

# **Crash Injury Data for Automotive Engineers**

## **Lessons from Real Life**

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# Motor Vehicle Crashes

- 1,000,000 deaths per year worldwide
- No. 2 global health problem by the year 2020 – W.H.O.

# **Crashes in the USA**

**40,000 killed**

(115/day, 1/13 minutes)

**3,000,000 injured**

# **Crash Injury for Engineers:**

**Femur load**

**HIC**

**TTI**



Real life!

It can't be replicated by dummies and  
standardized tests.









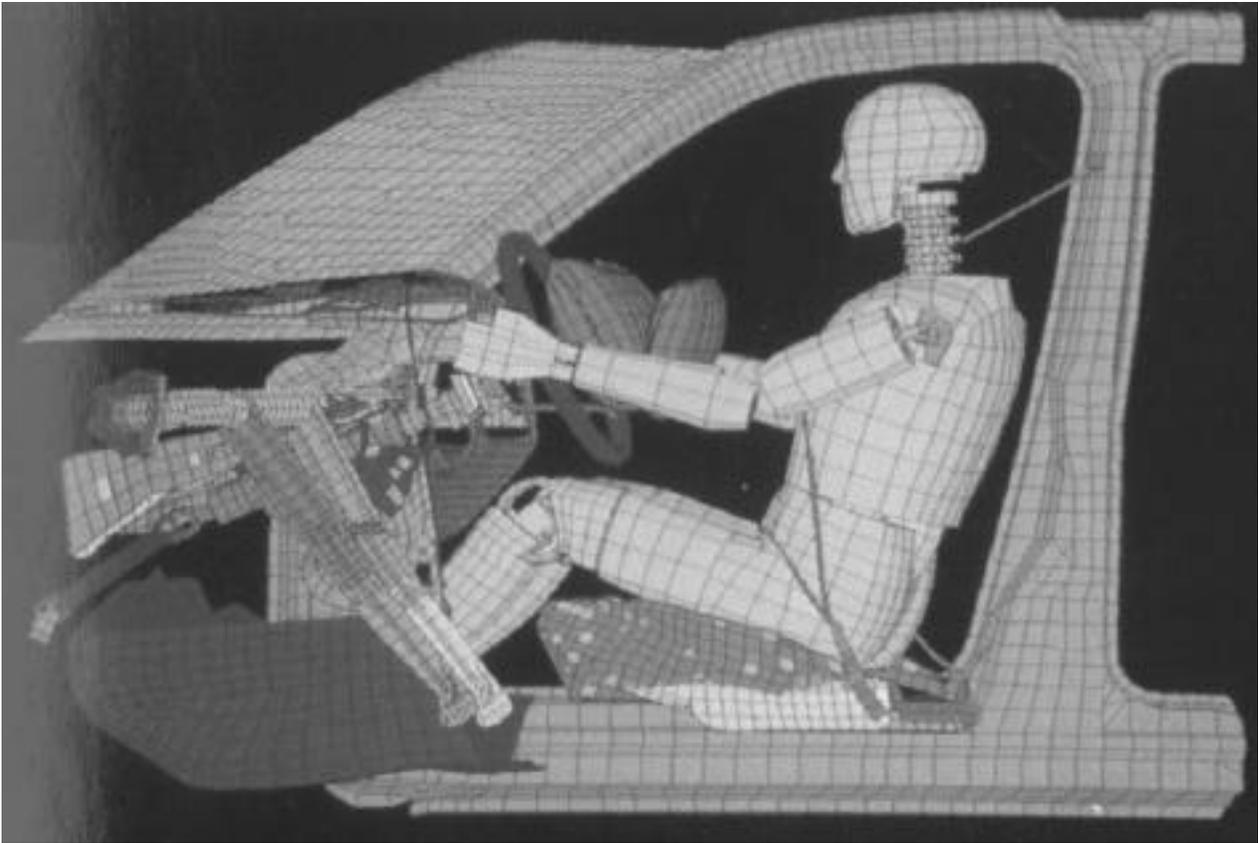
# Automotive Safety

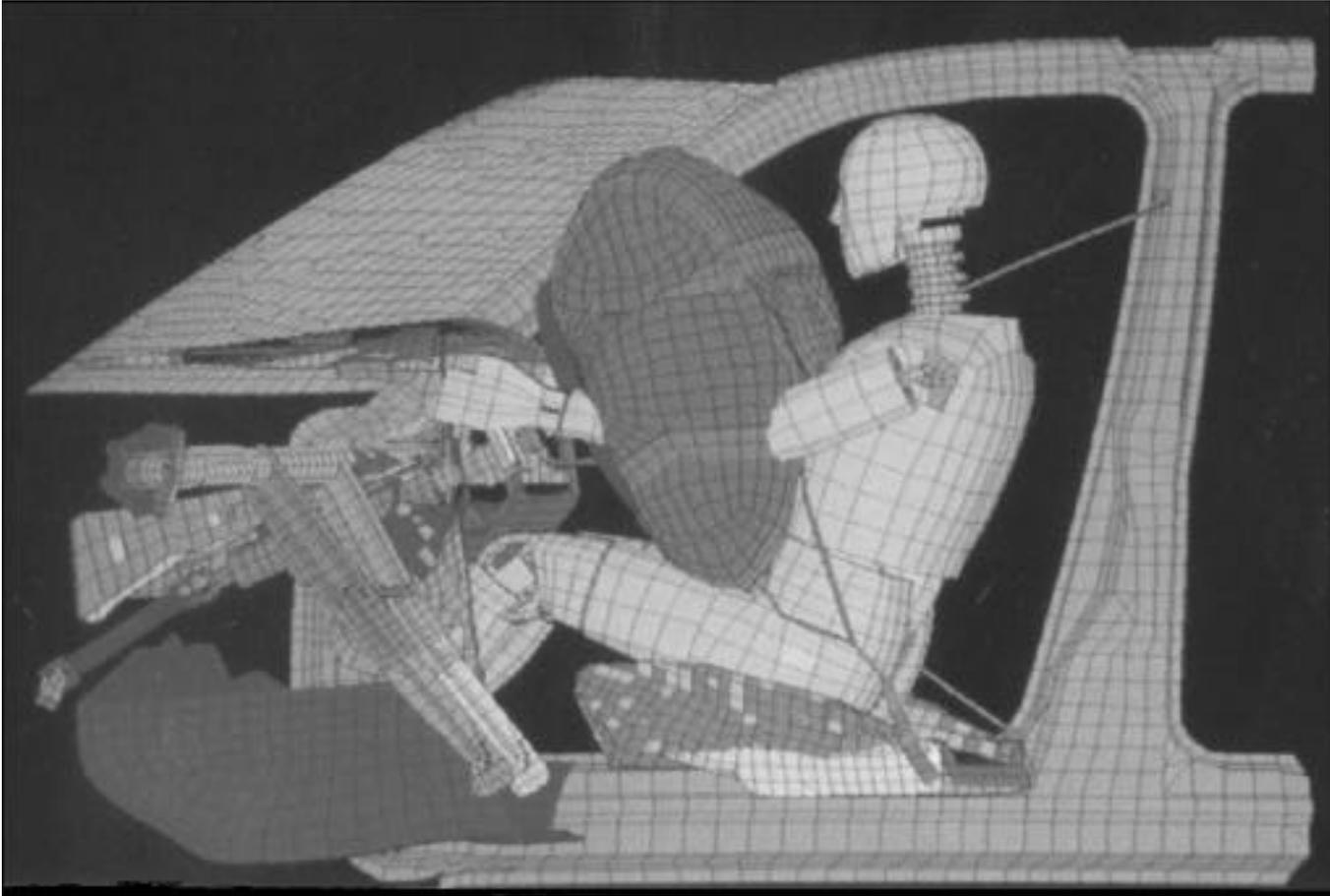
- It's not about numbers, forces, percentages.
- It's about people. Human loss and suffering.

