

UMDNJ

UNIVERSITY OF MEDICINE &  
DENTISTRY OF NEW JERSEY

# Age, Sex and MVCs: Achilles, Anthony and Cleopatra, and Sarah and Abraham as Motor Vehicle Crash Victims

December 6, 2001



# New Jersey Medical School-UMDNJ

## Departments of Anatomy, Cell Biology and Injury Sciences and of Surgery

### CIREN TEAM:

- o John H. Siegel, MD, FACS
- o Joyce A. Smith, MS
- o Nadegda Tenenbaum, MD
- o Laurie McCammon
- o Ruth Ross, PhD
- o Philip Marsh, MS
- o Esther Leibovich, BS

## CRASH RECONSTRUCTION:

- o Frank Costanzo (ACA)
- o Robert Freeth (ACA)
- o Robert Schaar (Dynamic Science)

## REGIONAL MEDICAL EXAMINER'S OFFICE:

- o Faruk Presswalla, MD

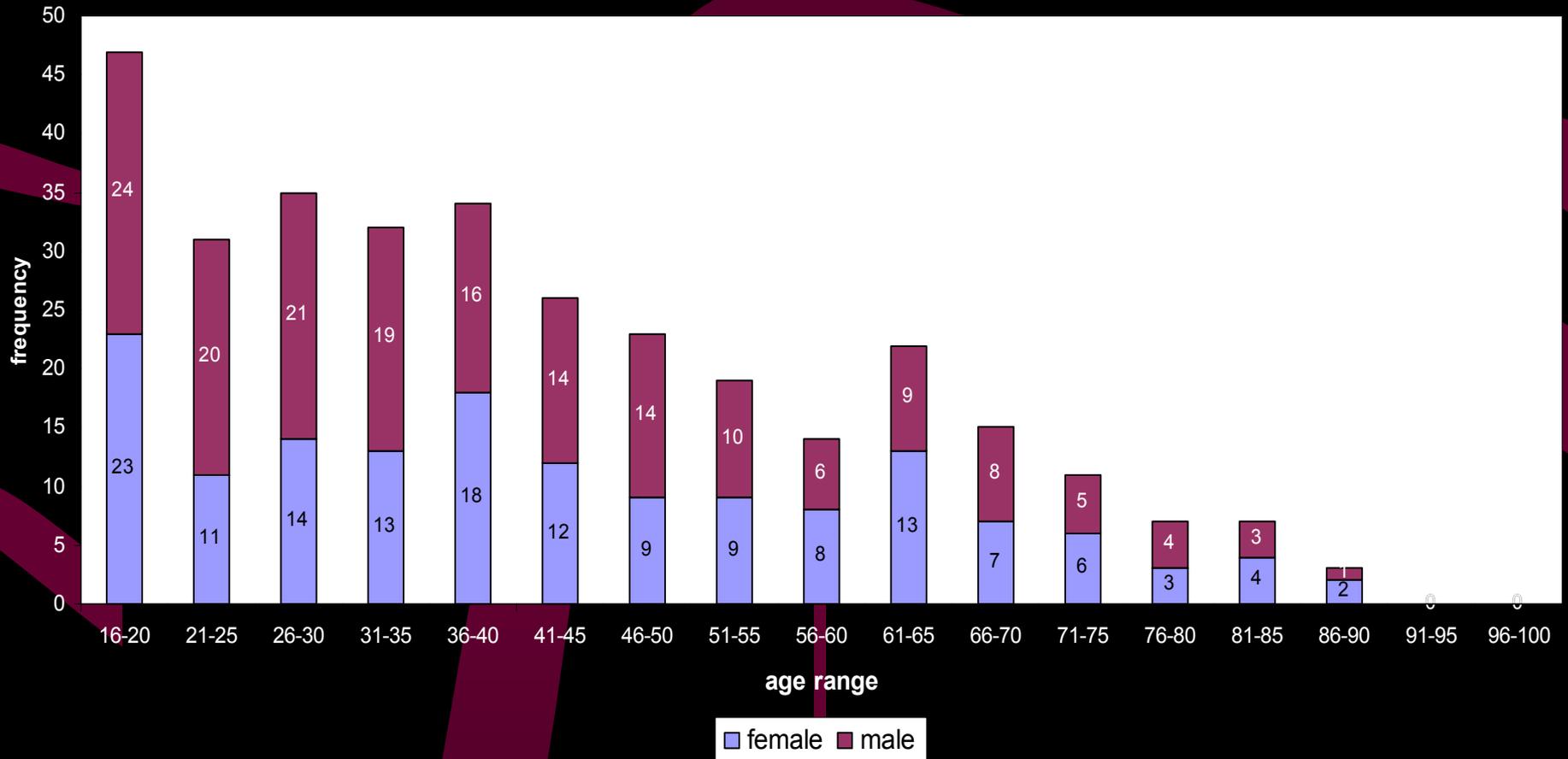
## ADDITIONAL CASES CONTRIBUTED BY:

- o Patricia C. Dischinger, PhD and Andrew Burgess, MD (University of Maryland-Baltimore and Charles McC. Mathias National Study Center for Trauma)
- o Stewart C. Wang, MD, PhD (Trauma-Burn Center, University of Michigan, and the University of Michigan Transportation Research Institute)
- o David Grossman, MD, MPH (University of Washington Harborview Medical Center and Harborview Injury Prevention and Research Center)

# Our Sample Group

gender	age range	Frontal crash	Lateral crash
male	16-44	111	35
	45-59	32	9
	60 +	31	12
female	16-44	86	37
	45-59	28	12
	60 +	38	6

