

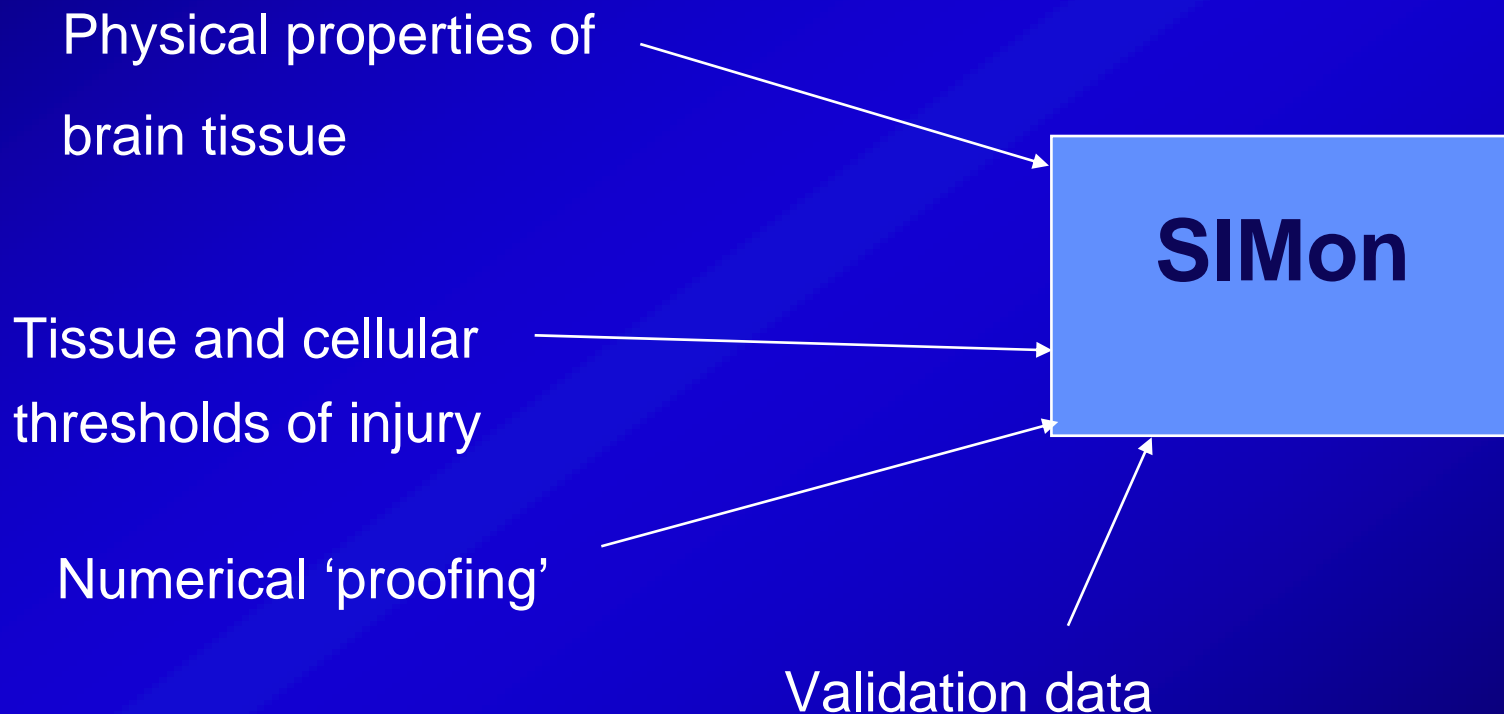
Archive of Nonhuman Primate Brain Injury Studies

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Southern Consortium for Brain Injury Biomechanics Overall Objective

The primary objective of the consortium is to generate the scientific foundation for a new method of predicting the probability of brain injury, given an applied input loading condition to the head

Head/Brain Research Domain - integration



Validating SIMon - Approaches

Approach (Disadvantage)

- Human volunteer (Injury? Biased)
- PMHS tests (Injury? Detection)
- Reconstructions (Reliability)
- Experimental models of TBI (Scaling, input, Species)

Archive

Goals

To evaluate recorded data from more than 150 subhuman primate inertial brain injury studies with the physiological data and biomechanical data.

