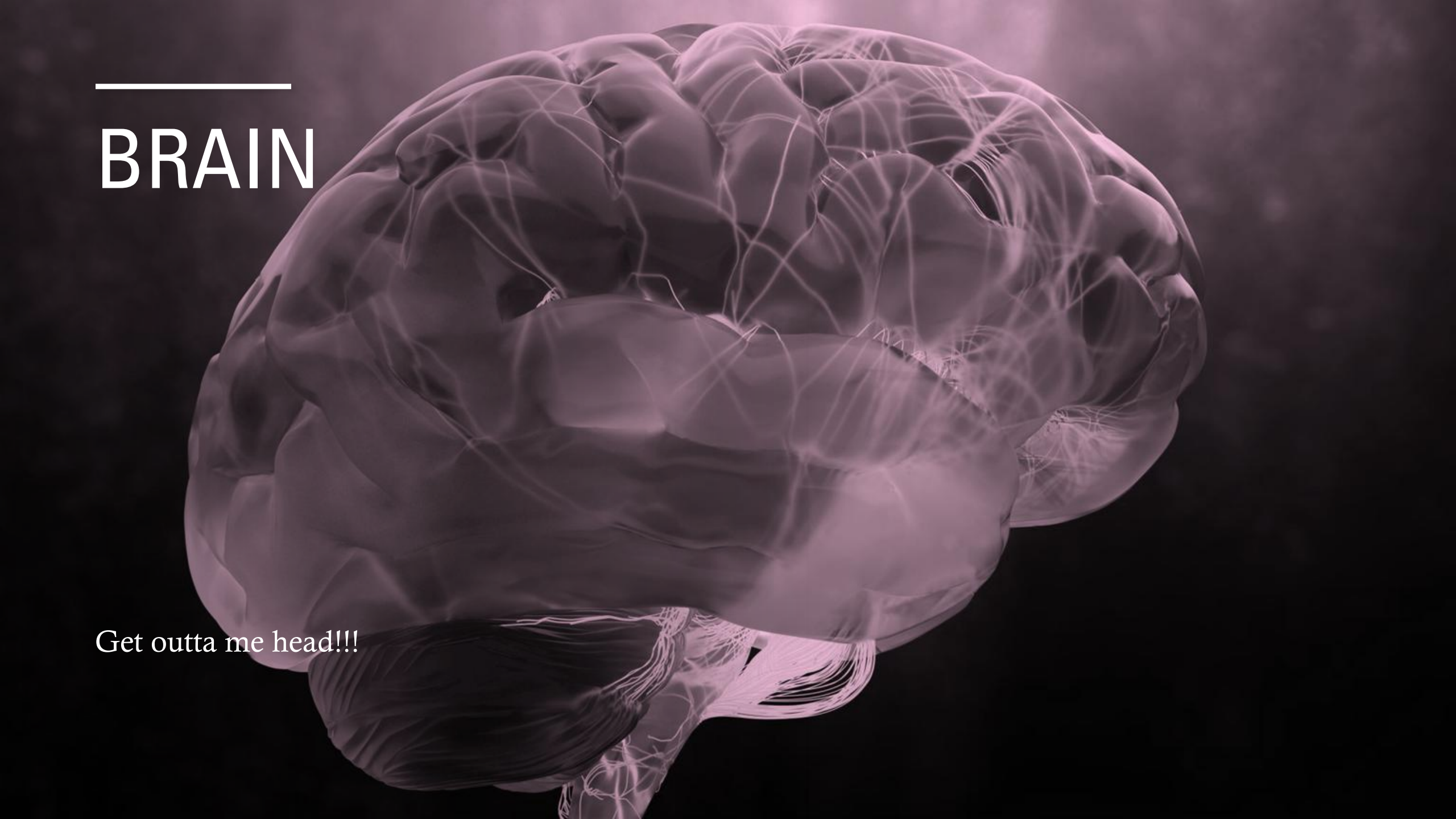
Nose

- 55 to 75 Gy when treated alone
- 20 to 30 Gy in combination with 50 Gy EBRT

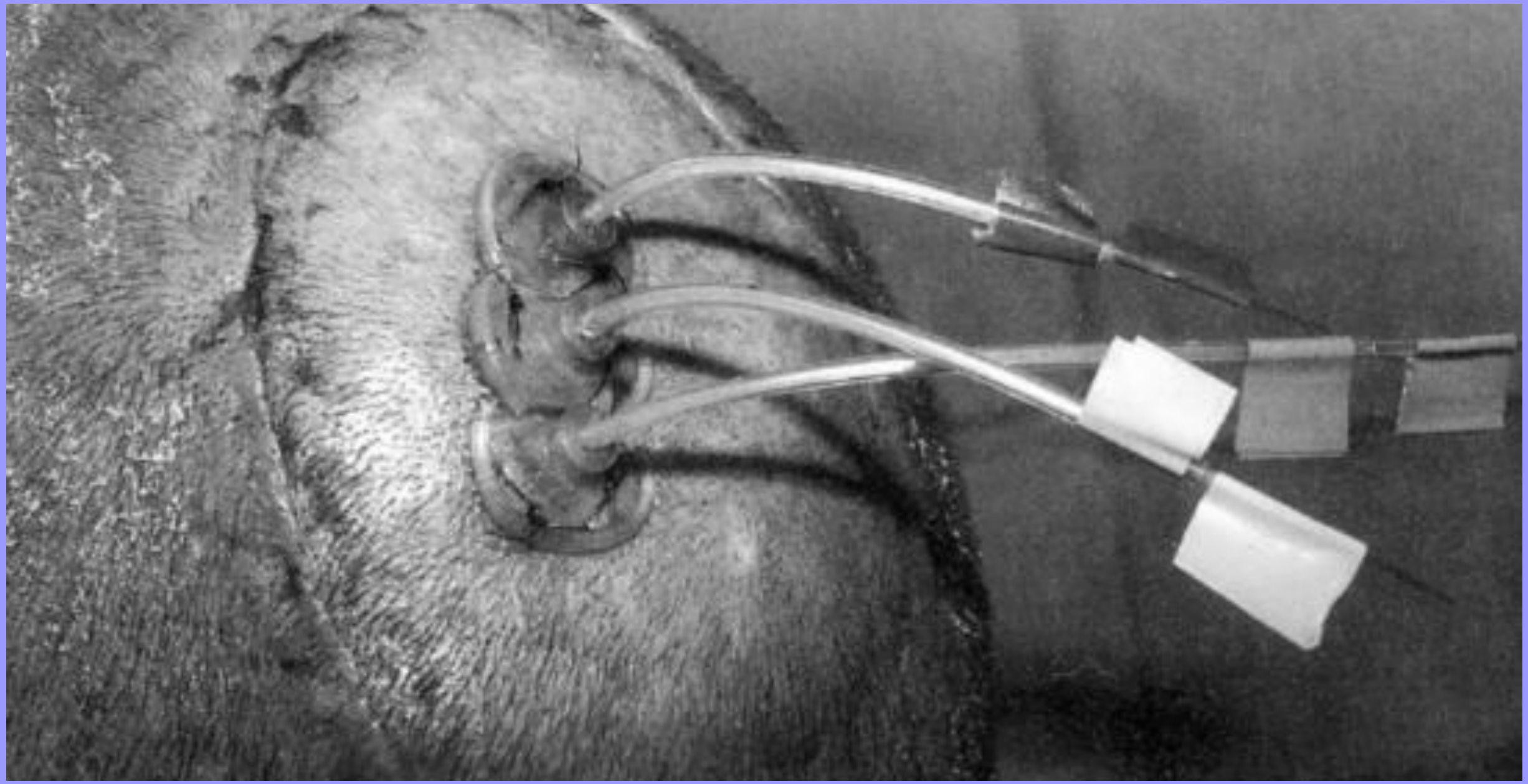



A
B
10 mm
A L
D (TG43)
%
300.00
200.00
150.00
100.00
85.00
50.00
10 mm
Coronal
-83.1 mm
Patient
CT 01
C
10 mm
D (TG43)
%
300.00
200.00
150.00
100.00
85.00
50.00
10 mm
CT 01
75/143
680.5 mm
Patient
D
10 mm
A L
D (TG43)
%
300.00
200.00
150.00
100.00
85.00
50.00
10 mm
Sagittal
25.8 mm
Patient
CT 01