# Age Distribution of Frontal Crash Sample Population

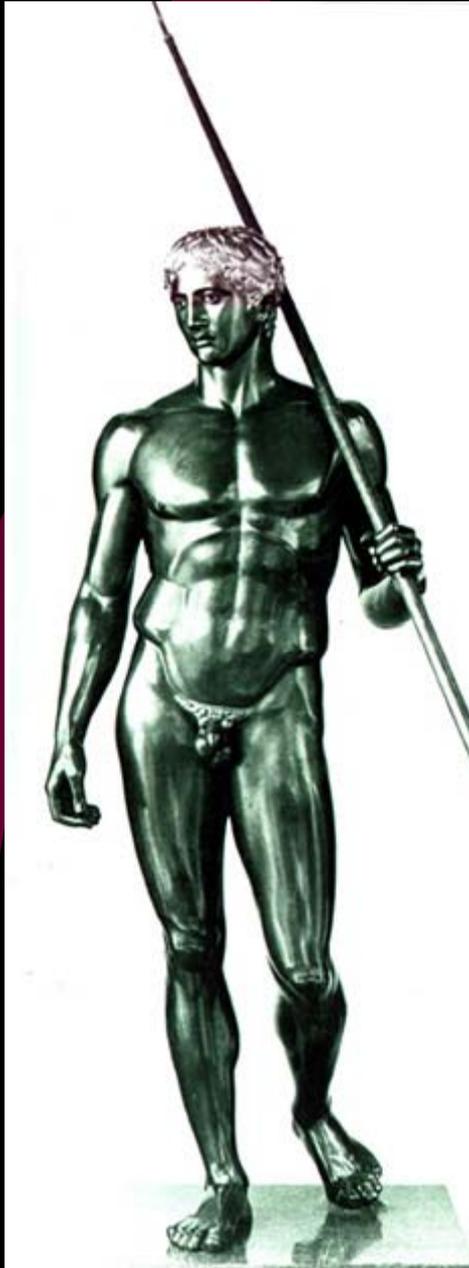


	MALE			FEMALE		
	16-44	45-59	60+	16-44	45-59	60+
N	111	32	31	86	28	38
Mean age (yrs)	28.78	51.34	70.58	28.80	50.43	72.66
Mean height (cm)	175.34	171.63	177.40	161.36**	162.79	163.60***
Mean weight (kg)	82.43	91.35+	82.20	69.36***	74.07**	71.52*
Mean ISS	20.95	26.87	22.70	20.57	21.93	29.91
Mean ΔV1 (kph)	50.0	51.20	39.72++	46.2	45.52	36.70+
Mean mass V1 (kg)	1337.2	1480.2+	1414.3	1305.3	1408.4	1386.9
Mean LOS	12.94	10.54	23.58+	11.80	10.70	20.32+
Mean ICU days	5.49	4.53	11.93	3.96	3.15	7.53
Mean GCS if TBI=1	10.65	10.38	12.64	11.64	11.78	11.74
Mean survival rate	83	72	61++	83	79	66+

+ = p<0.05 vs same gender, age 16-44  
 ++ = p<0.01 vs same gender, age 16-44

\* = p<0.05 vs same age, opposite gender  
 \*\* = p<0.001 vs same age, opposite gender  
 \*\*\* = p<0.0001 vs same age, opposite gender

# ACHILLES



*Vital young warrior,  
Hero of the Greek  
victory over Troy*

# Achilles

- 17 year old male unrestrained driver
- Weight = 104 kg (229 lbs)
- Height = 167 cm (5' 6")
- Airbag deployed
- Survivor

*Our American adolescent road warrior...*

*...has a high speed chariot crash*

- V1 = 1994 Honda Accord (1342 kg)
  - Delta V = 51.7 kph
  - Energy dissipated = 170,056 joules
  - Max crush = 81 cm at C1
- 
- V2 = tractor-trailer (454545 kg)