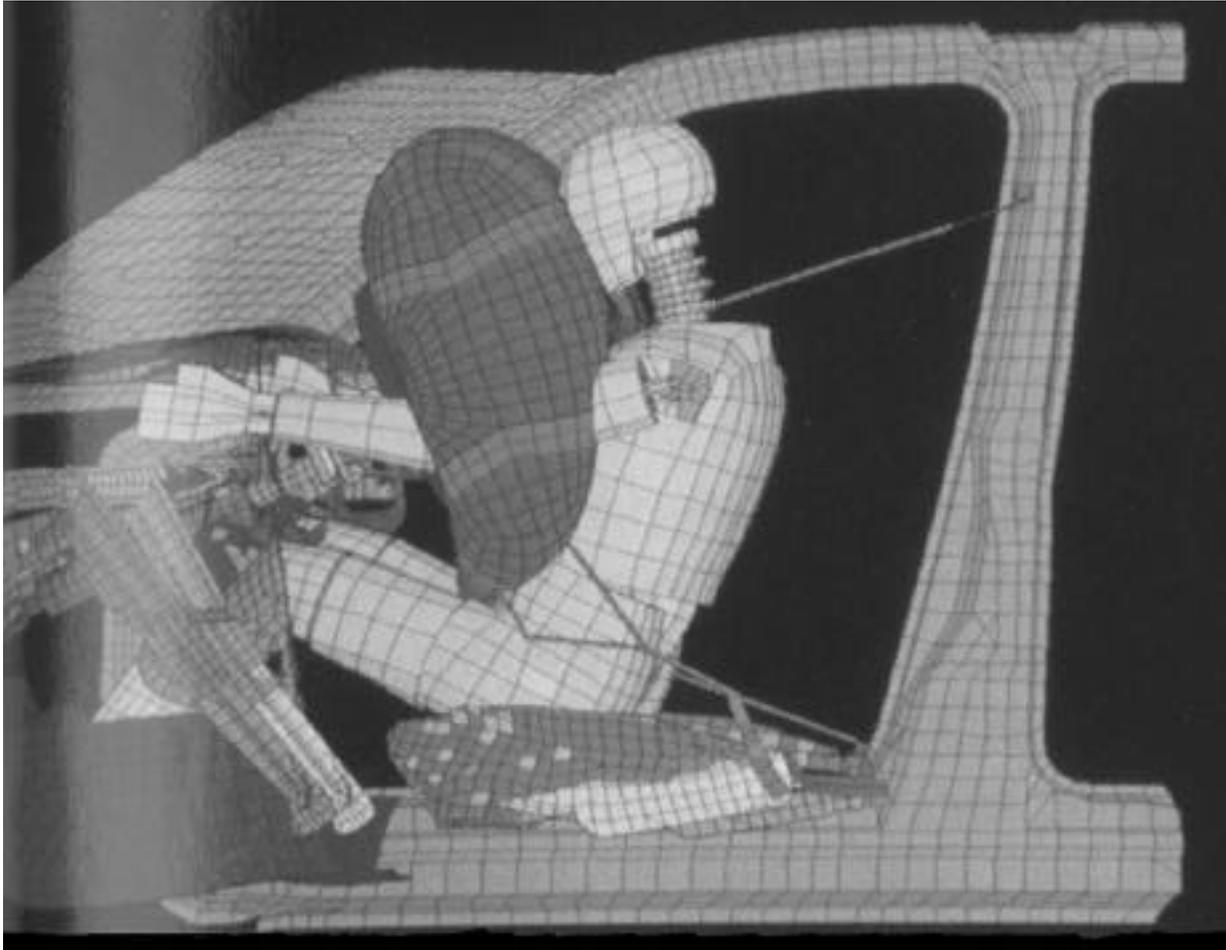


People don't sit still and behave  
logically.

Real life crash conditions may not resemble  
those in the crash laboratory.







# Case 1



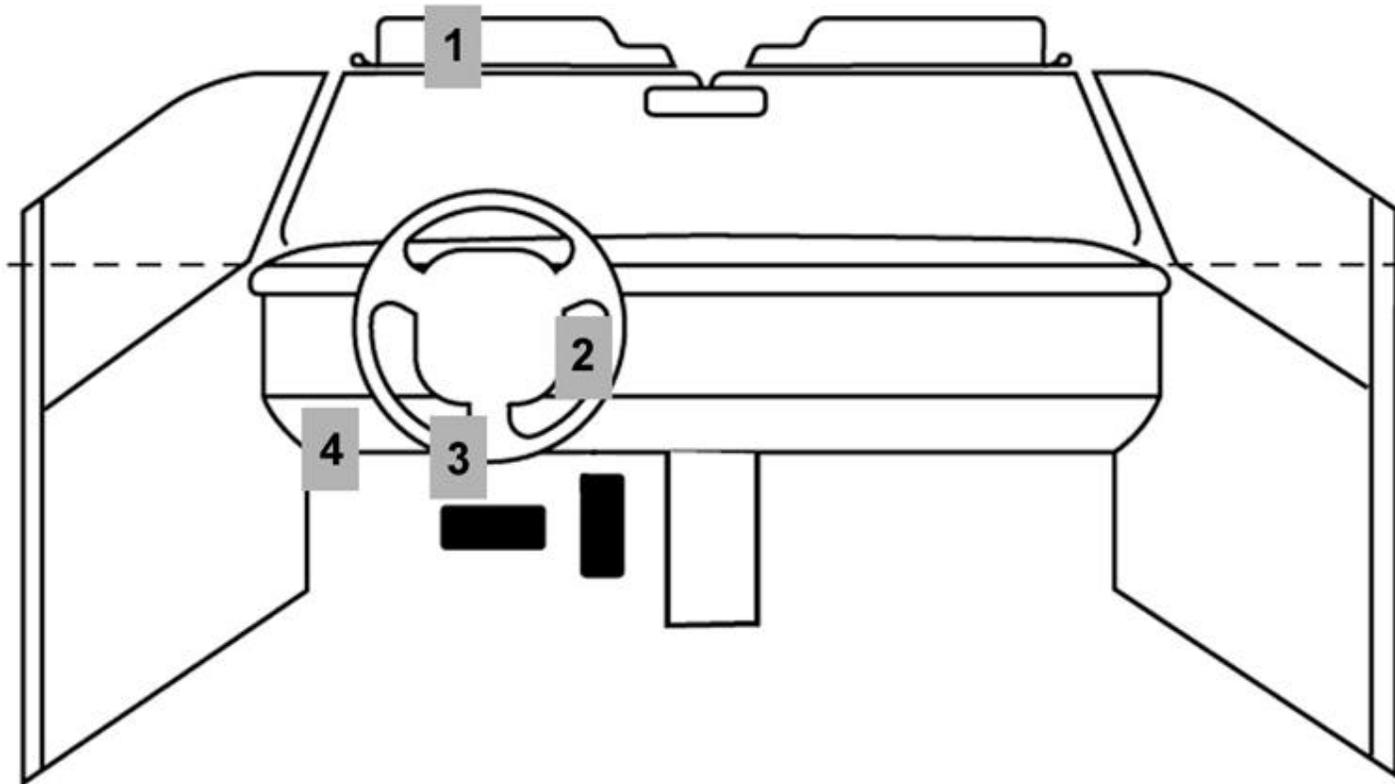
- **Case Vehicle: 1995 Ford Taurus**
- **Object Struck: Tree**
- **Impact Type: Offset Frontal (34% VOL)**
- **PDOF: 0**
- **CDC: 12FDEW3**
- **Direct Damage: 46 cm**
- **Max Crush: 81 cm**







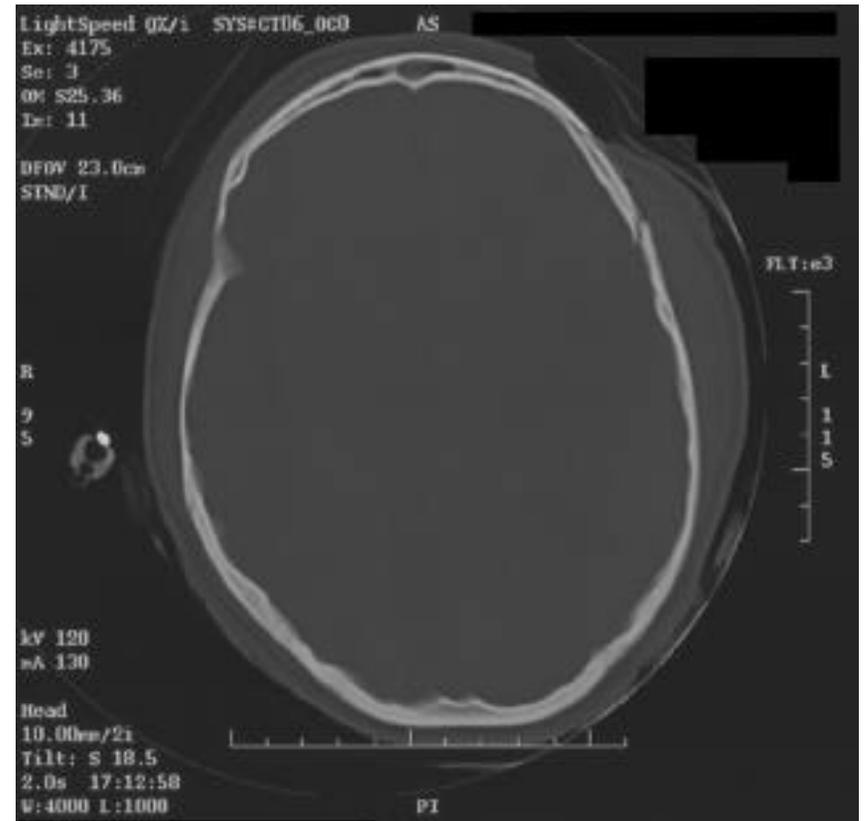
**Case Vehicle: 1995 Ford Taurus**  
**Object Struck: Tree**



- 1 = Scuff mark and vanity mirror broken**
- 2 = Scuff mark, key top broken and blood deposit**
- 3 = Visible dent**
- 4 = Visible dent**