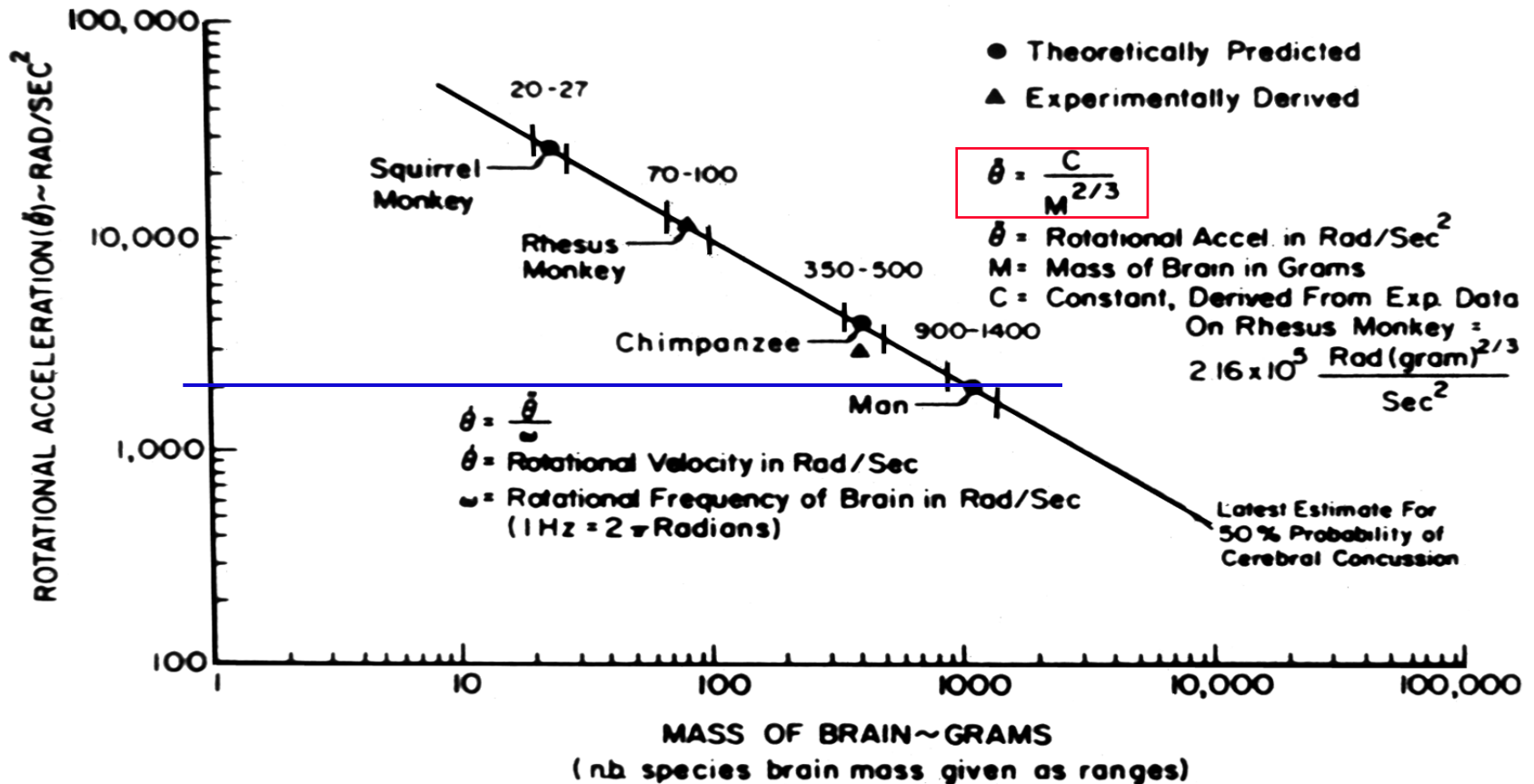
To develop a high quality dataset of the integrated information from a subset of these animal experiments for use in validating injury predictions from the SIMon project.

This data would provide critical PRIMATE validation data for the SIMon model to establish a performance corridor for predicting specific brain injuries.

