Radiation involves using rays of energy to destroy cancer cells.

Usually the energy used is x-rays.

The cells are destroyed when the energy damages the genetic material involved in the growth and division of cells.

Unfortunately, radiation therapy not only damages cancerous cells, it can also harm healthy cells.

Precise delivery is important to minimize the effects of the therapy on healthy cells.

Fortunately, healthy cells are usually able to fix most of the damage done themselves.
Radiation is a critical part of Breast Conserving Therapy

Lumpectomy + RT = Mastectomy
HOW RADIATION THERAPY IS ADMINISTERED

- **External Radiation**: This kind of radiation therapy uses a machine to target the tumor from outside the body. External radiation generally takes several weeks and is performed on an outpatient basis.

- **Brachytherapy**: Brachytherapy is a kind of internal radiation therapy. It uses a radioactive source that is put inside the body, either in or near the tumor.
HISTORICAL PERSPECTIVE

Interstitial Radium Brachytherapy for Breast Cancer 1917

Radiotherapy for Breast Cancer, London Hospital 1917
SIGNIFICANT PROGRESS HAS BEEN MADE IN THE RADIATION PLANNING AND DELIVERY

- Safer: less acute and long-term side effects
- Cheaper/more cost effective
- More accessible/convenient for the patients
Patients with early stage breast cancer have many RT options available to them
- “Standard” fractionation 5-7 weeks
- Hypofractionation 3-4 weeks
- Partial breast radiation 1 week
- IORT - intra-operative 10-20 min
Improvements in radiation planning resulted in decreased toxicity

- **Acute** - decreased rate of radiation dermatitis
  - Grade III moist desquamation 1% vs 10%

- **Long term**
  - Cardiac toxicity
  - Pulmonary toxicity-pneumonitis
  - Radiation fibrosis of breast
  - Brachial plexus injury
Novel techniques for delivery of WBI
- treatment in the prone position
- gating of treatment to the deep inspiratory phase of the respiratory cycle

Decrease the radiation dose to the lung and heart
RESPIRATORY GATING

Expiration: Beam OFF

Inspiration: beams ON
RT PLANNING: PRONE BREAST RT

- Suitable for pendulous breasts, where breast-only RT is required
- Results in reduction of dose to the lung
- Heart dose may be lower
- Potential reduction in dermatitis in the infra-mammary fold
Majority of recurrences are close to tumor bed...

- **Rationale**
  - decrease treatment time and improvement of quality of life
  - reduction in treatment toxicity
APBI (MAMMOSITE)
Typical treatment  5 days twice daily
Needed balloon-to-skin dist >5 mm, cavity size < 6 cm
Results:
- IBTR = 2.15% (4 yr=2.65%)
Toxicity:
- infection: 9.5%,
- Seroma: 27% (13% symptomatic)
- 2% fat necrosis
• Cosmesis: Good or excellent at 4 yrs: 91%
At a median follow-up of 10.8 years, no significant difference in the ten-year actuarial rates of LR, DFS, OS, and CSS between the two treatment arms.
A single dose of targeted radiation given at the time of lumpectomy.
PATIENT SELECTION

- Age > 50
- Invasive ductal carcinoma < 2 cm in size with margins > 2 mm
- Low or intermediate grade DCIS, size < 2.5 cm and margins > 3 mm

- Age 40-49 with “suitable” criteria
- Age > 50 AND: tumor 2.1-3 cm, estrogen receptor negative, invasive lobular carcinoma, margins < 2 mm, focal LVSI, DCIS < 3 cm not meeting “suitable” criteria
PATIENT SELECTION

- Age < 40
- DCIS > 3cm
- Margins positive

Patient selection is key!
Randomized clinical trials:
- ELIOT trial: Intraoperative radiotherapy with electrons
- TARGIT-A trial: 2000-2012. 5-year results of risk-adapted IORT versus WBRT.
  - >3000 patients in 11 countries
  - 5 year recurrence IORT 3.3% versus WBRT 1.3%
  - IORT concurrent with surgery 2.1% versus 1.1%
  - Fewer non-breast cancer deaths from stroke, MI and other cancers
  - Radiation-related quality of life factors: less pain, less breast and arm symptoms, better overall function

Registries:
- Dr. Mel Silverstein’s group, 2010-2017. 1000 cancers treated with Xoft IORT: Age >40, tumor < 3 cm, 94% ER positive. 28 ipsilateral recurrences (4 at the lumpectomy site, 13 same quadrant, 11 other quadrant), 4 axillary recurrences, 1 distant metastasis, no BC related deaths
Benefits

- Convenience
- Targeted treatment spares healthy tissue
- Fewer side effects
- Access to care
- Improved quality of life
- Reduced cost
Axxent® Controller Components

- Display Screen/Touch Screen Control
- Handheld Barcode Scanner
- Adjustable arm (in storage position)
- Well Chamber
- Wheel Brakes
Source high voltage cable attachment

Source connected to source nest

Applicator or hub attachment
Miniaturized X-ray Tube:  
The Electronic Brachytherapy Source

The Source Operates at 50 kV and 300 microamps (15 Watts)  
Low energy – High dose non-isotopic disposable source is unique to Xoft and allows for safe placement of source into surgical site without the need of a shielded bunker.

The lower energy of electronic radiation permits the treatment in an OR
EBX® HIGH DOSE, LOW ENERGY DELIVERS LESS RADIATION TO CRITICAL STRUCTURES (HEART, LUNG)

NO MODIFICATIONS TO THE OR
1. Sentinel Lymph Node Biopsy

2. Tumor Removal and Cavity Evaluation
Fill Balloon and Close Cavity With Sutures
Ultrasound to Confirm Skin Bridge

Minimal distance from balloon applicator surface to epidermis must be 1cm.

Measure Skin Bridge (=/>1cm)
MACHINE CONNECTION
QUESTIONS?