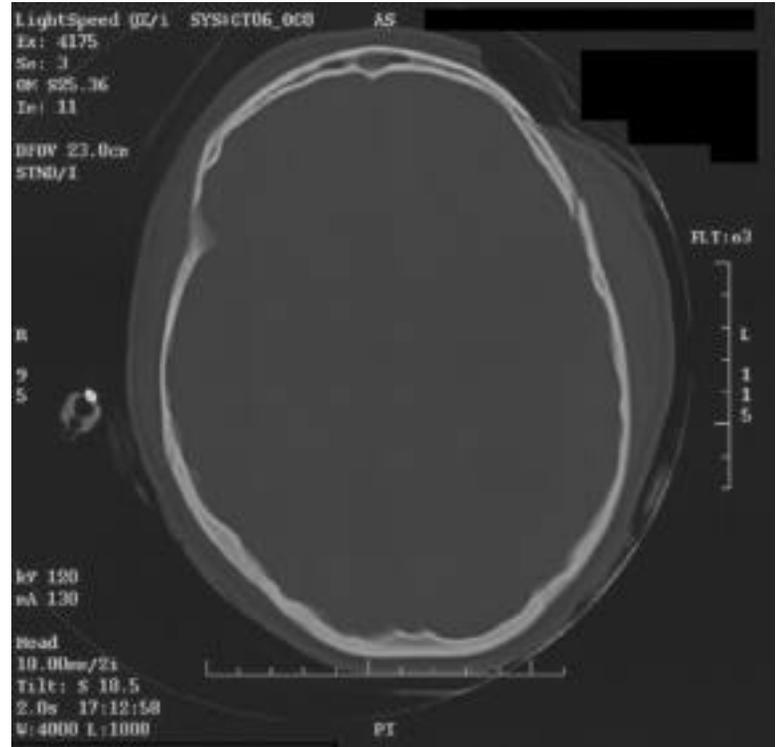


**Left forehead laceration**  
**Left frontal bone fracture**  
**Soft tissue swelling**















The population is comprised of a diverse collection of individuals.

There are few 50th percentile males.

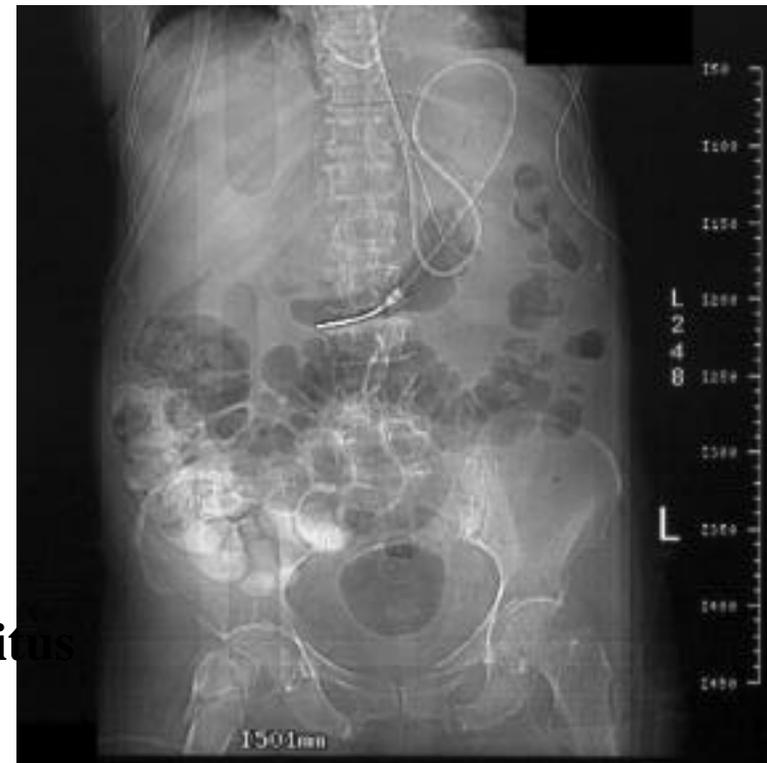
**A**

- Female, 165 cm, 77 kg
- Age = 27 years



**B**

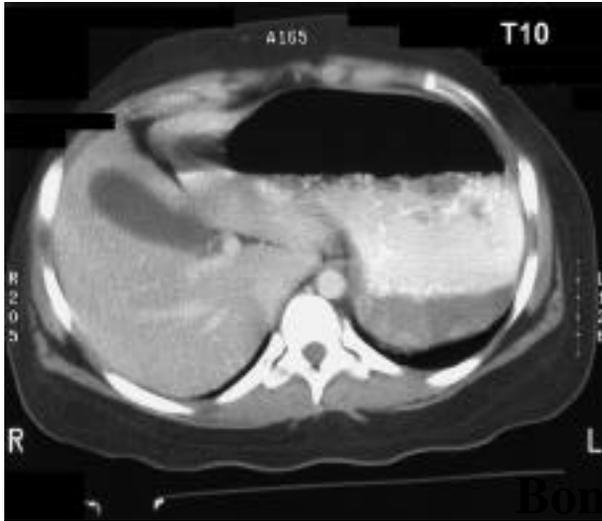
- Female, 165 cm, 78 kg
- Age = 78 years



Body Habitus

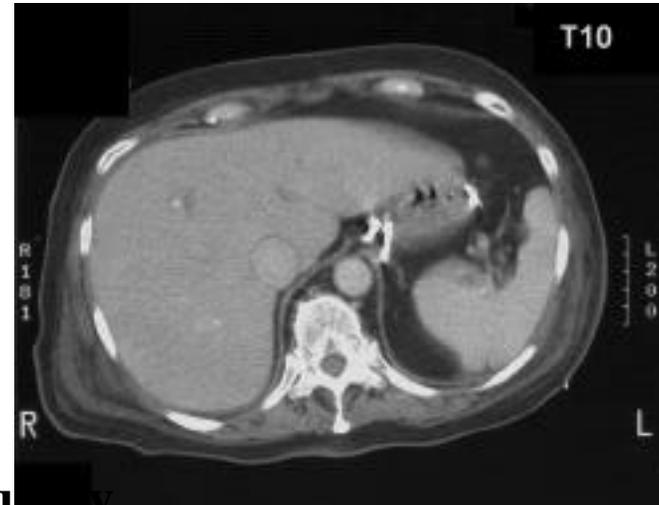
**A**

- Female, 165 cm, 77 kg
- Age = 27 years



**B**

- Female, 165 cm, 78 kg
- Age = 78 years



Bone density/quality

# C

- Female, 168 cm, 50 kg
- Age = 18 years



# D

- Female, 165 cm, 49 kg
- Age = 72 years



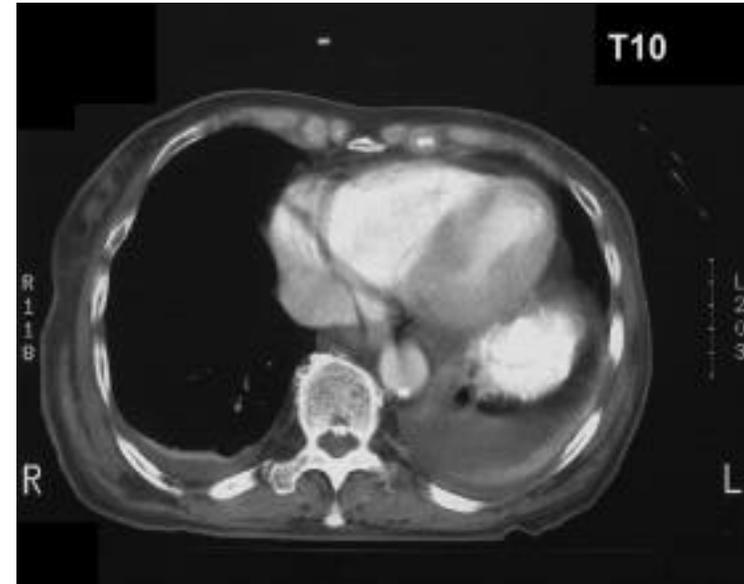
**C**

- Female, 168 cm, 50 kg
- Age = 18 years



**D**

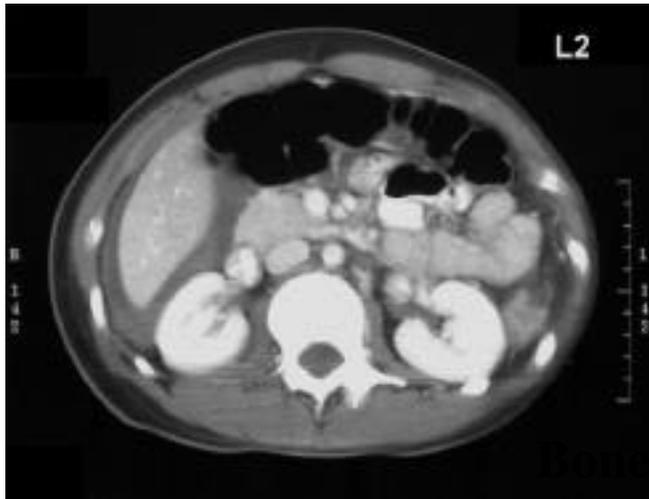
- Female, 165 cm, 49 kg
- Age = 72 years