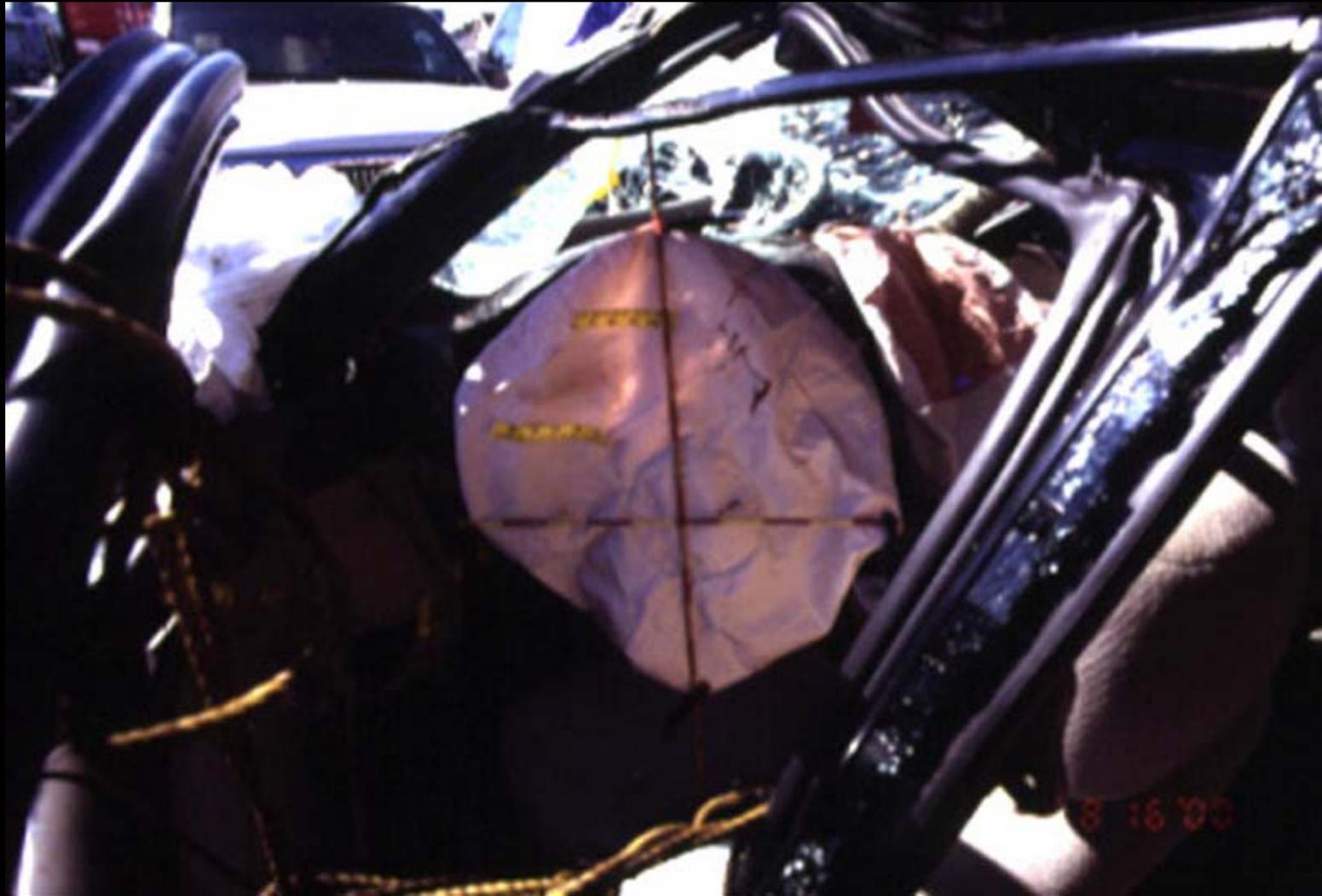




*Scene photograph*



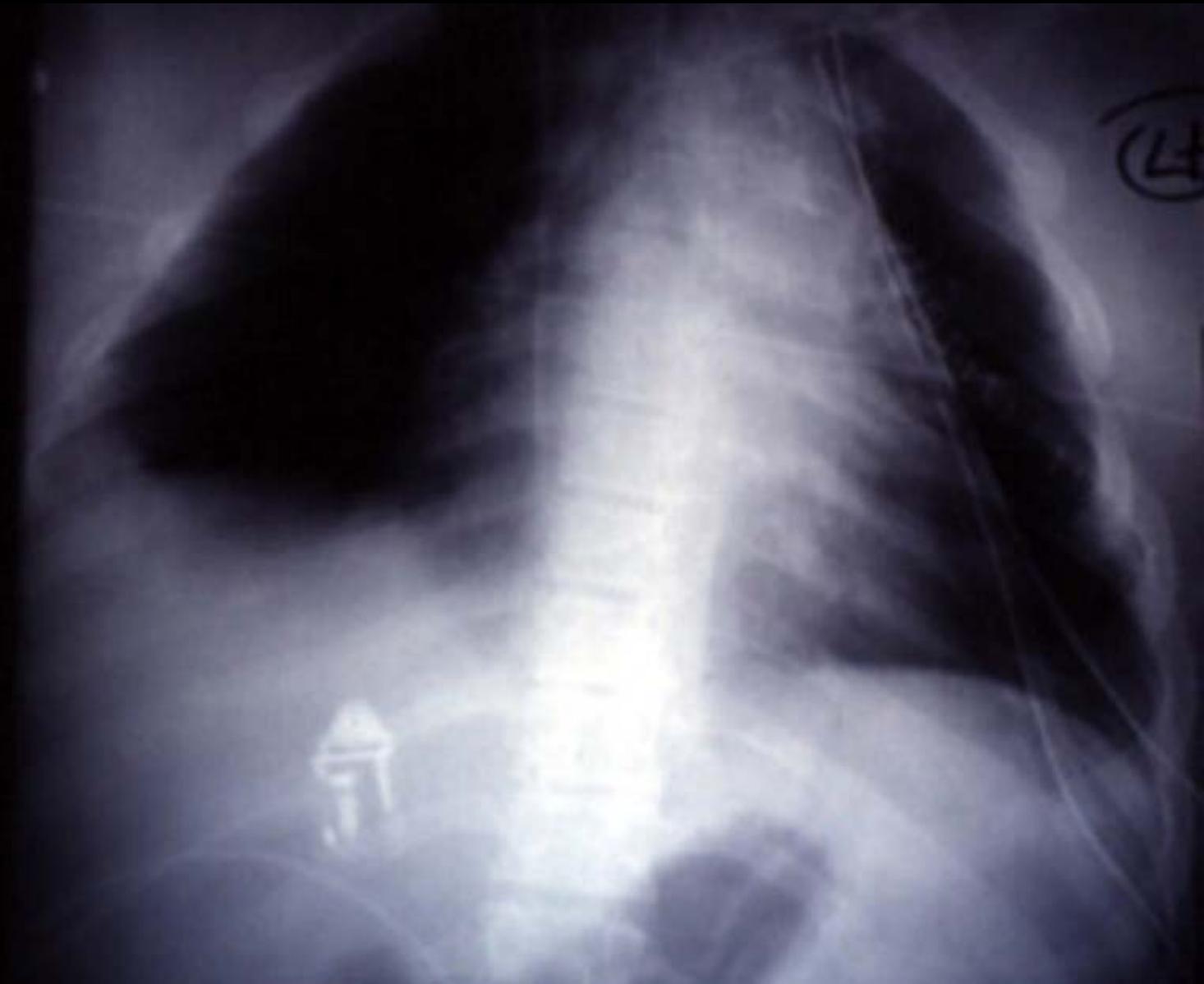
*Subject vehicle*



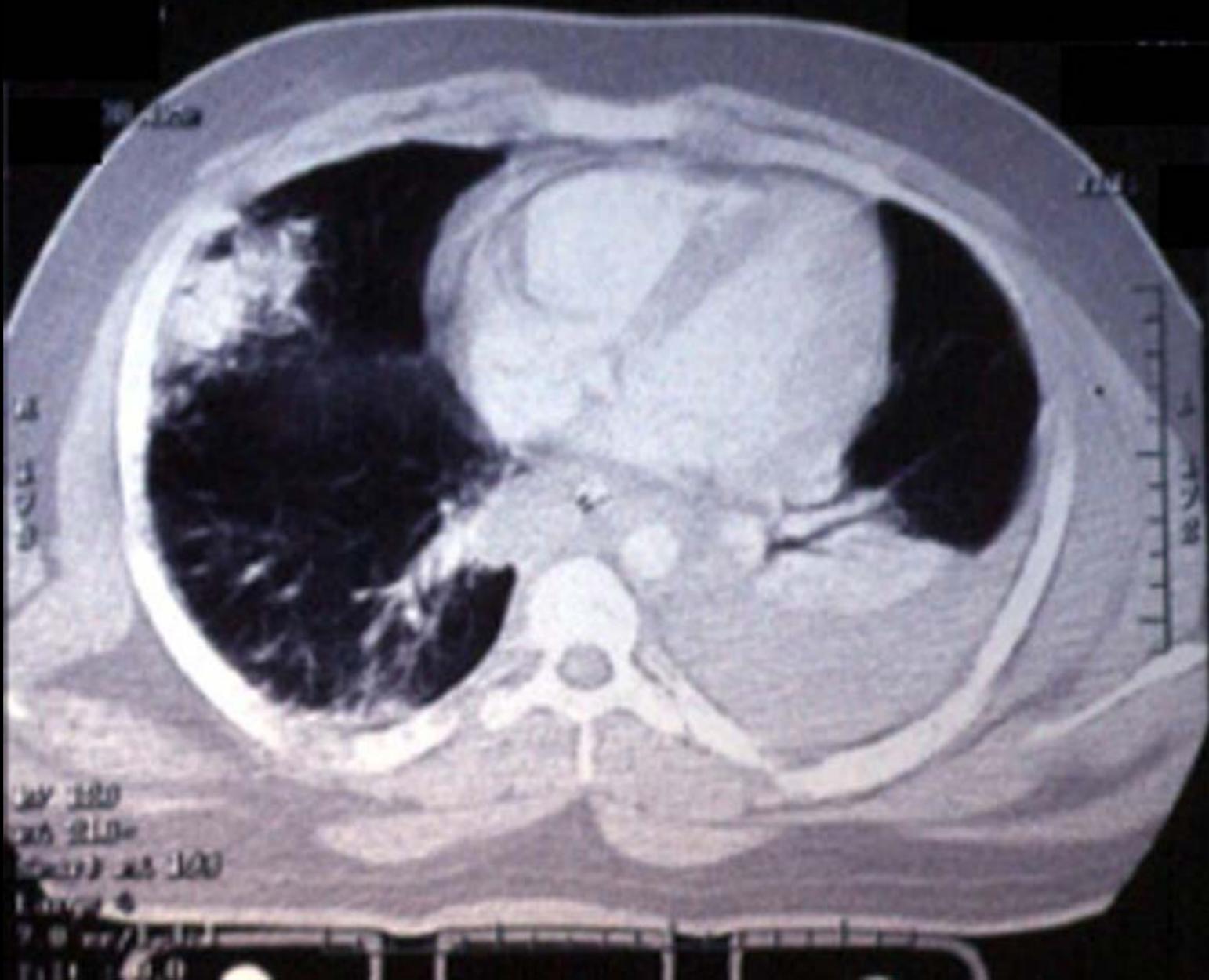
*Airbag deployment*



*No seat belt use*



*Widened mediastinum*



*CT of aortic disruption with left hemothorax*



*CT reconstruction showing aortic pseudoaneurysm*



*Left femoral fracture due to axial loading*

# Injury List

INJURY	SOURCE
Right frontal ICH	Windshield
Multiple rib fractures	Steering wheel rim
Right pulmonary contusion with large left HTX	Steering wheel rim
2 descending aortic ruptures	Steering wheel rim
Liver, spleen and bilateral kidney laceration	Steering wheel rim
Left axillary nerve injury	Left door panel
Left midshaft femur fracture	Left instrument panel