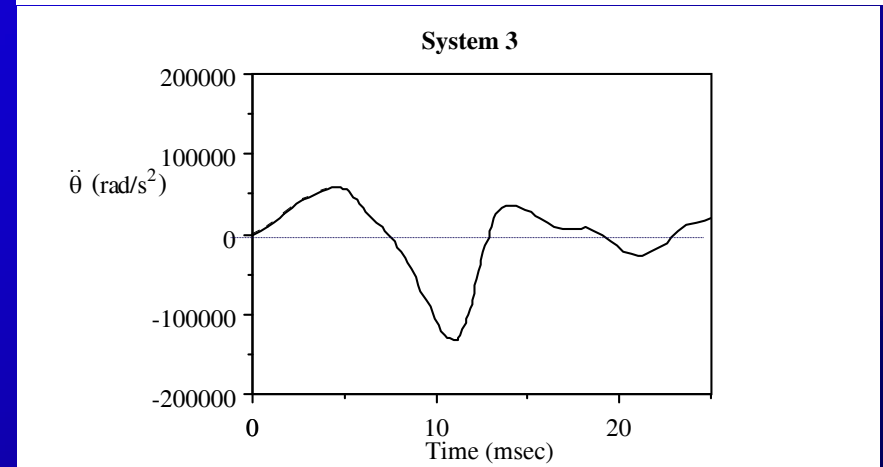
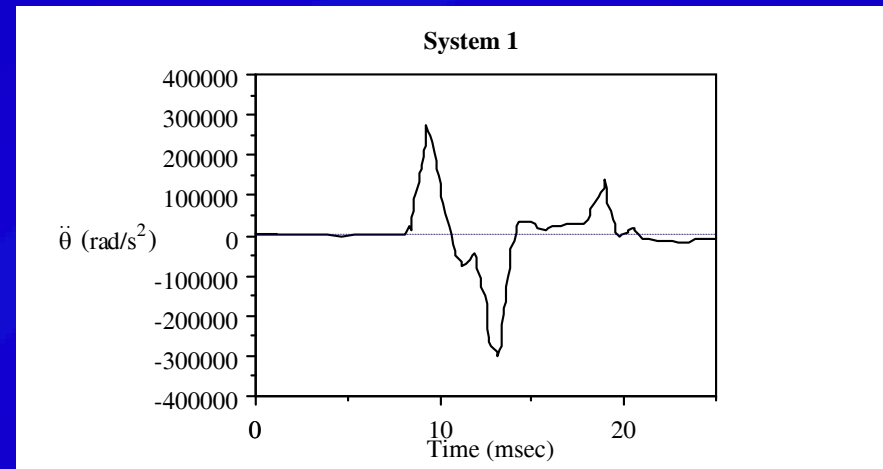
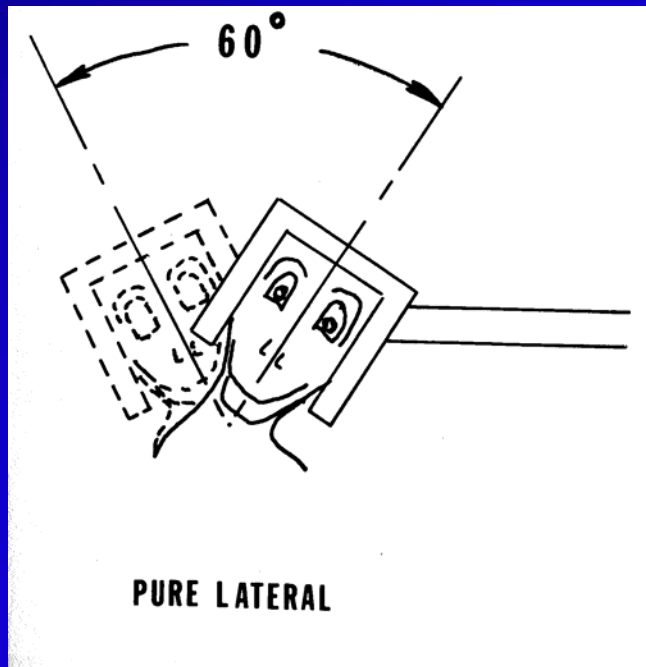
NIH - NHTSA Sponsored Primate Head Injury Studies 1976 - 1985

- 5 species (brain mass 20-145 gm)
 - Squirrel monkey
 - Rhesus monkey
 - Cyanomologus monkeys
 - Baboons
- Purely inertial rotational loads (no skull fracture)
- Loss of consciousness - concussion and coma
- Life-threatening subdural hematomas
- Single and repeated injuries
- Acute (hrs) and long-term survival (months)

Existing data sets - is this needed?