**Bone Density/Quality**  
**Muscle Mass/Quality**

**C**

- Female, 168 cm, 50 kg
- Age = 18 years



**D**

- Female, 165 cm, 49 kg
- Age = 72 years



Density/  
Muscle Mass/Quantity

## E

- Male, 183 cm, 86 kg
- Age = 38 years



## F

- Male, 183 cm, 80 kg
- Age = 79 years



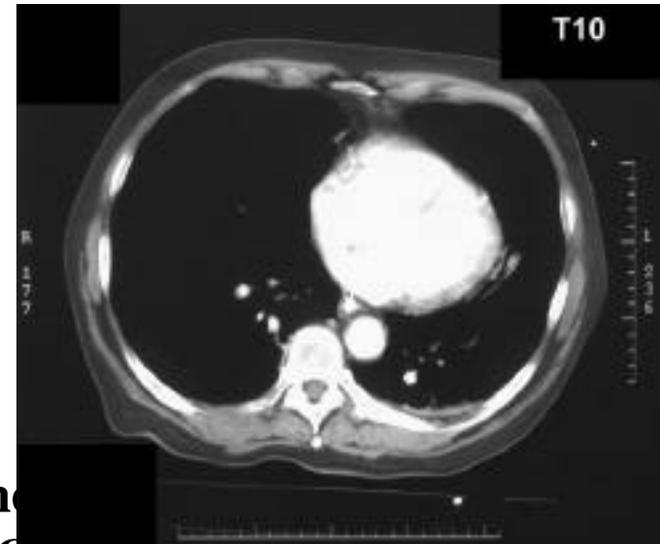
7A

- Male, 183 cm, 86 kg
- Age = 38 years



7B

- Male, 183 cm, 80 kg
- Age = 79 years



Bone Geom  
le Mass/Quality

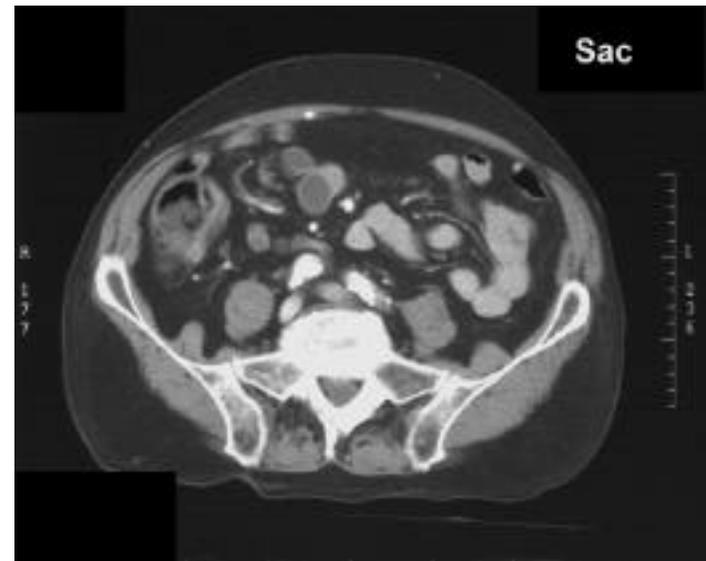
7A

- Male, 183 cm, 86 kg
- Age = 38 years



7B

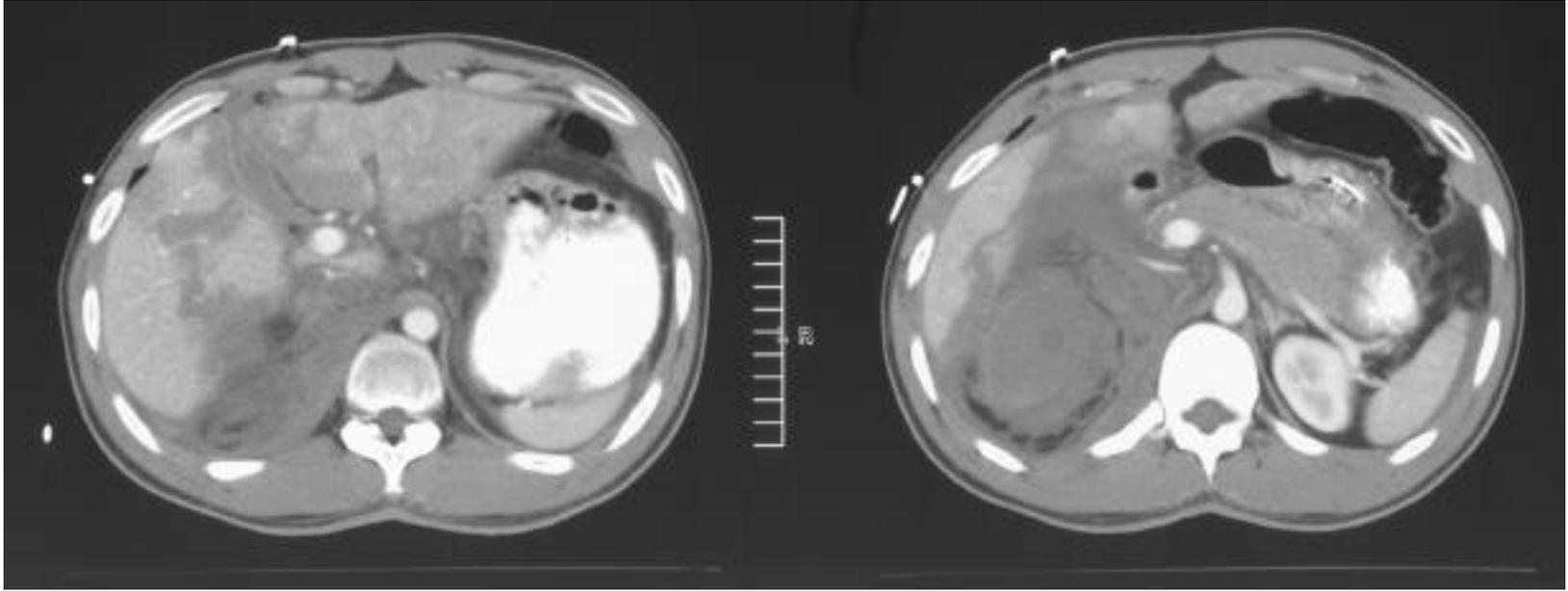
- Male, 183 cm, 80 kg
- Age = 79 years



**Bone Density**  
**Muscle Mass/Quality**  
**Fat Mass/Distribution**











# H

- Male, 38, 178 cm
- Weight = 73 kg



# G

- Male, 35, 180 cm
- Weight = 114 kg



**Fat Mass/Distribution**



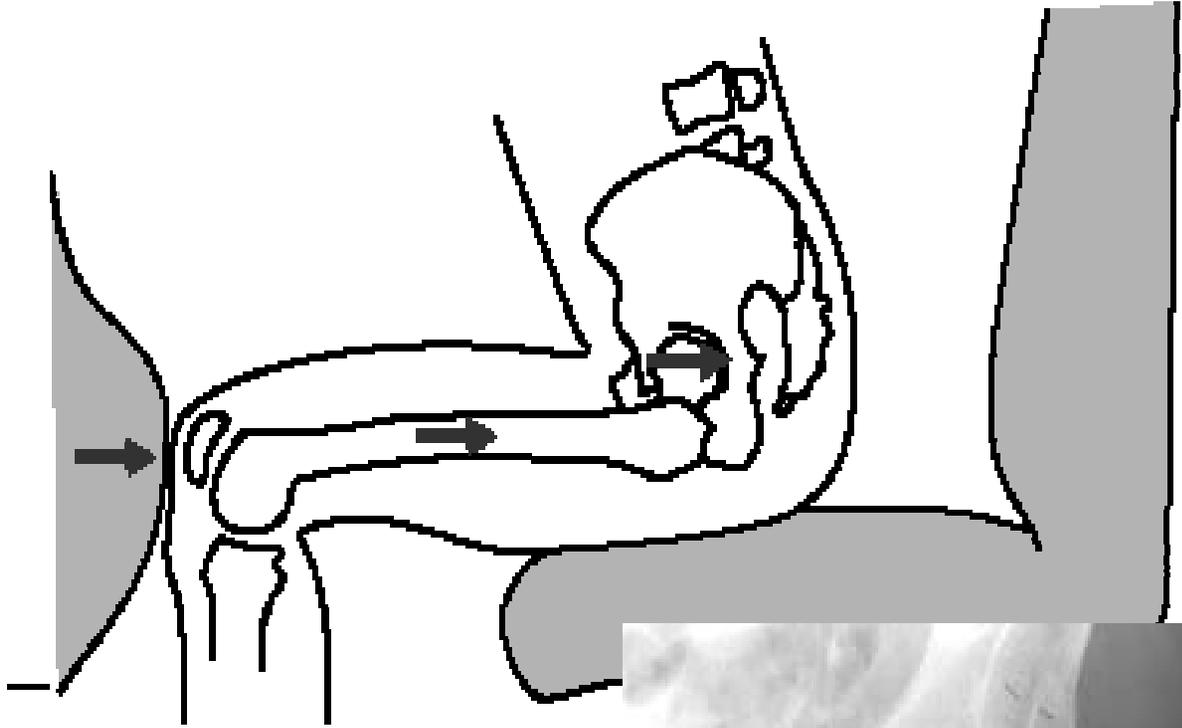
Safety systems effectiveness would be improved if they were tuned for the occupant, like skis for skiers and drugs for patients.

Lesson from medicine: Treat the patient, not the disease.