# CLEOPATRA

*Macedonian  
Queen of Egypt*

*Seductress of  
History*



# ANTHONY

*Fatal lover  
ensnared in  
her “sweet  
coils of grace”*

# Young Cleopatra

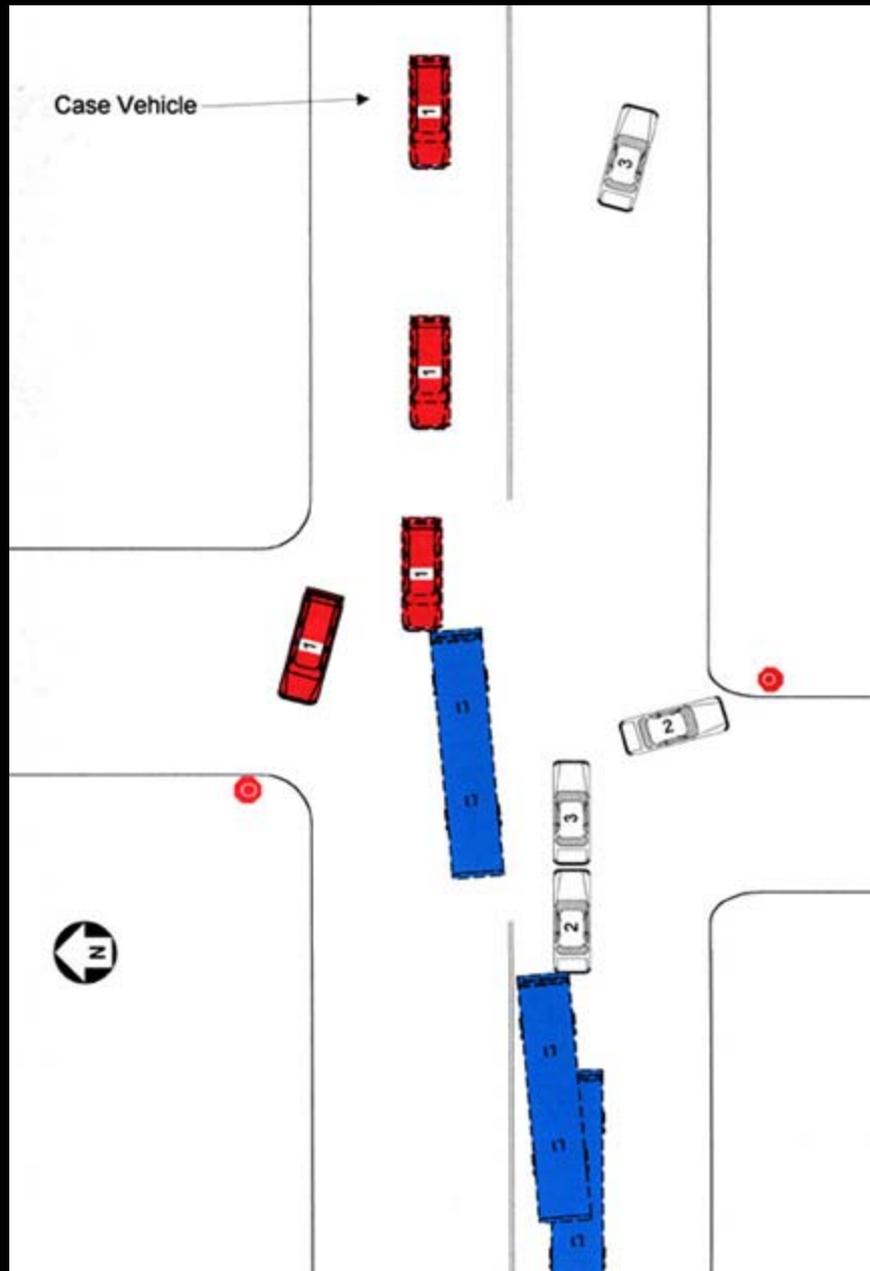
- 36 year old female unrestrained driver
- Weight = 60 kg (132 lbs)
- Height = 160 cm (5' 3")
- Airbag deployed
- Survivor

*Our modern young Cleopatra hastens to her rendezvous...*

*...in her SUV*

- V1 = 1998 Mitsubishi Montero Sport SUV (1930 kg)
  - Delta V = unknown
  - Energy dissipated = unknown
  - Max crush = 80 cm at C1
- V2 = transit bus

