



# “Is it possible that...?” Abusive Head Trauma and a Couple Controversies



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# Objectives

- Review abusive head trauma pathology
- Discuss and debunk two common alternative theories to abusive head trauma

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# Abusive Head Trauma

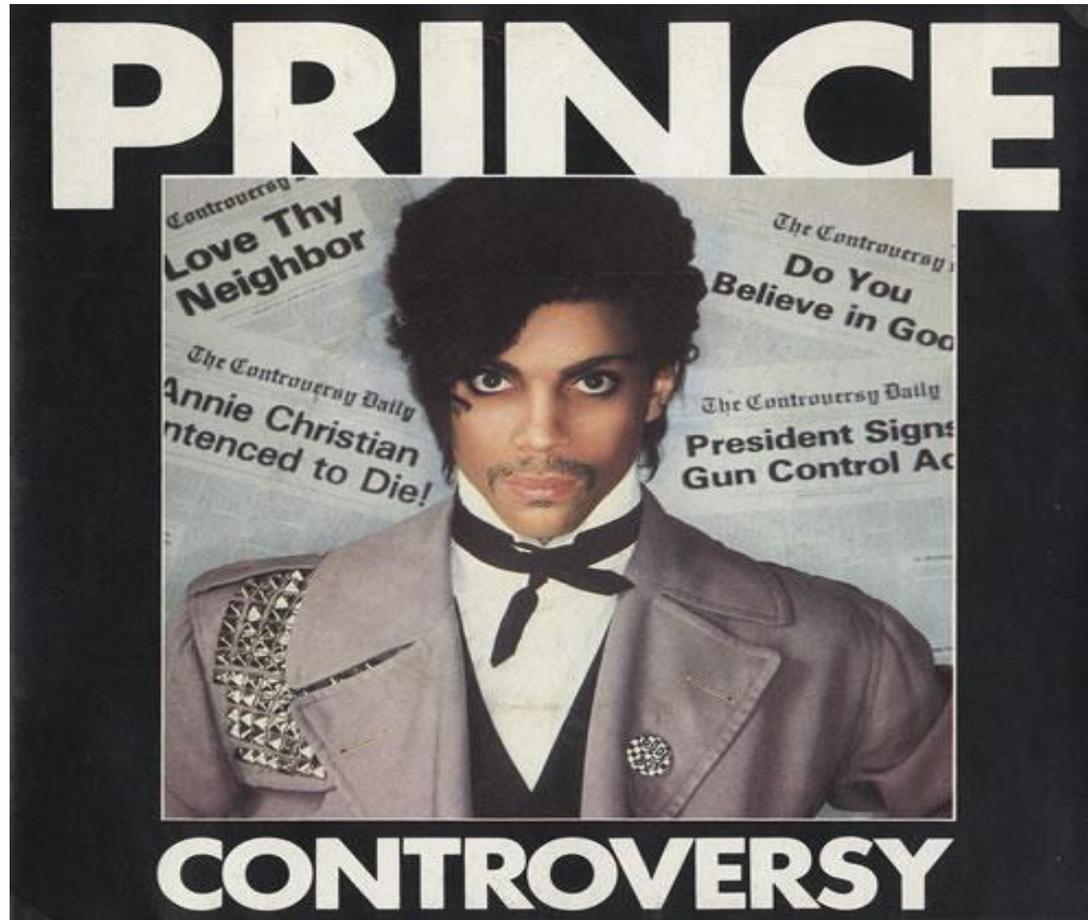
## Mechanisms

- Direct blunt impact (blow to head; baby or child is throw down)
- Shaking (acceleration/deceleration -- think whiplash-like injury)
- Combination of shaken and impact
- Asphyxiation/hypoxia

## Injury Types

- Intracranial Hemorrhage – bleeding inside of the skull
- Traumatic Axonal Injury
  - “Shear injury”
  - Contusions
- Cytotoxic Injury- injury to the brain cell
- Ischemic Brain Injury- from lack of oxygen
  - Atrophy
  - Encephalomalacia

# How much contention could there be?!



# There Is No Medical Controversy

- **Broad medical consensus:** AHT is a true trauma event. Careful diagnosis can rule out other confusing conditions and mimics.
  - It is unethical to state that aggressive shaking is safe!
  - Prevention efforts must continue and focus on safety.
  - Choudhary AK, et al. Consensus statement on abusive head trauma in infants and young children. *Pediatr Radiol.* 2018 Aug;48(8):1048-1065. doi: 10.1007/s00247-018-4149-1. Epub 2018 May 23. PMID: 29796797.
- **Narrow legal controversy:** Cadre of defense-focused professionals creating a culture of denial and discord in court settings.
  - Testimony confusing the actual diagnosis permeates public opinion.
  - Downstream effect on our ability to keep children safe.