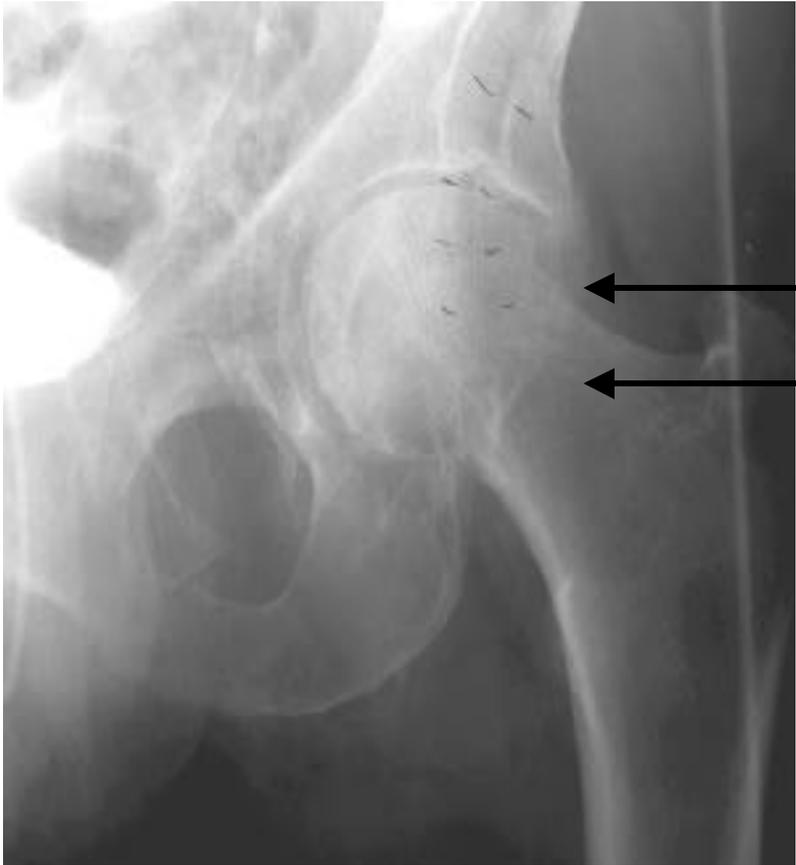
Treatment and prevention must be customized: surgery, chemotherapy, narcotics, antibiotics.

# More lessons from medicine

- One can't cure or prevent every disease.
- Problems and solutions need to be prioritized.
- Each intervention has a different risk/benefit ratio.
- Short and long-term outcome of each intervention must be assessed.

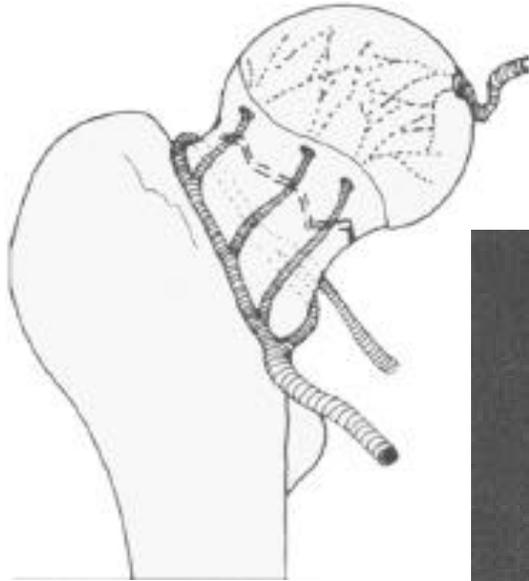






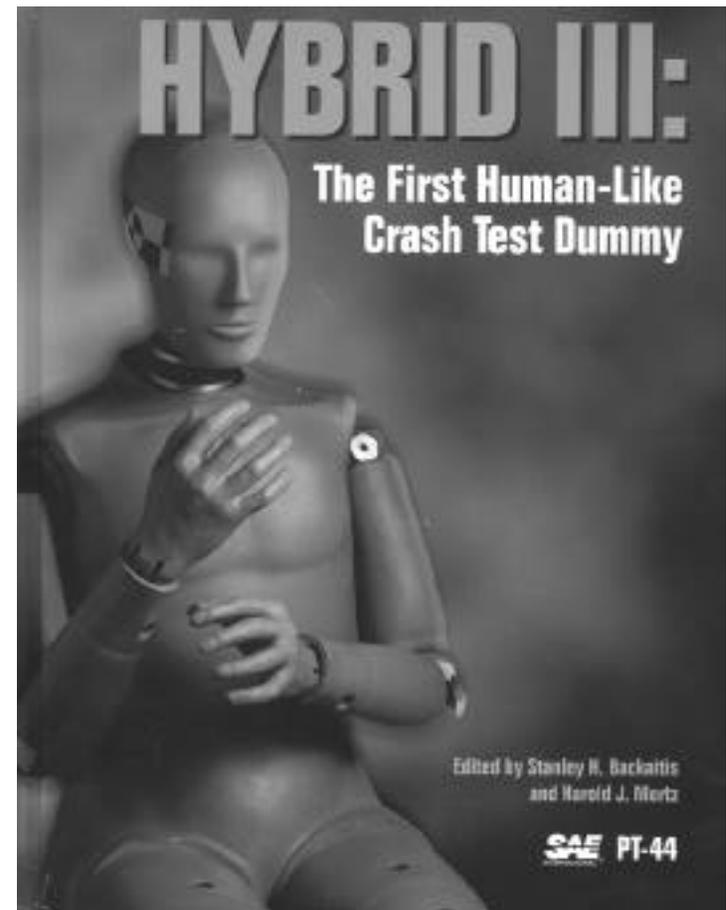






# Automotive Safety

- Vehicles are safer than they have ever been.
- Laboratory testing has led to great improvements in safety.



Laboratory findings must be validated with real life observations.

# CIREN

- Thousands of data elements
- Detailed injury analysis
  - Severity
  - Source
  - Mechanism of injury.
- Medical specialists, automotive engineers, bioengineers, crash investigators...



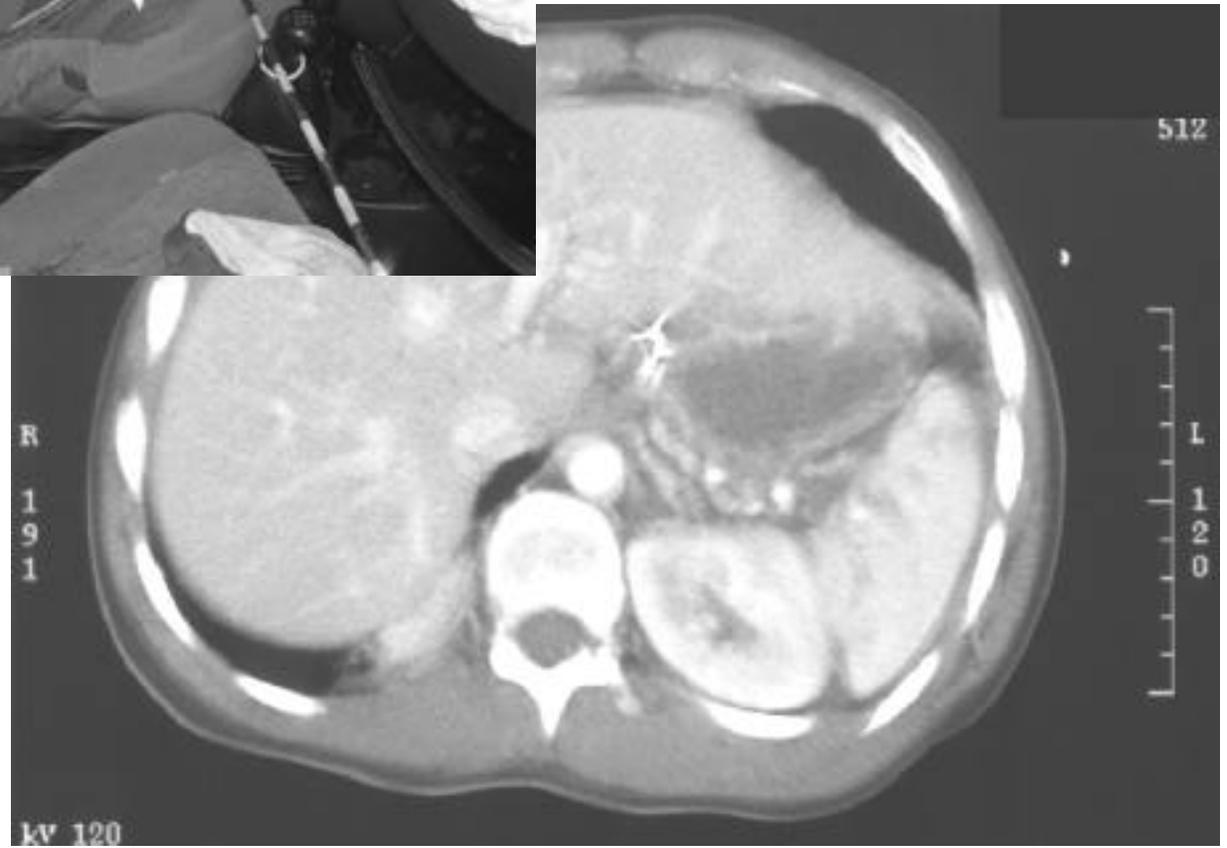














Tr: 154+C

DFOV 32.0cm

BONE

512

R

2

0

1

L

1

2

0





It's difficult to solve a problem without understanding its mechanism.

