SYLLABUS

TC37: Functional Neurosurgery and DBS

Thursday, November 17, 2011 09:00 - 12:30 Hall 3

Marrakesh, Morocco, November 12-17, 2011

XXth WORLD CONGRESS OF NEUROLOGY

XXth WCN 2011 MARRAKESH World Congress of Neurology

WFN

SMN SOCIETE MAROCAINE DE NEUROLOGIE

WCN Education Program

Thursday, 17 November, 2011

09:00-12:30

FUNCTIONAL NEUROSURGERY AND DBS

Chairperson: **Tipu Aziz**, *USA*

HOW CAN WE USE FUNCTIONAL NEUROSURGERY IN EPILEPSY
Christian Elger, *Germany*

CURRENT INDICATIONS AND RESULTS OF DEEP BRAIN STIMULATION FOR MOVEMENT DISORDERS
Badih Adada, *Lebanon*

FUNCTIONAL NEUROSURGERY, CURRENT AND FUTURE DIRECTIONS
Tipu Aziz, *USA*

10:30-11:00 *Coffee Break*

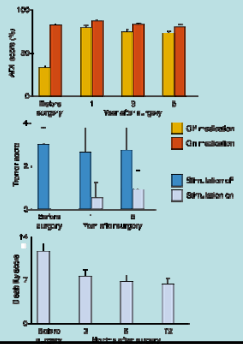
Functional Neurosurgery, Current and Future Directions

Professor Tipu Z Aziz, D.Med.Sci
Nuffield Department of Surgery
University of Oxford

UNIVERSITY OF OXFORD

Established DBS Indications

- Parkinson's Disease
- Tremor
- Dystonia



Parkinson's Disease

- Pre-op
- Unpredictable OFF periods
- Severely disabled in OFF state by tremor & akinesia

Parkinson's disease treated

- L Dopa
- On-Off Effects
- Dyskinesias
- Psychiatric effects

Parkinson's disease

- No understanding of the neural mechanisms
- 1979 MPTP case report
- 1983 primate MPTP model
- Electrophysiology
- 2-DG studies

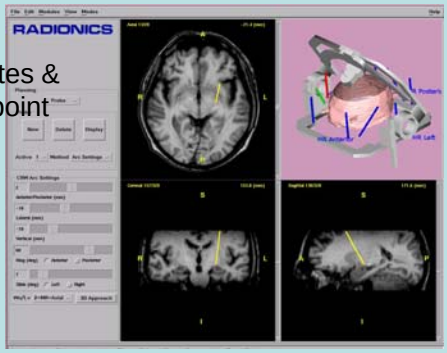
Frozen Addicts

STN lesion in MPTP primate

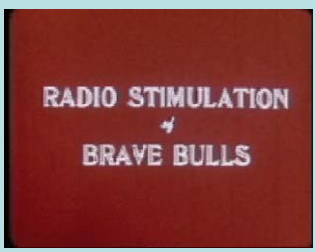
- Parkisonian Primate
- L-DOPA responsive
- Unilateral STN lesion
- Total Reversal
- 2-DG studies reduced uptake in PPN

Surgical Technique

- Co-ordinates & entry point set



Deep Brain Stimulation



Deep Brain Stimulation

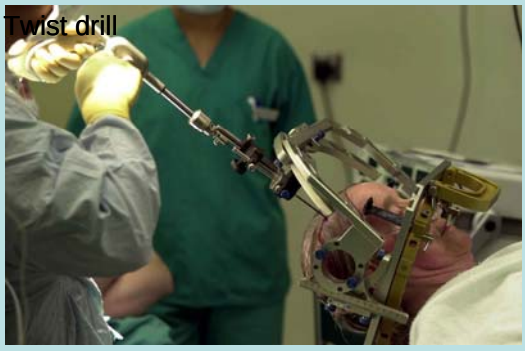
- Reversible
- Safer bilateral surgery
- Expensive
- Multiple surgeries over patient lifetime

Models of DBS Mechanisms

- Depolarisation block
- Activation of neuronal terminals that inhibit/excite efferent outputs (synaptic modulation)
- Depletion of efferent transmitters
- Network jamming
- Enhancement of transmitter release

Surgical Technique

- Twist drill



Surgical Technique

- Macrostimulation

Surgical Technique

2-DG studies in MPTP primate

Over active STN
Excess inhibition of PPN
Could STN surgery be therapeutic?
DeLong-Ibotenic Acid lesions of STN
Crossman- RF lesions of STN

STN Stimulation

PPN and Parkinson's Disease

- Degenerate in parkinsonian brain.
- Degenerate in akinetic non-parkinsonian disorders eg MSA and PSP.
- Also degenerate in DYT1 dystonia.

