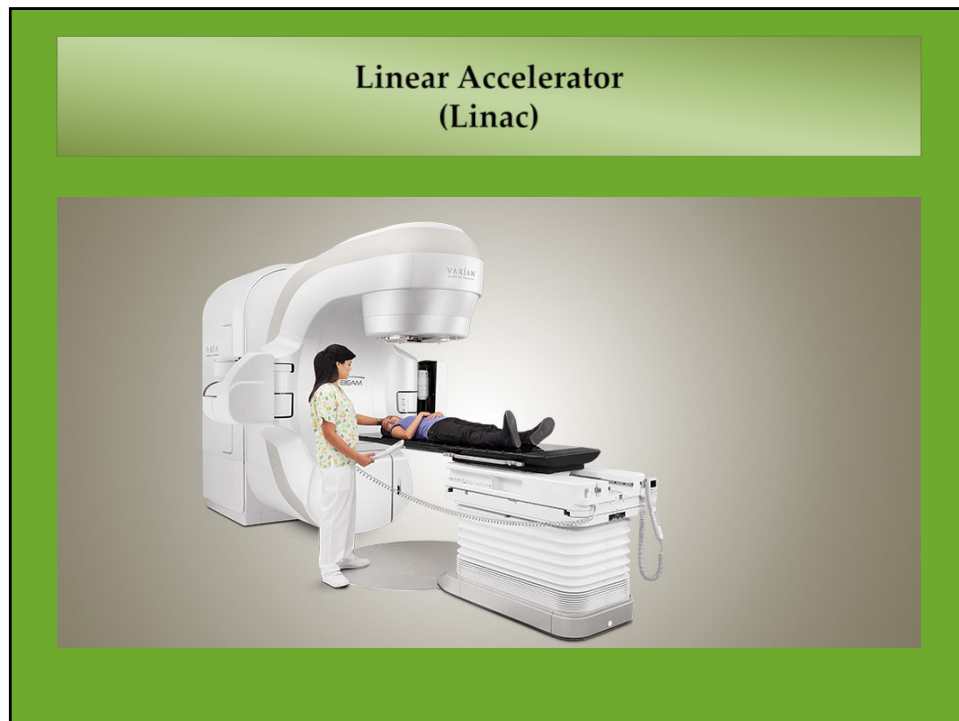


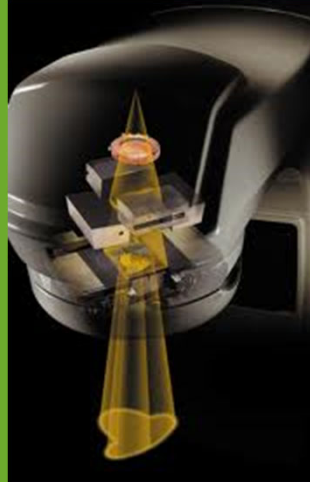
1



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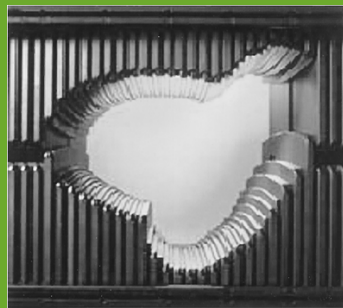
Principles of Modern Radiotherapy Technique Modern RT Delivery:  
Multi-leaf Collimator (MLC) and IMRT (Intensity Modulated Radiotherapy)