Typhoid

Polio

Smallpox



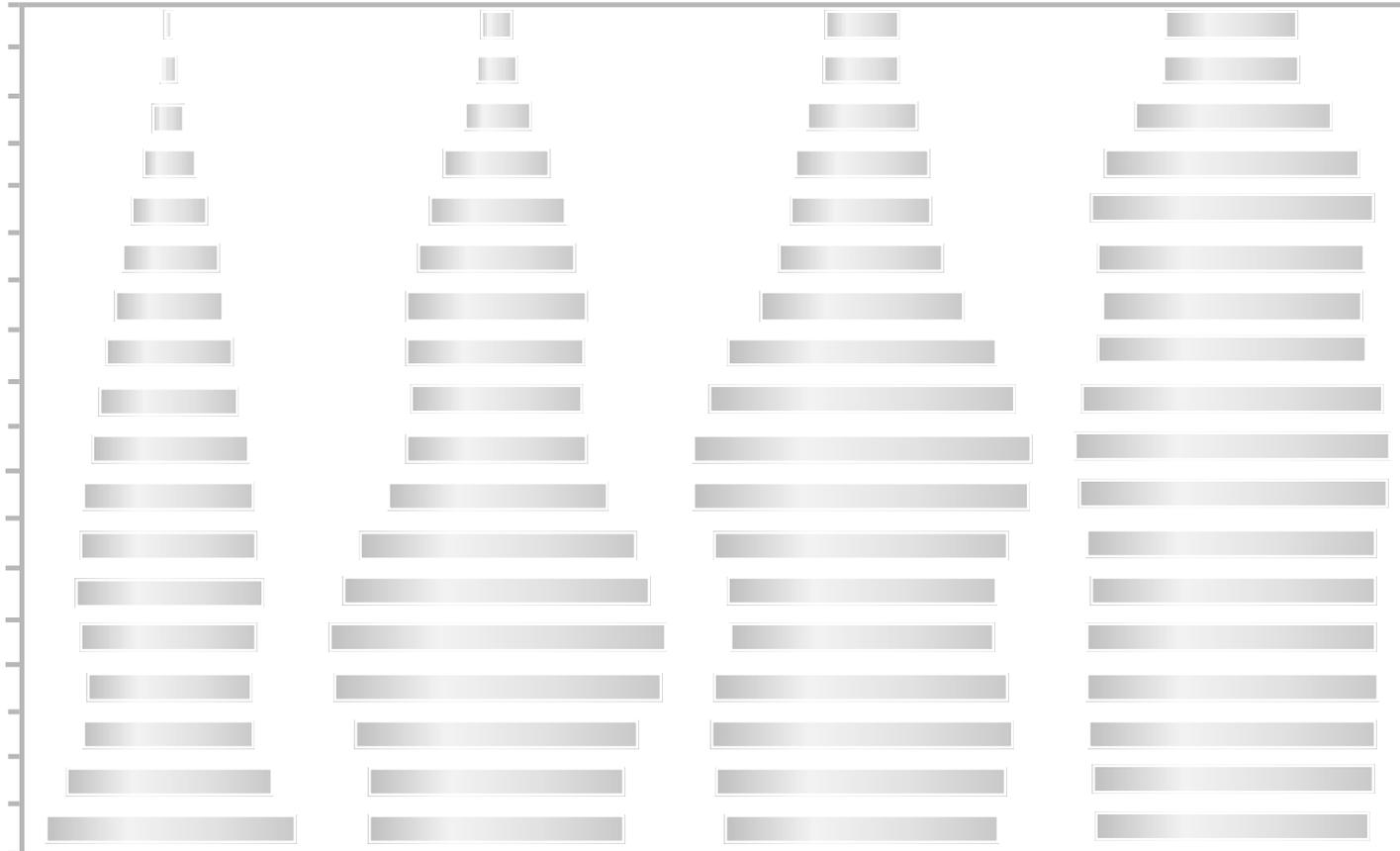


There is nothing permanent except change.

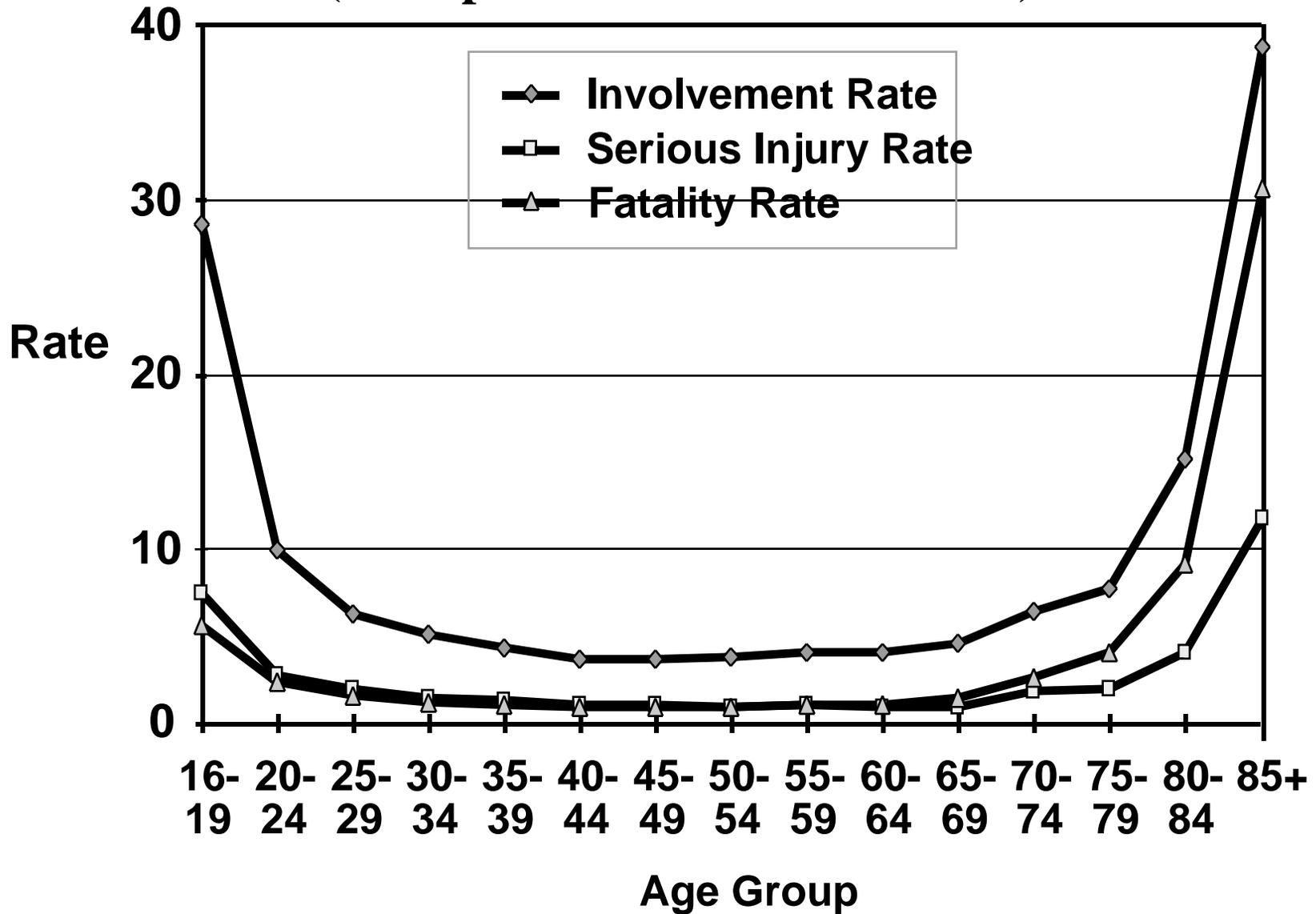
*Heraclitus*

“The only steady state is death.”

