The Clinical Benefits and Challenges of the VSI CyberKnife System

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CyberKnife® Components

- Linear accelerator (6MV)
- Robot
- Image tracking system
  - KV x-Ray sources
  - Image detectors
  - 6D tracking
  - Fiducial and fiducial-less tracking
- Motorized couch
- Integrated treatment planning system

Linear accelerator

- 6MV X-band
- 1000 MU/min (2.5 times faster)
- Robot 20% faster

Image tracking system

- KV x-Ray sources
- Image detectors
- 6D tracking
- Fiducial and fiducial-less tracking
Iris Variable Aperture Collimator

- Rapidly change beam geometry
- Up to 12 beam sizes per linac position

Robotic Collimator Changer

- Automatically exchanges collimators robotically without entering the rooms

Fiducial tracking

- Can be used for any part of the body
  - Routine on all prostate cancer cases
  - Optional on lung cancer cases
  - Required for liver, pancreas, kidney tumors (due to respiratory motion)

Xsight Lung Tracking

- Uses the density of a lung cancer tumor on x-ray for tracking
**Xsight Lung Tracking**
- Uses the density of a lung cancer tumor on x-ray for tracking

**Xsight Spine Tracking**
- Used the treat spinal lesions
- Used the treat tumor without using fiduicals or Xsight lung tracking

**Xsight Spine Tracking**
- Used the treat tumor without using fiduicals or Xsight lung tracking

**Skull Tracking**
- Using the treat intracranial or skull tumors
Accounting for Respiratory Motion

- 4D CT and generation of ITV
- Respiratory gating
- Breath hold
- Respiration synchronized
  - CyberKnife
Respiratory tracking

- Treatment beam moves to follow the breathing cycle
  - Fiducial tracking or Xsight lung tracking
  - Optical markers on a special patient vest to track breathing cycle

Prior to treatment start: creation of dynamic correlation model
- Imaging system takes pictures of fiducials/tumor at discrete points of time
  - Optical markers are monitored in real time by a camera system

Position of fiducials compared with breathing cycle
Respiratory tracking

- This process repeats throughout the treatment, updating and correcting beam delivery based upon the patient’s current breathing pattern.

Thank You!