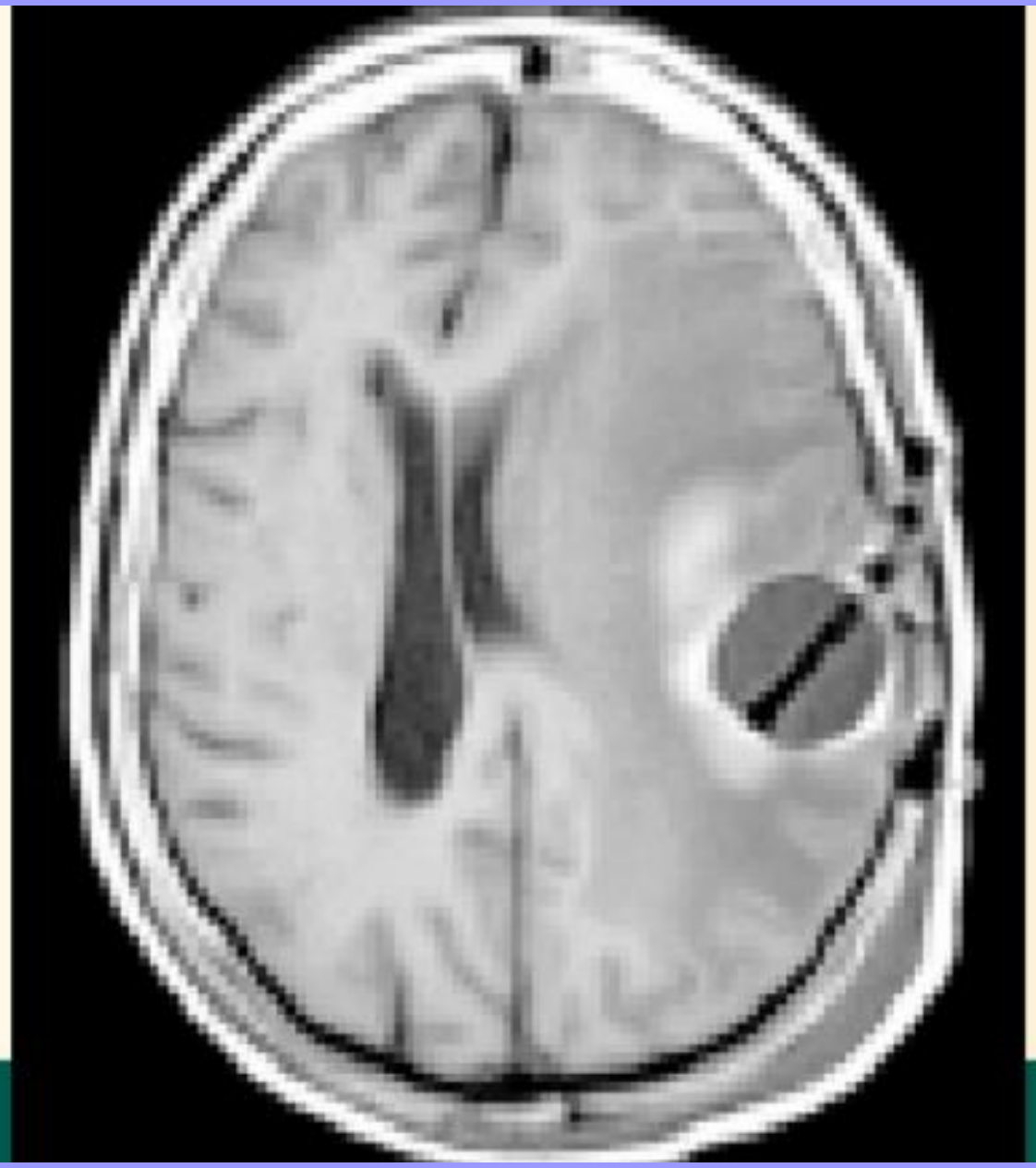
BRAIN



Get outta me head!!!



Brain Tumors

- Going out of style with the broader adoption of stereotactic radiosurgery
- Has been done using I-125 seeds
- Cf-252 has been used
- Also Ir-192
- Newer balloon techniques
  - GliaSite filled with Iotrex

- 40 to 60 Gy
- 0.5 to 1 cm from balloon surface