# Increase in the Number and Percentage of Older People



# Involvement, Injury, and Fatality Rates (rates per vehicle miles of travel)



# Vehicle fleet changes as truck sales increase



Vehicle Incompatibility:  
Mass, Stiffness, Geometry



# In a changing world

- Real-life human data is irreplaceable.
- Reality checks are absolutely essential since all assumptions/approximations are suspect.
- *Golden opportunity at present with the recent introduction of innovative safety systems.*

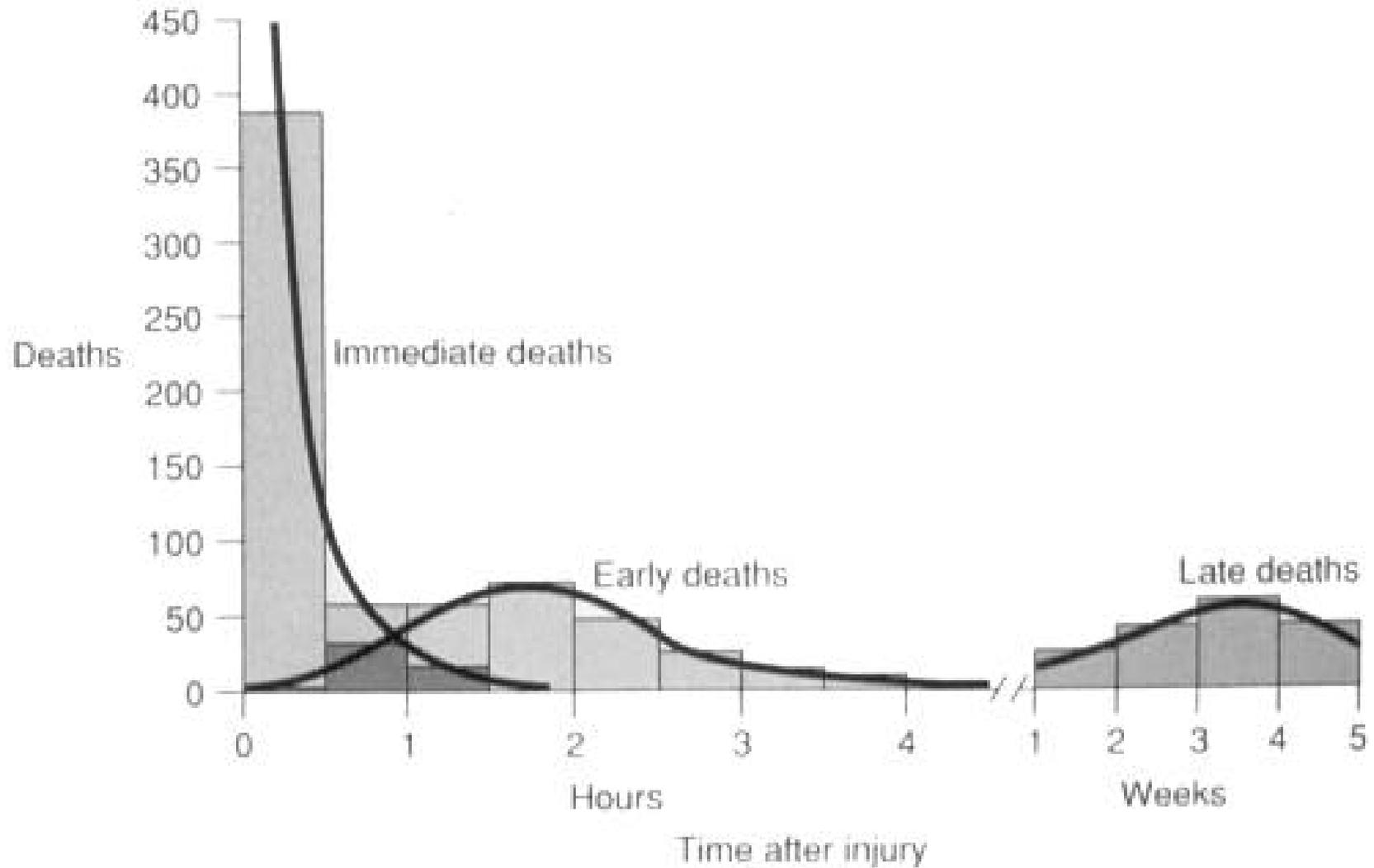
Time is of the essence!

To save injured people.

To make cars safer.



# Trauma Deaths



When time is of the essence,  
Communication is critical.



# Trauma Deaths

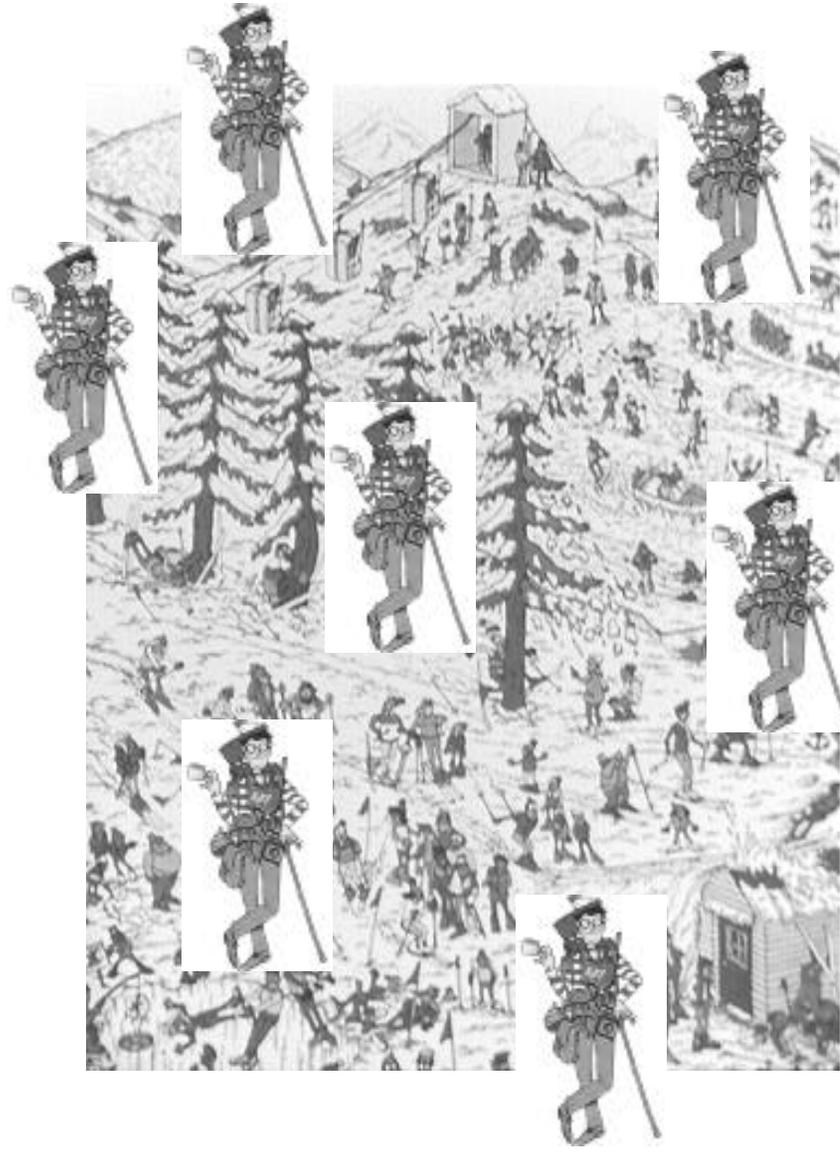
- There are many ways to die:

**Airway** - face, neck

**Breathing** - lung, chest wall

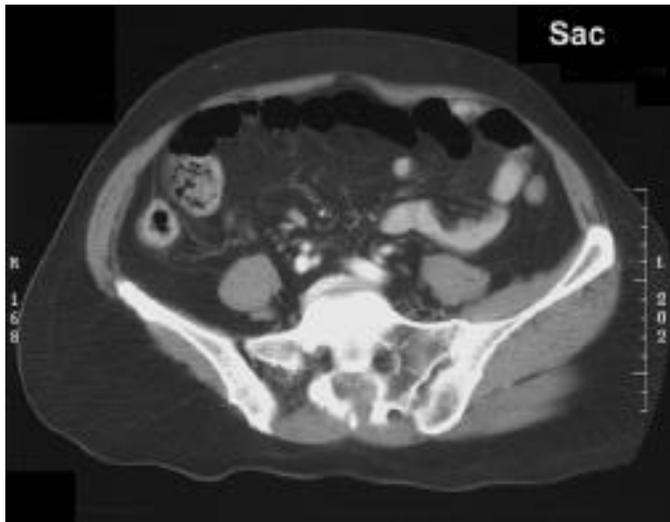
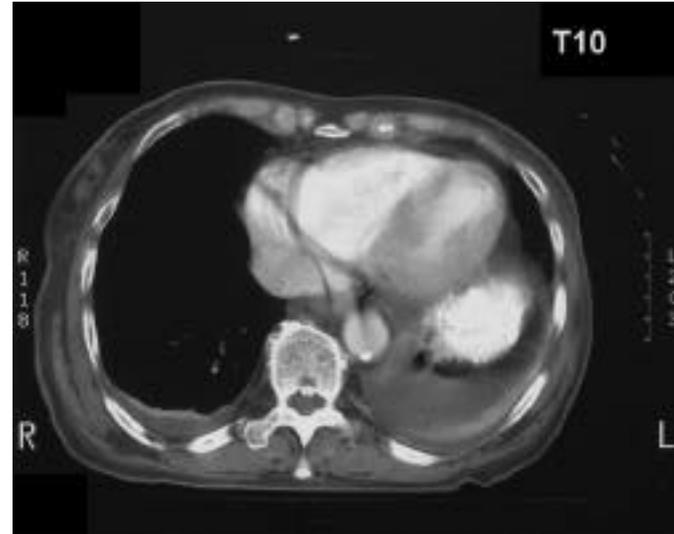
**Circulation** - heart, blood vessels, organs



