Democrats Radiosurgery
John R. Adler, M.D.
Stanford University

CONFLICTS OF INTEREST

• ZAP Surgical Systems
• Cureus Inc.
• Stanford University

Free Parking!!

“If you have no conflicts, I have no interest”
What neurosurgeons can do for patients is driven by our tools.

Radiosurgery: A Quiet Revolution

In 2003 the number of CPT codes for radiosurgery (then 61793) that were submitted exceeded the number of codes submitted for craniotomy for tumor, not meningioma.

Research

Effect of Radiosurgery Alone vs Radiosurgery With Whole Brain Radiation Therapy on Cognitive Function in Patients With 1 to 3 Brain Metastases
A Randomized Clinical Trial
TWO MILLION

- Two million brain tumor patients worldwide are potential candidates for stereotactic radiosurgery
- Yet only 150,000 receive such treatment
- Costs and complexity of legacy technologies push radiosurgery out of reach for too many

Radiosurgery: Problems & Opportunities

- Very expensive technology: $5M+
- Requires complex & costly hospital facility
- Most SRS facilities based on multi-purpose RT linacs
  - Devices cross multiple surgical specialties
  - More Flexibility = MORE complexity
- Complex radiosurgical devices require considerable training
- Out of reach for >90% of the world population
THAT WAS THEN. **THIS IS NEXT.**
A New Day Dawns....

ZAP-X GYROSCOPIC RADIOSURGERY

- No shielded treatment vault
  - Operating under full clinical workload with 1m safety perimeter
  - Resulting in <1.0 mSv dose/year
- Enables simpler point of care where the patients are:
  - Department expansions
  - Satellite facilities
  - Physician offices
  - ASCs

SELF-SHIELDED
**LINAC-BASED**

- Optimized for cranial radiosurgery, with steep dose gradient
  - 3MV S-Band linear accelerator
  - 1500 MU/minute
  - 45 cm SAD
  - 260+ non-coplanar beam angles
- No compromises of brain SRS for general RT

**Optimized Collimation**

- Multiple circular apertures
- Collimator leaks <0.01% of the primary radiation beam
- In comparison, multi-purpose radiotherapy MLC leakage ~.5%
SAFETY INNOVATION

- Real-time dose validation
  - Consumable MV dosimeter independently audits expected exit dose in real-time
  - Mitigates potential risk of mechanical or human error

APPLICATIONS

Primary & metastatic brain tumors
Functional & vascular disease (e.g., trigeminal neuralgia, AVM)
Head & neck lesions
Cervical spine lesions

ZAP-X GYROSCOPIC RADIOSURGERY

Shielded Treatment Sphere
MV Imager/Dose Monitor
Imaging Detector
Collimator
LINAC
Patient Table (3 degrees of freedom)
KV Tube
MV Tube
Shielded Rotary Shield
Shielded Vertical Door
Steering Motor System
EXOSKELETON

- 3D gyroscopic gantry mobility
  - Two axes of motion give > solid angle coverage
- 83 cm bore diameter
  - Similar to large bore CT or CT-Sim
  - 1.4X larger than standard MRI (60 cm)
- 165 cm treatment sphere interior

IMAGE GUIDANCE

- Integrated KV imaging system provides real time tracking
- Intra-fraction image guidance & auto-alignment throughout SRS
- User-defined frequency

TREATMENT PLANNING

- Image types
  - Primary: CT
  - Secondary: MRI, PET
  - CT, additional CT
- Isocentric planning & delivery
  - Forward
  - Inverse
- First gen system already allows for satisfactory conformity with complex target shapes
Radiomodulation

- Radiosurgery at non-lesioning doses
- Specific nodes (gray matter) or connections (white matter) within a brain circuit are targeted
- Hypothesized to focally reduce metabolic activity
- Circuit up-regulation or down-regulation
- Potential to be a major advance in the treatment of psychiatric illnesses

Cg25 Irradiation for Intractable Bipolar Disorder

John R. Adler, Jr., Scott Soltys, Brent Solvason
Stanford
60 Gy to bilateral subgenual cingulate: Significant decline in depression scores in 2/3 patients, sustained at 1 year

Hamilton Depression Score

The Future of Neurosurgery?

Year 2264
Precision Directed Energy?
Who said?

“I would like to see the day when somebody would be appointed surgeon somewhere who had no hands, for the operative part is the least part of the work.”

Harvey Cushing