**MULTI-LEAF COLLIMATOR**

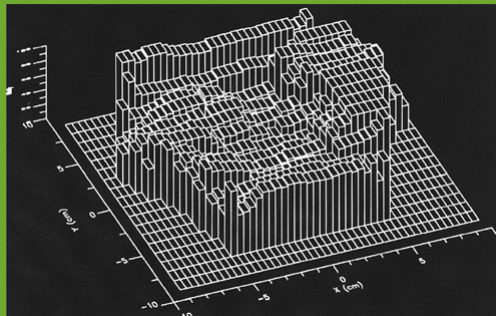


3

**IMRT**



Typical Multi-leaf Collimator  
looking towards radiation  
source

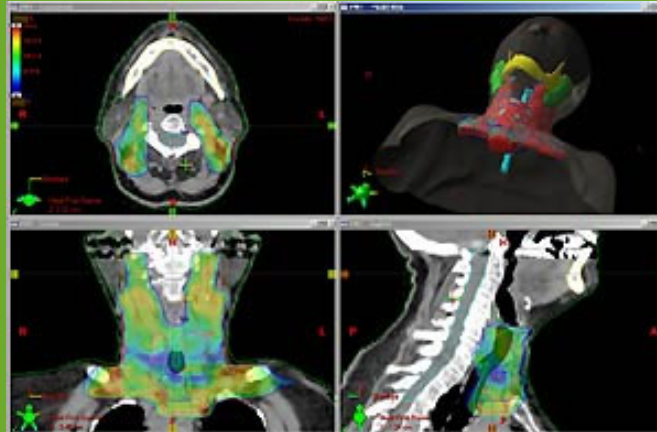


Intensity Profile in an IMRT  
Beam

4

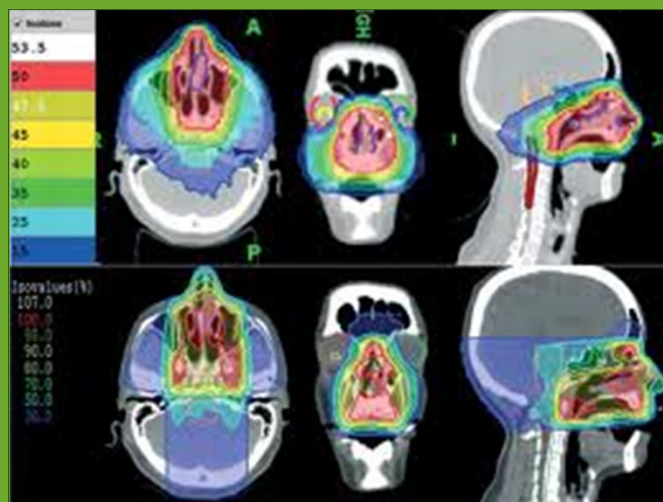
## Principles of Modern Radiotherapy Technique

3D Planning



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## Principles of Modern Radiotherapy Technique RT Delivery: 3D Conformal RT vs. IMRT



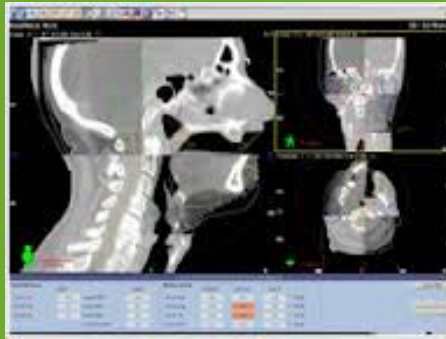
IMRT

3D CRT

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## Principles of Modern Radiotherapy Image Guided RT (IGRT)

*Cone Beam CT*



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*"We got the treatment, now what's the disease?"*



### Rationale of Radiotherapy Decision Making:

- Intent:
  - Radical /curative (Definitive): alone or with chemotherapy
  - Adjuvant (postoperative or consolidative after chemotherapy)
  - Neoadjuvant (preoperative)
  - Palliative
- Risk vs. benefit
- Prior treatment at same location

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## Principles of Definitive RT

- ❖ Meaning: RT as the **principal** modality for **gross** disease
- ❖ Organ and function preservation
- ❖ Examples : early Breast, prostate, skin, head and neck, cervix, anal, loco-regionally advanced lung cancers
- ❖ Side effects : may accept **some**
- ❖ Technique: **sophisticated** focusing on reduction of dose to at risk normal structures
- ❖ Dose: **high**
- ❖ Course duration: **long**

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## Principles of Adjuvant RT

- ❖ Meaning: RT as an **additional** modality aiming at preventing recurrence, mainly by eradicating **microscopic or subclinical** disease
- ❖ **Preoperative**, more commonly **postoperative**, or **consolidative** after chemotherapy
- ❖ Examples are numerous: rectal, lymphomas, head and neck, uterine body, pancreas, STS, skin,
- ❖ Side effects : **less** than definitive RT
- ❖ Technique: **Sophisticated**
- ❖ Dose: **less** than definitive RT
- ❖ Course duration: **less** than definitive RT

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## EMERGENCIES IN RT

- ❖ **Spinal Cord Compression by cancer**
- ❖ **Superior Vena Cava Syndrome**
- ❖ **Some instances of acute hemorrhage due to cancer not amenable to other interventions**

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## MALIGNANT SVCS

- ▣ **Edema of face and UEs**
- ▣ **Dilated veins on the chest wall**



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## MALIGNANT SPINAL CORD COMPRESSION

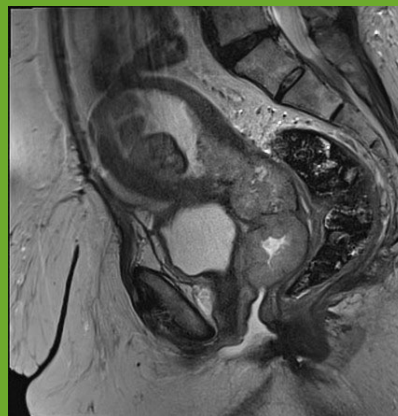
- ▣ Surgery (when possible)+ RT better than RT alone especially with motor dysfunction
- ▣ Most effective if before Motor dysfunction sets in
- ▣ Some tumors may be managed with RT alone e.g., multiple myeloma



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## HEMORRHAGE

- ▣ When severe and cannot be controlled by other means (not the first resort)
- ▣ Effect is delayed and not immediate
- ▣ Examples:
  - Cervix
  - Lung