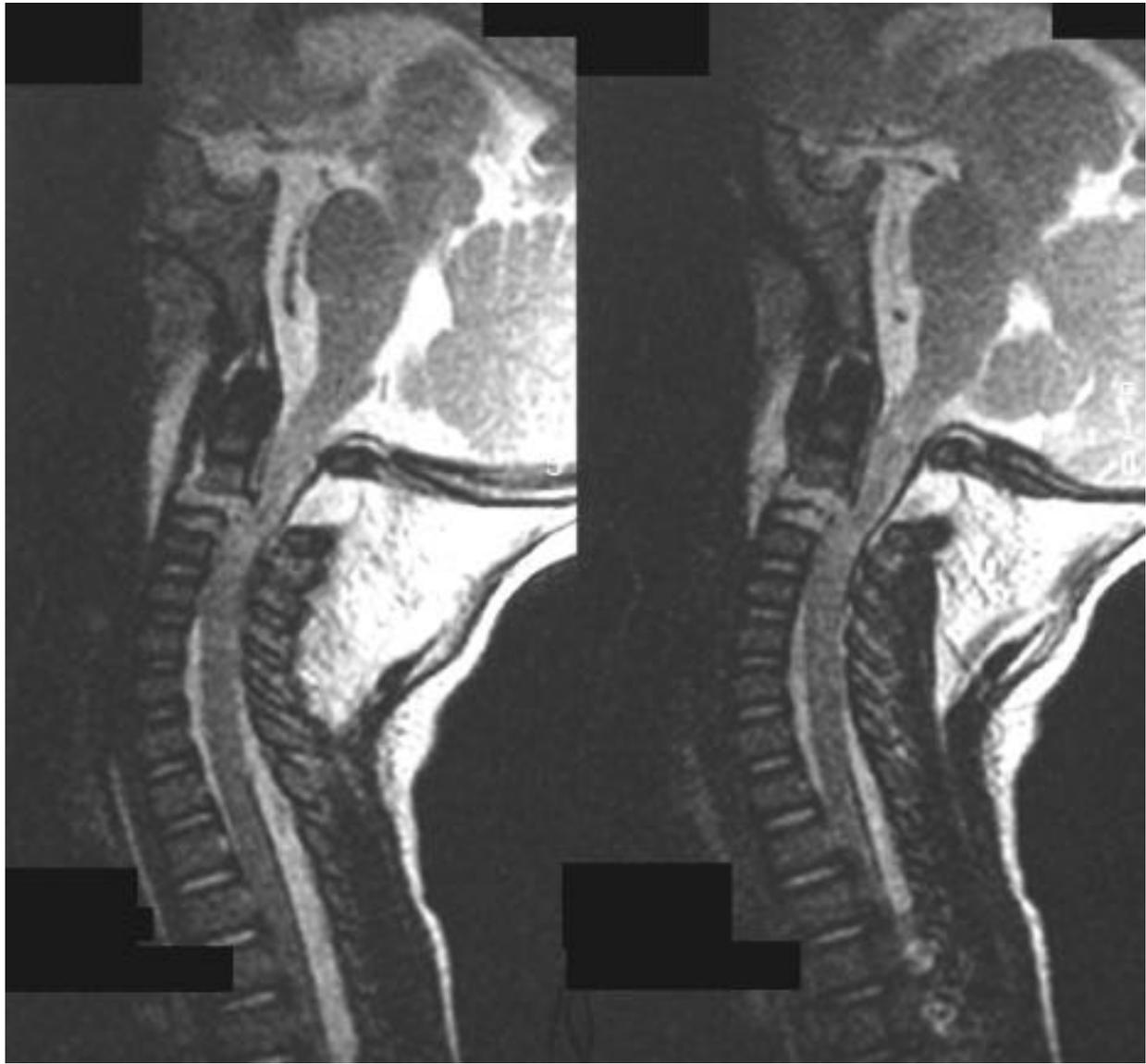


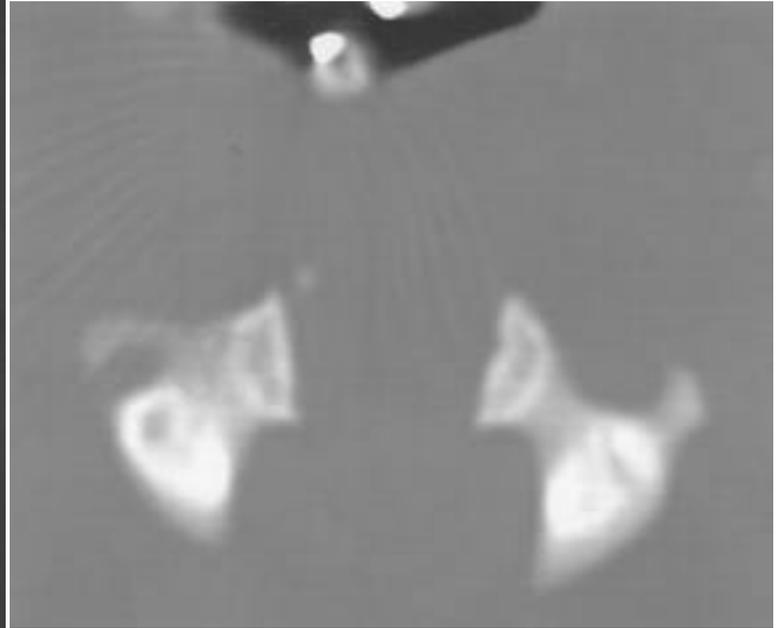
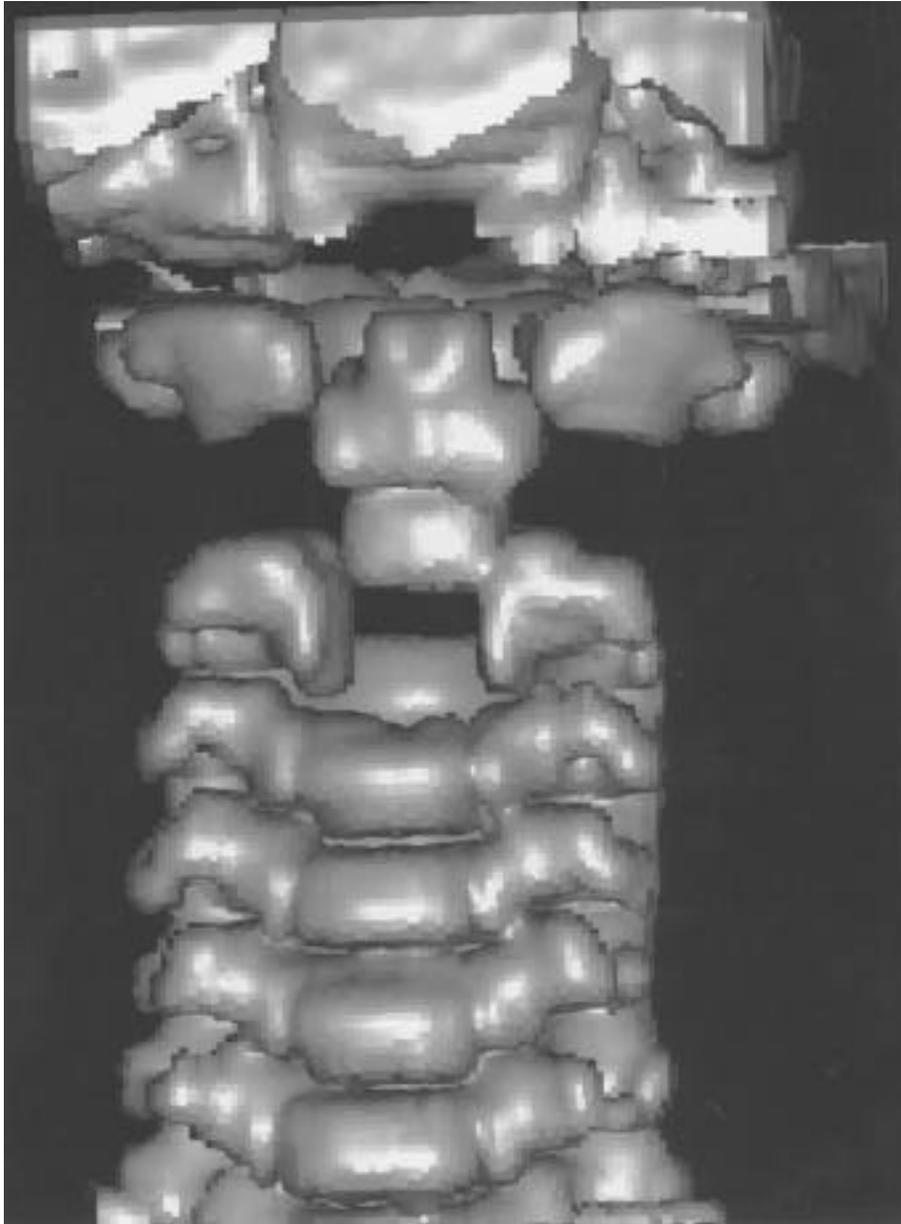














# Golden Hour

Notification

Extrication & Transport

Resuscitation

Diagnostic Evaluation

Treatment

Record of the occupant's body's response to the crash.

Anatomic detail, three dimensional.

CIREN subjects are real-life crash dummies.

# CIREN

- Engineers, physicians, crash investigators, regulators.....
- Thousands of data elements
- Detailed injury analysis
  - Severity
  - Source
  - Mechanism of injury

# CIREN



Not only data....but mutual  
understanding and communication...  
People working together to save people.

# CIREN Network