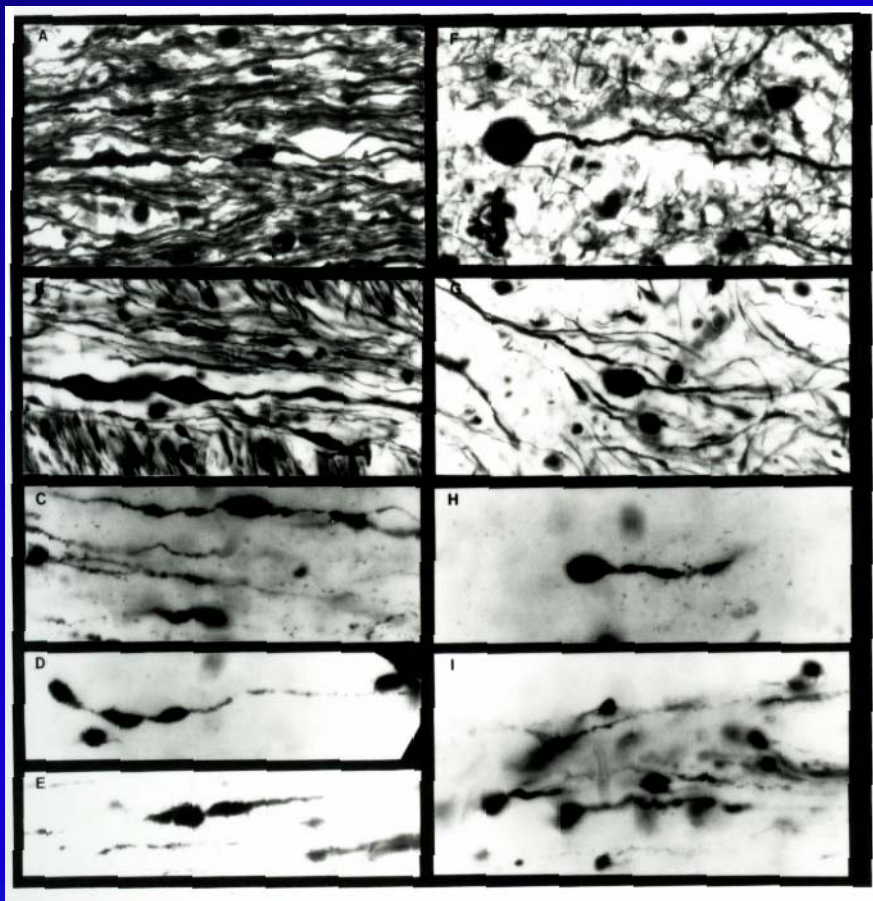


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Penn Primate Pathology Data

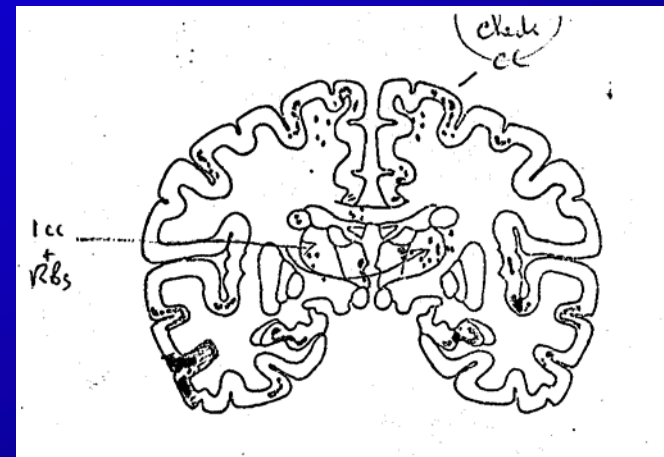
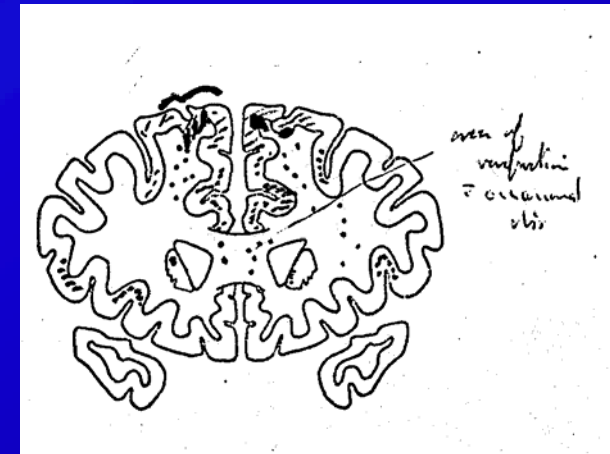
Micrograph analysis