*Scene diagram*





*Scene photo*



*Subject vehicle*



*Subject vehicle*



*Airbag deployment*



*No seat belt use*

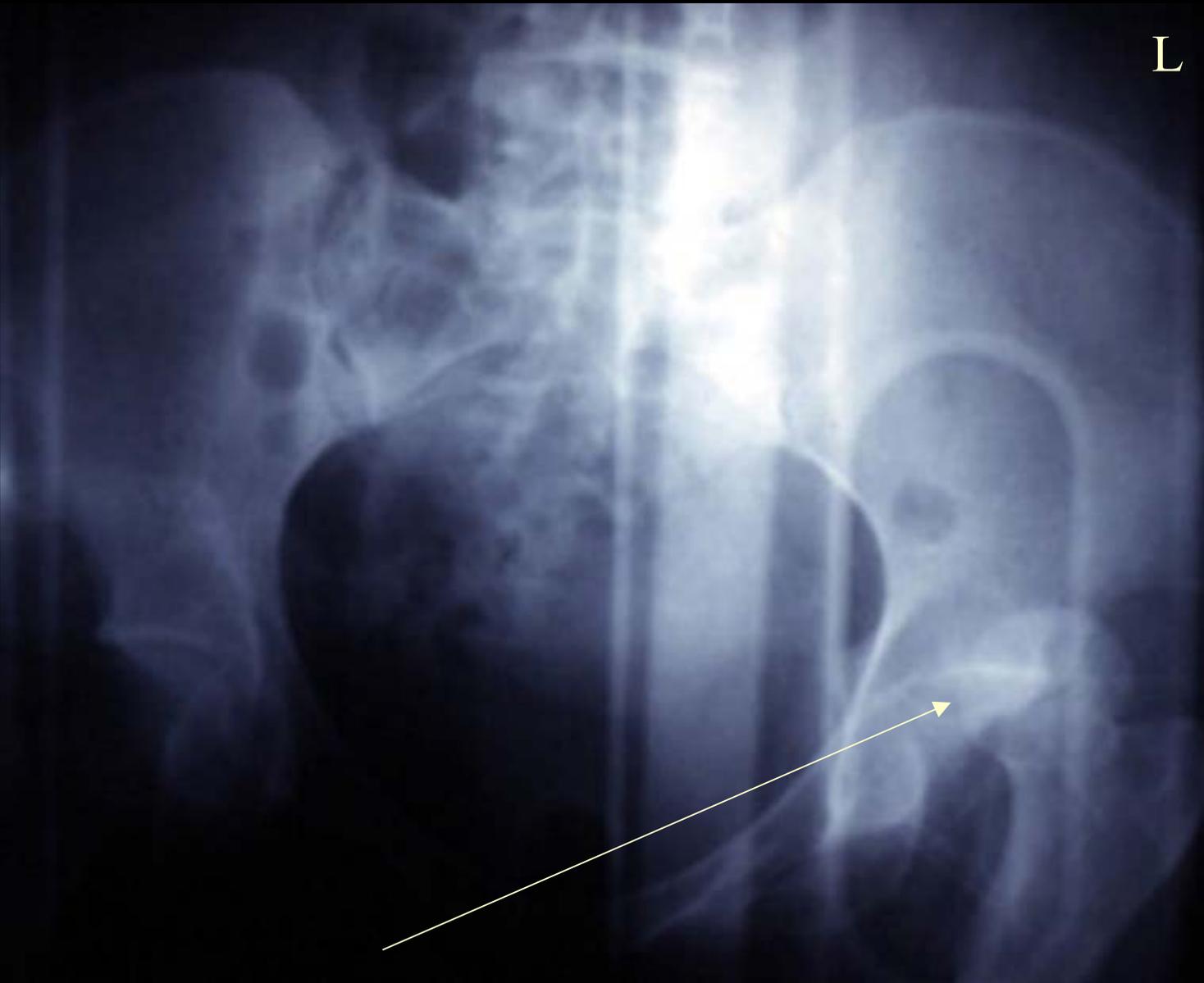


*Interior view*



*Steering wheel mark across upper abdomen*

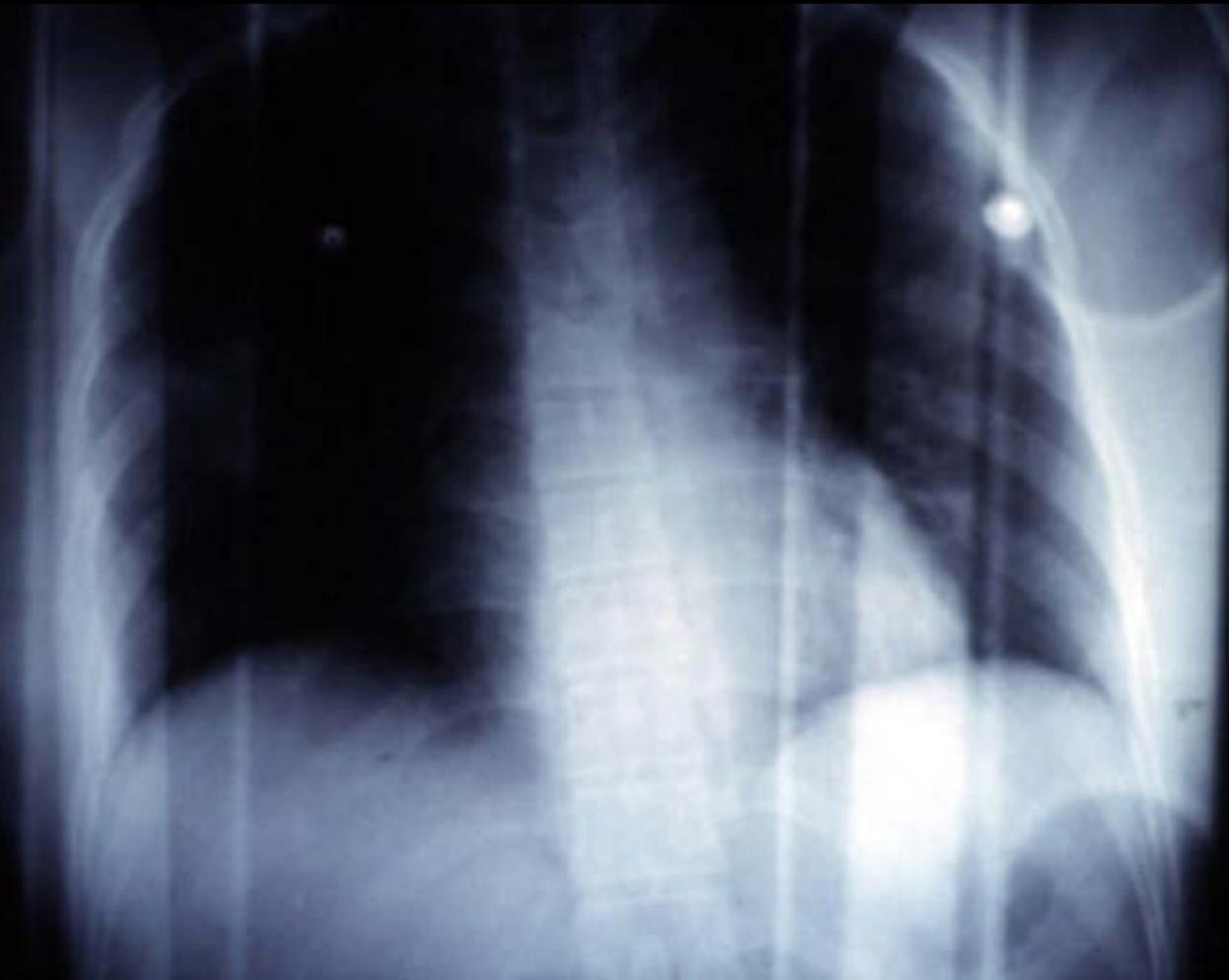
L



*Left hip dislocation*



*Right femur fracture*



*Multiple rib fractures*

R



*Lung contusion below rib fractures*

# Injury List

<b>INJURY</b>	<b>SOURCE</b>
Chest and breast contusions	Airbag cover
Right multiple rib fractures	Airbag & Steering wheel
Right pulmonary contusion	Airbag & Steering wheel
Liver contusion	Steering wheel rim
Left hip dislocation	Instrument panel
Right midshaft femur fracture	Instrument panel
Right patella fracture	Instrument panel