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"To cure sometimes  
To relieve often  
To comfort and support always"

Edward L. Trudeau 1848-1915

### SOME "GROUND RULES" FOR PALLIATIVE RADIOTHERAPY

#### Principles of Palliative Radiotherapy For symptom Relief:

- ❖ Treatment Time: Short
- ❖ Side effects : minimal
- ❖ Convenience and cost

Robert G Parker (JAMA Dec 14, 1964. Vol.  
190, No. 11 pp 126-128)

#### Principles of Palliative Radiotherapy to "abort" symptoms

- ❖ Treatment Time: longer
- ❖ Side effects : minimal to mild

Van Oorschot et al. (Seminars in Oncology ,  
2011; 38(3): 443-9)

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### Symptoms of Cancer That May Be Successfully Addressed by Palliative Radiotherapy

#### Pain from:

- Progressive growth of primary tumor (any site)
- Bone metastases
- Brain metastases
- Visceral metastases
- Nerve root or spinal cord compression

#### Bleeding from:

- Head and neck cancers
- Skin cancers
- Upper and lower gastrointestinal cancers
- Genitourinary cancers
- Gynecologic cancers
- Metastases to any of the above sites

#### Neurologic symptoms from:

- Brain metastases including leptomeningeal carcinomatosis
- Nerve root or spinal cord compression

#### Obstructive symptoms from:

- Cough and dyspnea related to airway obstruction
- Dysphagia/odynophagia from esophageal obstruction
- Early satiety from gastric outlet obstruction
- Relief from biliary obstruction
- Pelvic obstruction

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## The dilemma



*"Whether 'tis nobler in the mind to suffer  
The slings and arrows of outrageous Fortune,  
Or to take arms against a sea of troubles,  
And by opposing, end them? To die, to sleep—"*

Hamlet Act IIII

William Shakespeare c. 1603

**Always weigh risks vs. benefits carefully especially when  
intent is palliation**

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## Adverse Effects of RT

### General Paradigm

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The most pragmatic classification of tissues with respect to RT response:  
*"Early-responding" and "Late-responding" tissues*

- ▣ *"Early" radiation response ("Acute")*
  - During or shortly after RT
  - Mechanism: Cell depletion, i.e., parenchymal reaction
  - Transitory
- ▣ *"Late" radiation response ("Chronic")*
  - In all tissues
  - Both parenchymal and stromal
  - No clear separation between *proliferating* and *functional* cells
  - Permanent to varying degrees

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*Early Effects  
 (Days-weeks)*

- ▣ *Rapidly dividing self-renewal tissues will manifest RT effects early:*
  - *Mucosal surfaces (GIT, bone marrow, salivary)*
  - *Skin*
  - *Ovaries/testis*
- ▣ *Severity depends on :*
  - *Volume exposed to RT*
  - *Dose*
  - *Tissue type*

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### *Delayed Early Effects (months)*

- ▣ *Slowly dividing tissues:*
  - *Liver*
  - *Lungs*
  
- ▣ *Severity also depends on :*
  - *Volume exposed to RT*
  - *Dose*
  - *Tissue type*

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### *Late Effects*

- ▣ *Non-self renewal tissues show mainly late effects:*
  - *Neurological tissues*
  
- ▣ *Fibrosis*
  - *Liver*
  - *Lung*
  - *Skin*
  - *Any tissue*

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**CTCAE.v5**

**Common Terminology Criteria  
for Adverse Events (CTCAE)**

**Version 5.0**

Published: November 27, 2017

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

[https://ctep.cancer.gov/protocoldevelopment/electronic\\_applications/docs/ctcae\\_v5\\_quick\\_reference\\_5x7.pdf](https://ctep.cancer.gov/protocoldevelopment/electronic_applications/docs/ctcae_v5_quick_reference_5x7.pdf)

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**CTCAE.v5**

- ▣ **Five grades**
  - **G1 Self limited w/o intervention**
  - **G2 Needs medical intervention, no hospitalization**
  - **G3 Needs med or surgical intervention, possibly hospitalization**
  - **G4 Life threatening**
  - **G5 death**
- ▣ **Eg Dermatitis**

Dermatitis radiation	Faint erythema or dry desquamation	Moderate to brisk erythema; patchy moist desquamation, mostly confined to skin folds and creases; moderate edema	Moist desquamation in areas other than skin folds and creases; bleeding induced by minor trauma or abrasion	Life-threatening consequences; skin necrosis or ulceration of full thickness dermis; spontaneous bleeding from involved site; skin graft indicated	Death
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Definition: A finding of cutaneous inflammatory reaction occurring as a result of exposure to biologically effective levels of ionizing radiation.

Navigational Note: Synonym: Radiation induced skin toxicities (CTCAE v3.0)

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Thank you for your attention!

**Questions?**

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