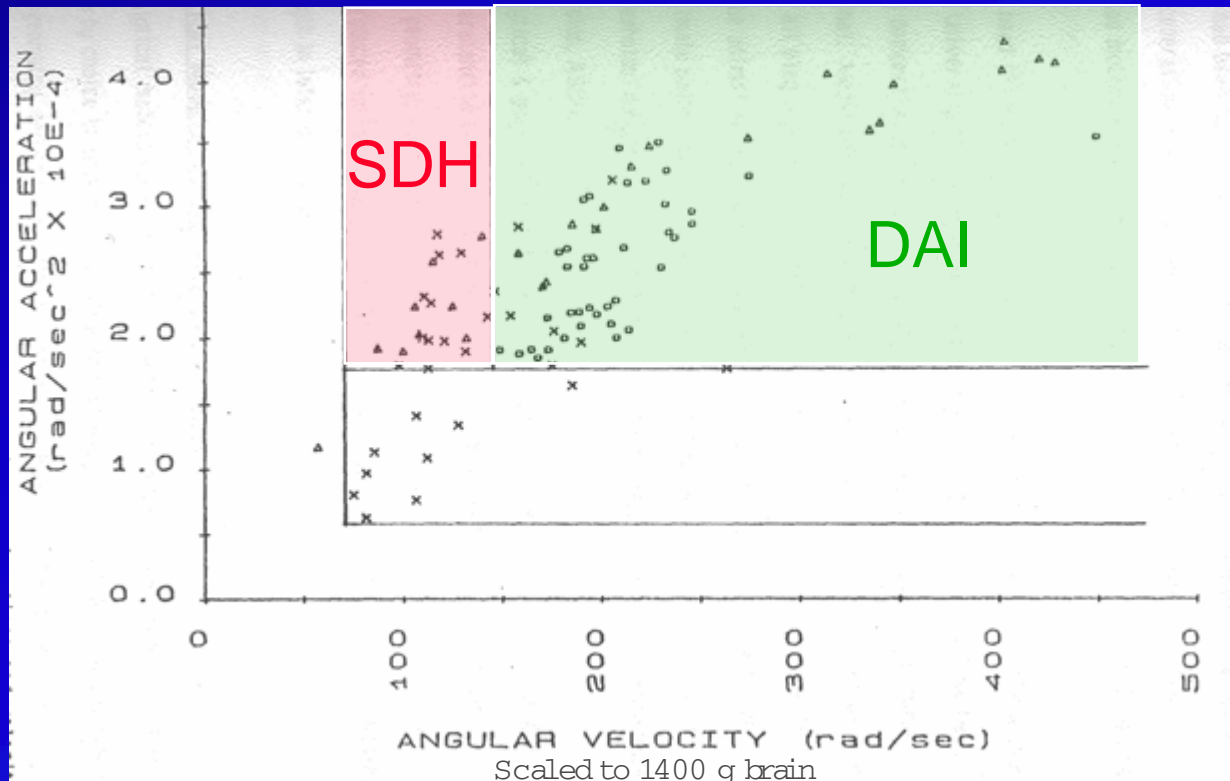
Subhuman Primate

Human

Gross evaluation



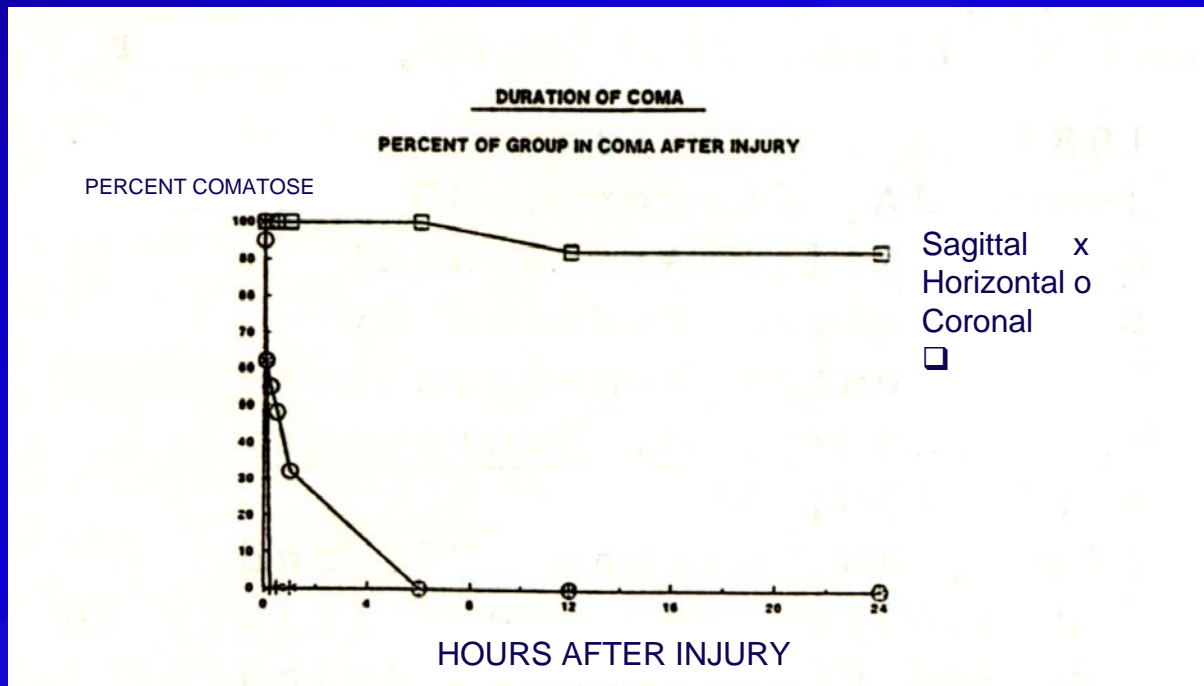
Approximating the conditions associated with different injuries



- Thresholds are injury-specific
- Importance of load direction

Functional consequences of inertial loading

Effect of Rotation Direction



Specific Objectives

- Transfer materials from Glasgow to Penn - *Year 1*
- Catalogue biomechanical information - *Year 1*
 - Linear tangential acceleration trace
 - Locations of center of rotation, center of mass, accelerometer
 - Peak rotational acceleration magnitude, direction, duration
 - Brain mass data
- Catalogue tissue blocks, stained tissue slides, and histological reports at University of Glasgow - *Year 1*
- Scan in graphical and photo information - *Years 1 and 2*
- Digitize acceleration traces - *Years 1 and 2*
- Select several well-characterized cases from coronal, sagittal, and horizontal plane rotational studies for use in SIMon validation - *Years 1 and 2*

The challenges of the archive

- Historical data
- Multiple points of information - need to centralize
- Data quality and assurance
- Access and security

Reducing the data set

- Emphasize data quality and completeness
- Biomechanical data
- Histopathological data
- Physiology data

Reducing the data set

Biomechanical Data

- Full acceleration trace? Off axis?
- Integration and signal fidelity
- Velocity and displacement within range
- Noise analysis and signal error
- Specific linkage design /motion constraints