# Mature Cleopatra

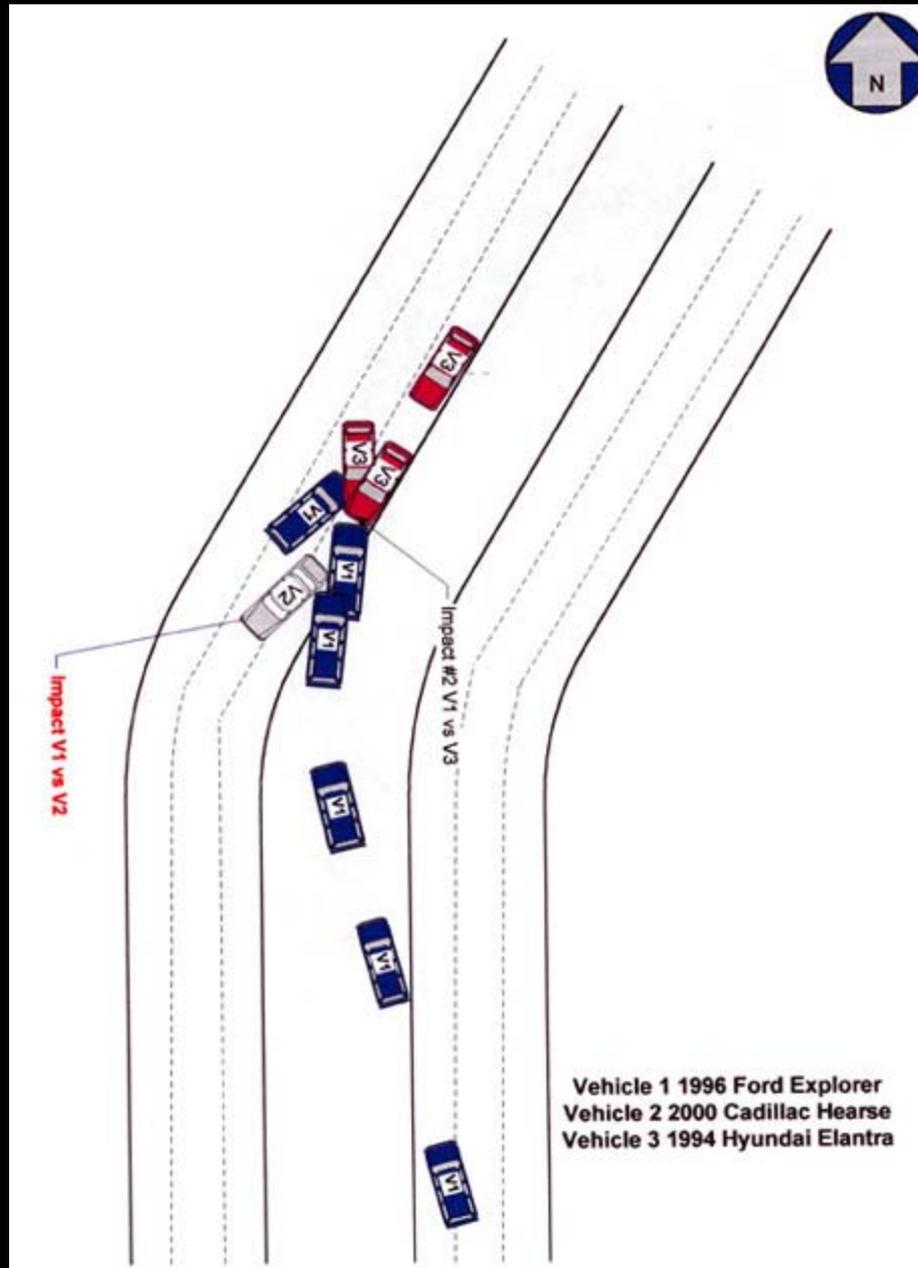
- 47 year old female
- Seatbelt-restrained driver
- Weight = 77 kg (169 lbs)
- Height = 170 cm (5' 7")
- Airbag deployed
- Survivor

*Dragged along by fate...*

*...in a more conservative chariot*

- V1 = 1996 Ford Explorer (1631 kg)
  - Delta V = 53.7 kph
  - Energy dissipated = unknown
  - Max crush = 61 cm at C3
- V3 = 1994 Hyundai Elantra (1122 kg)
  - Driver fatality in V3