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# Controversy #1

“Shaking alone can’t possibly cause these injuries!!!”



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# Does shaking really cause injuries?

- Several 'professional' defense witnesses (pathologists, neurosurgeons, and neurologists) refuted *Shaken Baby syndrome* diagnosis in court.
- 2004 British Medical Journal prints editorials from these individuals, again questioning the diagnostic criteria, science and existence of SBS.
- There is no scientific model of shaking injury.
  - Does anyone want to offer their child for a prospective study on the effects of shaking?!!

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# Can shaking really cause injuries?

## Where the Controversy Began

- Whiplash studies in primates gave us threshold values for force necessary to cause a concussion in an adult.
- Non-human, single event.

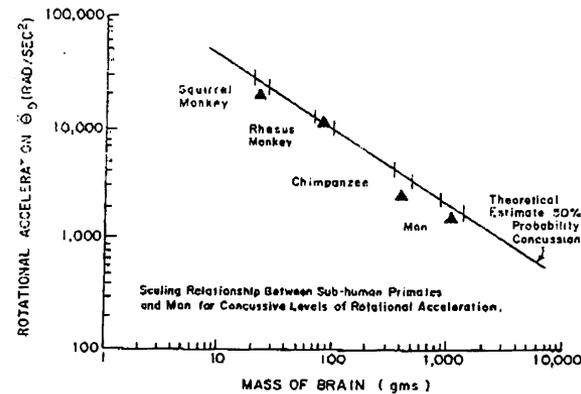
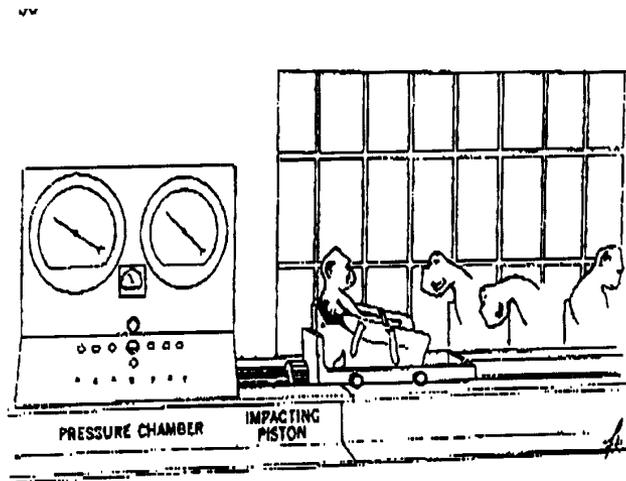


Fig. 6. Theoretical scaling of probability for onset of cerebral concussion in primates assuming that the crucial variable between species is mass of brain and that the crucial injury mechanism is severe shear strain imposed by brain rotation.

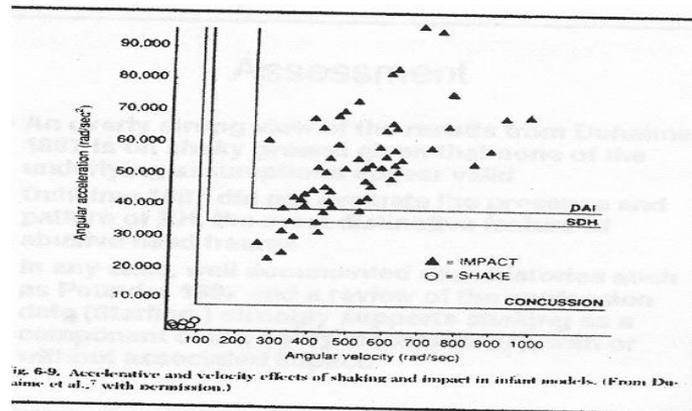


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# Can shaking really cause injury?

## Where the Controversy Began

- 1987 Duhaime 2 part study: 48 infants with AHT (30/48 blunt impact to the head) & a biomechanical experiment
- Shaking alone did not reach threshold for concussion or SDH.
- Cited as a prior evidence that shaking alone can not cause injury.