Reducing the data set

Histopathological Data

- Availability
- Consistency of outcomes
- Data clarity
- Data comparability

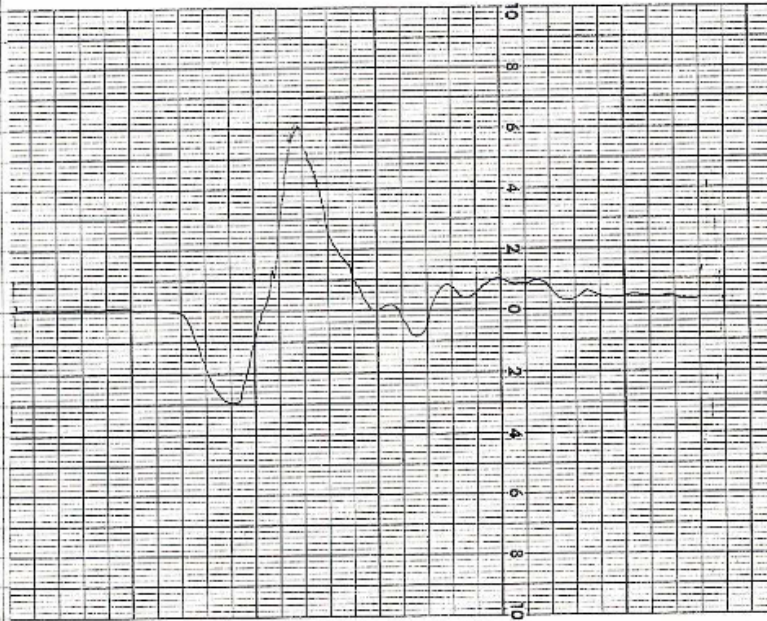
A typical case study

- Baboon
- Lateral direction
- Comatose, severe traumatic coma grade 5
- Full histopathology

Evaluating and proofing the content

Fidelity of the biomechanical data

B-21 8.7 R_g ♂ brn wts not avail.
 1/12 died 1/15 coma



RECORDING CHART M ENDEVCO San Juan Capistrano, California 92675

No cal here, so assume 30 boxes = 1500g, 10 mm = 5 mm/sec

$$\frac{2.95}{3.5} = .84$$

$$g_c @ c_g = \frac{30 \text{ boxes} \times 1500 \text{ g}}{30 \text{ boxes}} \times .84 = 1260 \text{ g}$$

$$\ddot{z} = 1260 \text{ g} \times \frac{396 \text{ in}^2/\text{s}^2}{1 \text{ g}} \times \frac{1}{2.95 \text{ in}} = 1.649 \times 10^5 \text{ in/s}^2$$

$$\ddot{z} = 11.5 \text{ m/s}^2$$

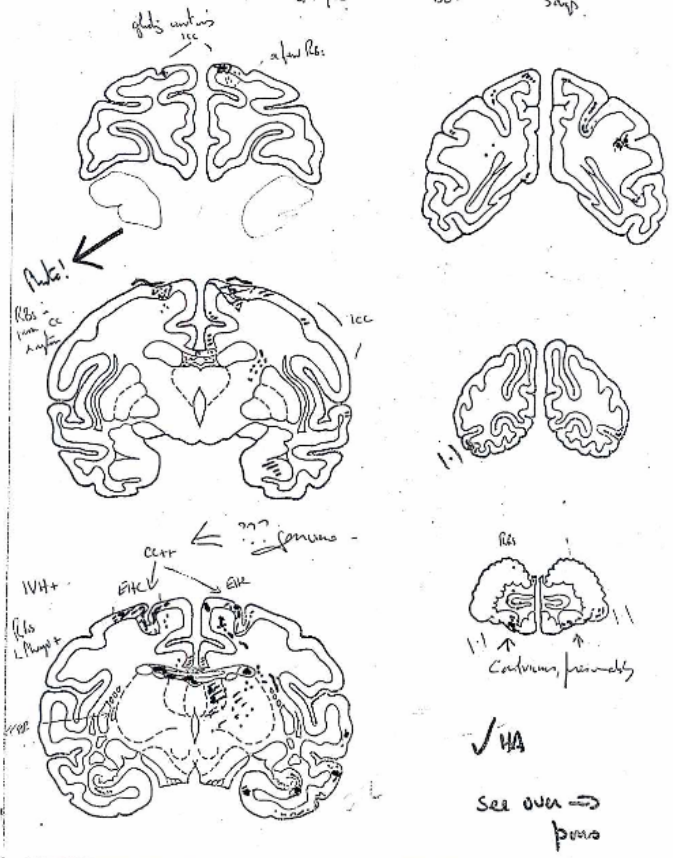
- Integration of signal (check)
- Error analysis (check)
- Linkage design (check)

Evaluating and proofing the content

Completeness of the neuropathological
data

Coronal Sections of Monkey Brain (97)

G 11/82 821 3hps



QuickTime™ and a decompressor are needed to see this picture.

Securing access to the content

- Advisory Board formed
- Proposal submission process developed
- Proposal review process in place
- Proposal monitoring
- Public dissemination

Deliverables to the NHTSA

- Complete biomechanical profiles
 - 6 lateral
 - 5 horizontal
 - 1 oblique
 - 3 sagittal
- Histopathology data
- Access and followup process

Acknowledgements

Funds were provided by the Southern Consortium for Injury Biomechanics