POST-MPTP

- Parkinsonian after MPTP

POST-MPTP + BICUCULLINE

- Note reversal of parkinsonian signs

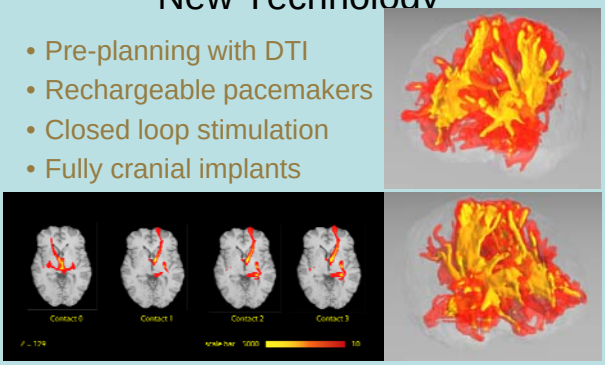
PPN DBS Freezer-Fallers

Neuropathic Pain DBS

Cingulate DBS Depression

New Technology

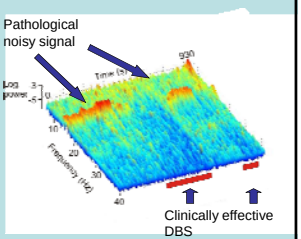
- Pre-planning with DTI
- Rechargeable pacemakers
- Closed loop stimulation
- Fully cranial implants



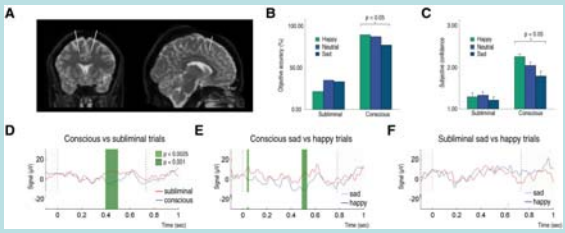
Owen *et al* (2008) *JCON*

Pathological Oscillations in PD

- Established the nature of the pathological 'noisy' signal in the brain in PD
- Demonstration that DBS works by suppressing local 'noise' in the brain
- Proof that one of the key functions of the human basal ganglia is the optimisation of motor programs given feedback on recent performance

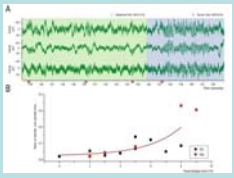


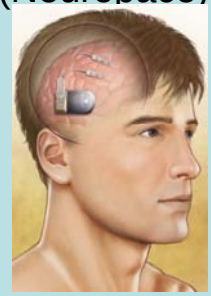
ACC DBS for Pain



Cranial Device (Neuropace)

- Closed loop
- Cranial implant
- Epilepsy
- Under trials





Green *et al* (2009) *Neurology*

Brain Machine Interface

- Rhesus Monkey
- Implanted electrodes
- Robotic arm

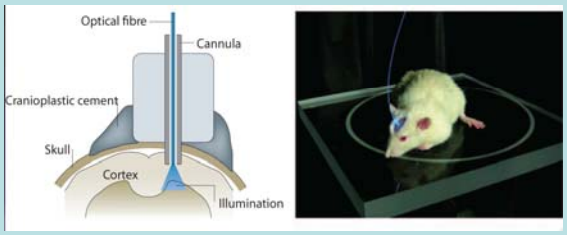
Optogenetics

Optical Deconstruction of Parkinsonian Neural Circuitry

Viviana Gradinaru,[1,2]* Murtaza Mogri,[1]* Kimberly R. Thompson,[1]
Jaimie M. Henderson,[3] Karl Deisseroth[1,4]†

Deep brain stimulation (DBS) is a therapeutic option for intractable neurological and psychiatric disorders, including Parkinson's disease and major depression. Because of the heterogeneity of brain tissues where electrodes are placed, it has been challenging to elucidate the relevant target cell types or underlying mechanisms of DBS. We used optogenetics and solid-state optics to systematically drive or inhibit an array of distinct circuit elements in freely moving parkinsonian rodents and found that therapeutic effects within the subthalamic nucleus can be accounted for by direct selective stimulation of afferent axons projecting to this region. In addition to providing insight into DBS mechanisms, these results demonstrate an optical approach for dissection of disease circuitry and define the technological toolbox needed for systematic deconstruction of disease circuits by selectively controlling individual components.

Optogenetics



Optogenetics

- Hegemann, Bamberg,Nagel 2005:
- Channelrhodopsin-2 excites to Blue light
- Same folks: Pigment inhibits to Yellow light
- Deisseroth 2007: Lateral Hypothalamus
- CHR-2-wakes sleeping mice by release of Orexin

Optogenetics

Fiberoptic Control of Locomotion in ChR2 Mouse

Acknowledgements

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