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# Limitations....

- Thresholds from *monkeys* or scaling from adult thresholds
  - Monkey and baby human brains are similar???
  - Data suggests injury thresholds in infant brains are lower than predicted by their mass





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# Limitations...

- Thresholds derived from *single accelerational events*
  - Repetitive angular accelerations (shaking) may lead to very different consequences
- We simply *don't know* what the injury thresholds are for infant brains undergoing repetitive accelerational movements
  - Again, who wants to offer their infant to this type of study?!



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# What do we know???

- Studies regarding perpetrator confession data
  - Starling, et al. 2005
    - 81 cases with perpetrator admissions included
    - 55 perpetrator admitted to shaking
    - No impact described in 54%
    - Immediately symptomatic in 91% of cases describing SX
      - Other 9% less clear, but symptoms within 24 hrs

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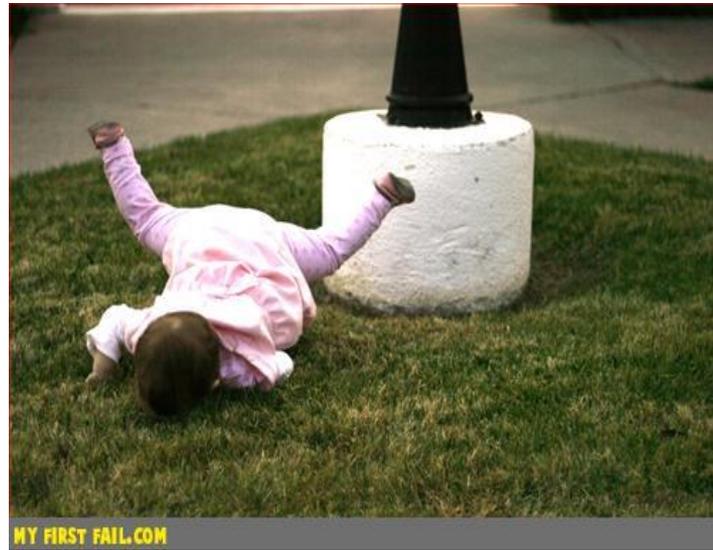




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# Controversy #2

"This child died from a fall off the couch...!!!"





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# Case Study

- 11 mo male, previously healthy
- Home with mother's boyfriend
- Loud bang and squeal heard in bedroom
- Patient found on "hard linoleum floor," face down... on some steel-toed boots
- Pt went apneic and was given rescue breaths over mouth and nose



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# Can Short Falls Kill?

John Plunkett, MD (2001)

- Found 18 fall-related head injury fatalities
  - Review of falls from playground equipment from 1988-1999
- Falls reported from 2-10 ft height
- Mean age of 5.2 years
- Reported 12/18 with a “lucid interval”
  - Only 4 reported >1 hour
  - One assoc. with epidural hematoma
  - None were completely asymptomatic

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# Can Short Falls Kill?

- Chadwick, et al. (2008): Reviewed literature and databases on injuries from children's falls (<4.7 ft) from 1999-2003
- Deaths per million children < 5yo per year in CA
  - 316: birth defects
  - 165: prematurity
  - 33: cancer
  - 38: respiratory disease
  - 22: homicide
  - **0.48: short falls**
  - This is likely the MAXIMUM number (could it be zero?)

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# Can Short Falls Kill?

- Chadwick, et al (2008) also highlighted several limitations to Plunkett's study
  - 12 year search to locate 18 fatalities
  - Half of the cases were children >5yo
  - Some cases were unwitnessed
  - One case not "short fall"
  - Cause of death in one case was uncertain

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# Exceptions to Short Linear Falls

- Epidural hemorrhage – space occupying EDH especially in older children; not often associated with abuse
- Ruptured AVM and arachnoid cysts
- Bleeding disorders (rare)
- Hemorrhage with a pre-existing intracranial defect
  - Cerebral atrophy
  - Increased extra-axial spaces
  - Prior-intracranial bleed

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# Can Short Falls Kill a Child?

- Yes, rarely, and under specific circumstances
- These cases are *usually* self evident by history and have distinct pattern of injury
  - Adults falling downstairs while carrying infant
  - Children in walkers tumbling downstairs
  - Playground falls to hard surfaces
  - Falls in older children after climbing trees, heights

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# Questions??



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