*Scene diagram*





*Scene photo*



*Subject vehicle*



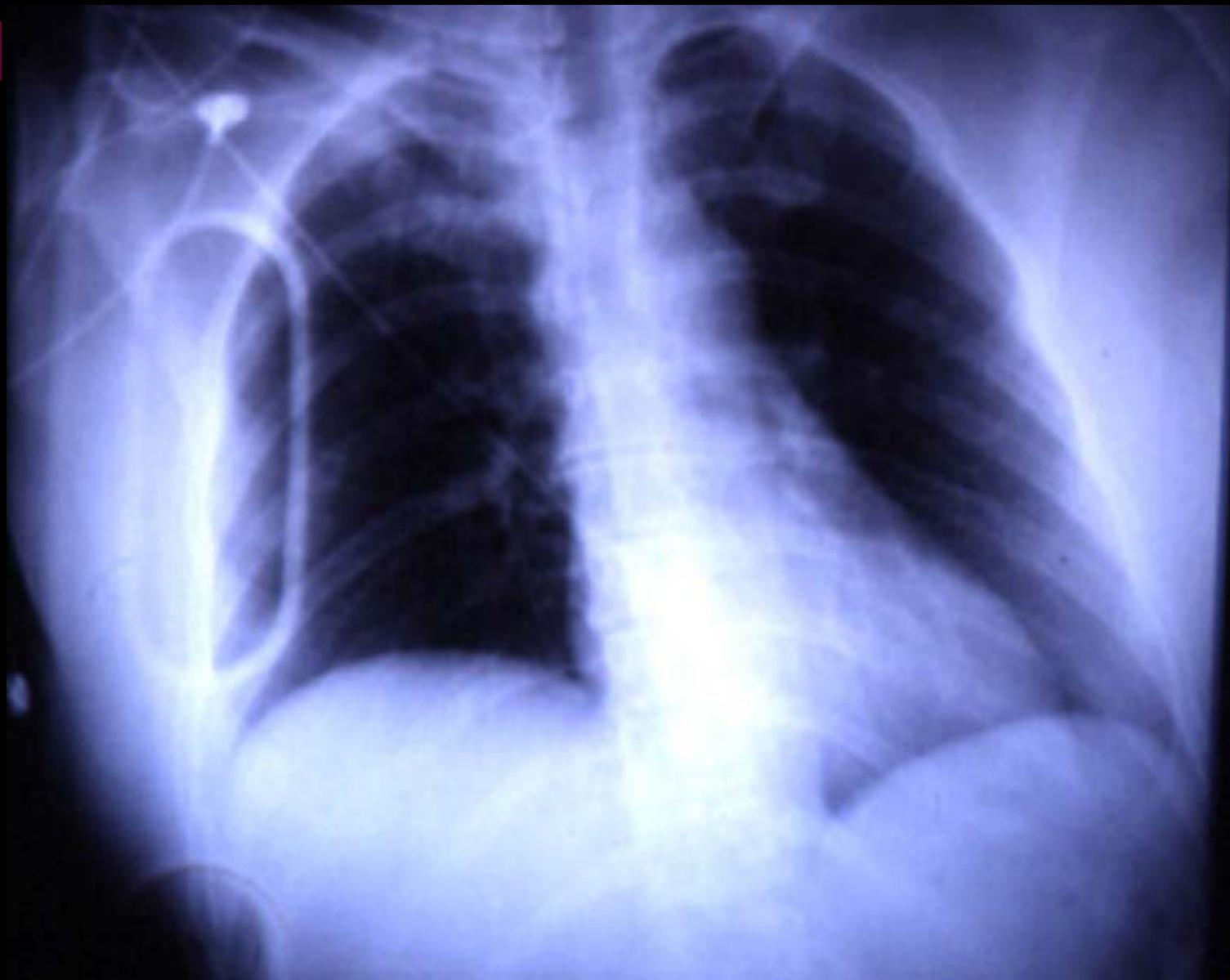
*Air bag deployment*



*Head and facial injuries*

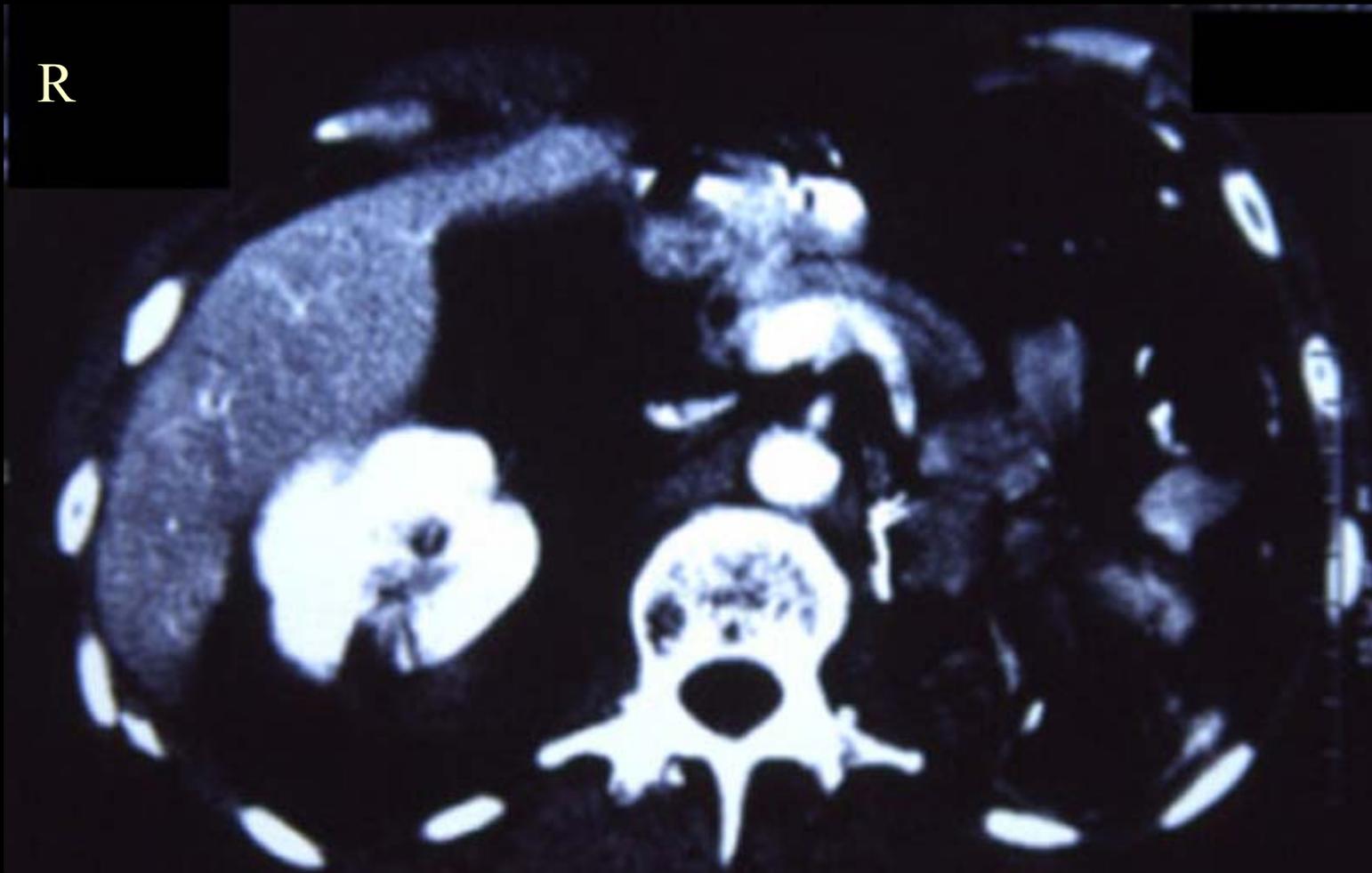


*Seat belt marks*

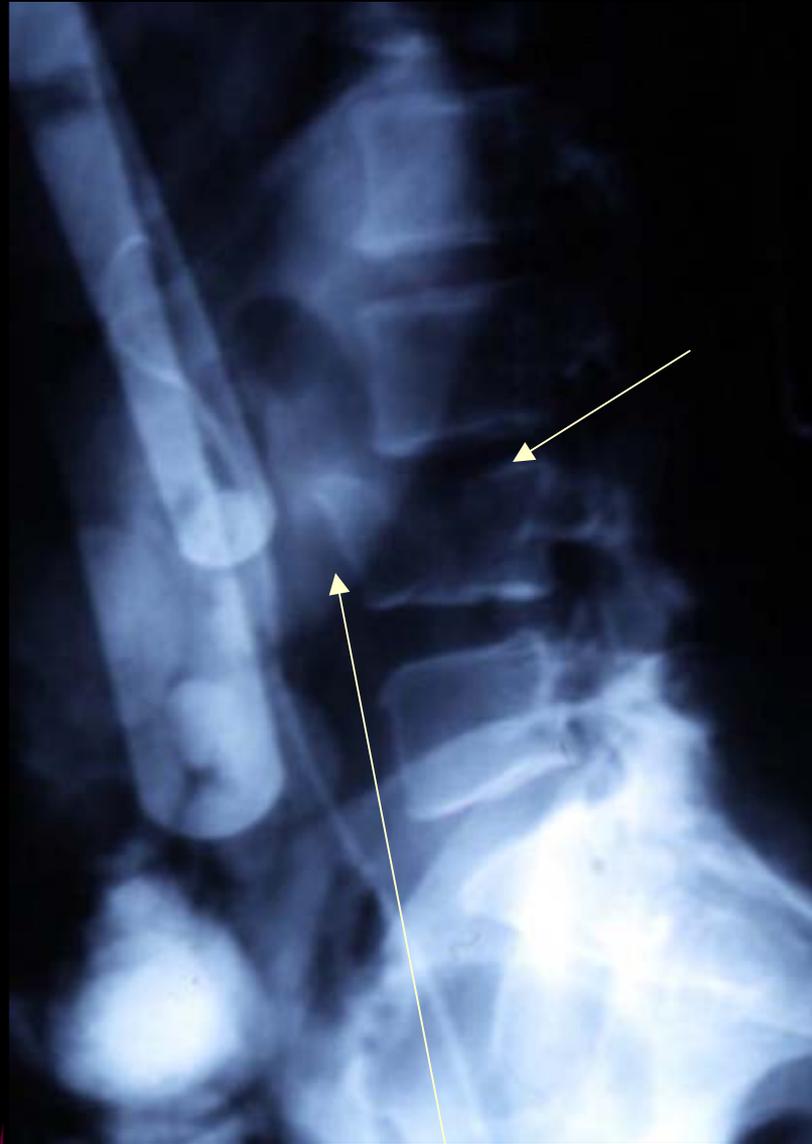


*Right 7<sup>th</sup> rib fracture*

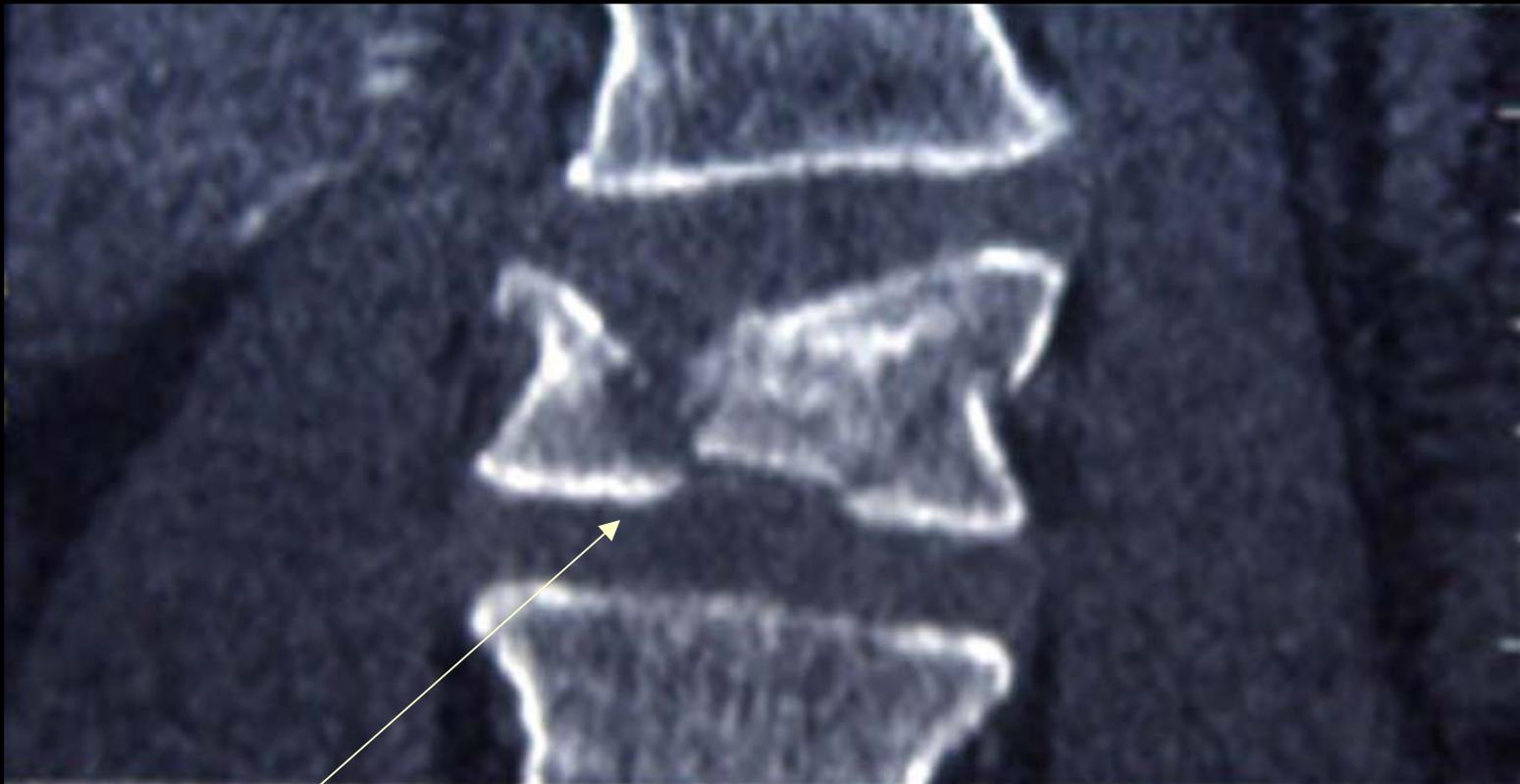
R



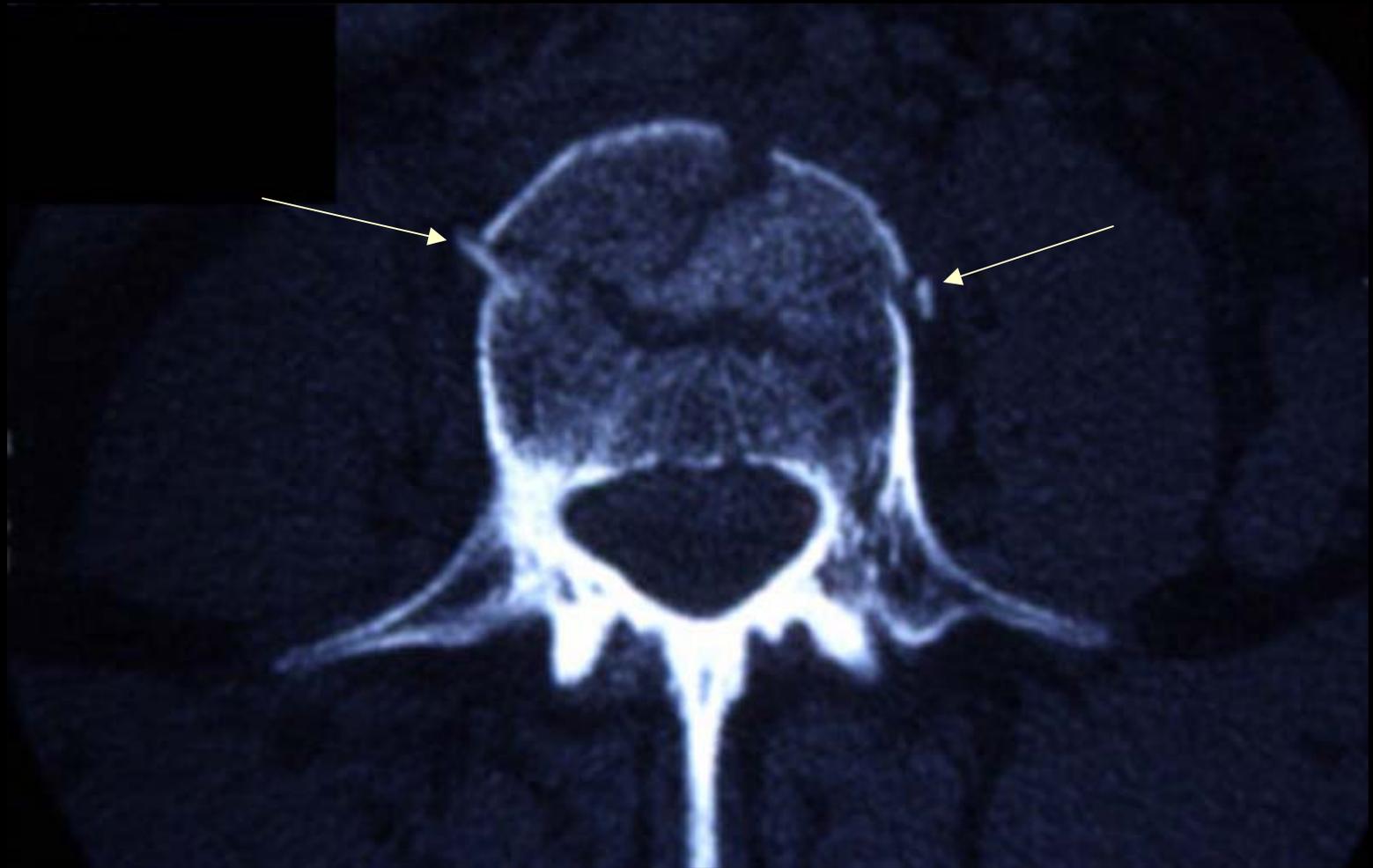
*Right kidney laceration from seat belt*



*Left 4<sup>th</sup> lumbar burst fracture from seat belt*



*Left 4<sup>th</sup> lumbar burst fracture from seat belt*



*Left 4<sup>th</sup> lumbar burst fracture from seat belt*

# Injury List

INJURY	SOURCE
Left internal capsule hemorrhage	Airbag
R parietal, L midbrain contusion	Airbag
Right 7 <sup>th</sup> rib fracture	Seatbelt restraint
Right lower abdominal contusion	Seatbelt restraint
Right kidney laceration (grIV)	Seatbelt restraint
L4 burst body fracture	Loading from restraint
L4 facet fracture	Loading from restraint

# Young Anthony

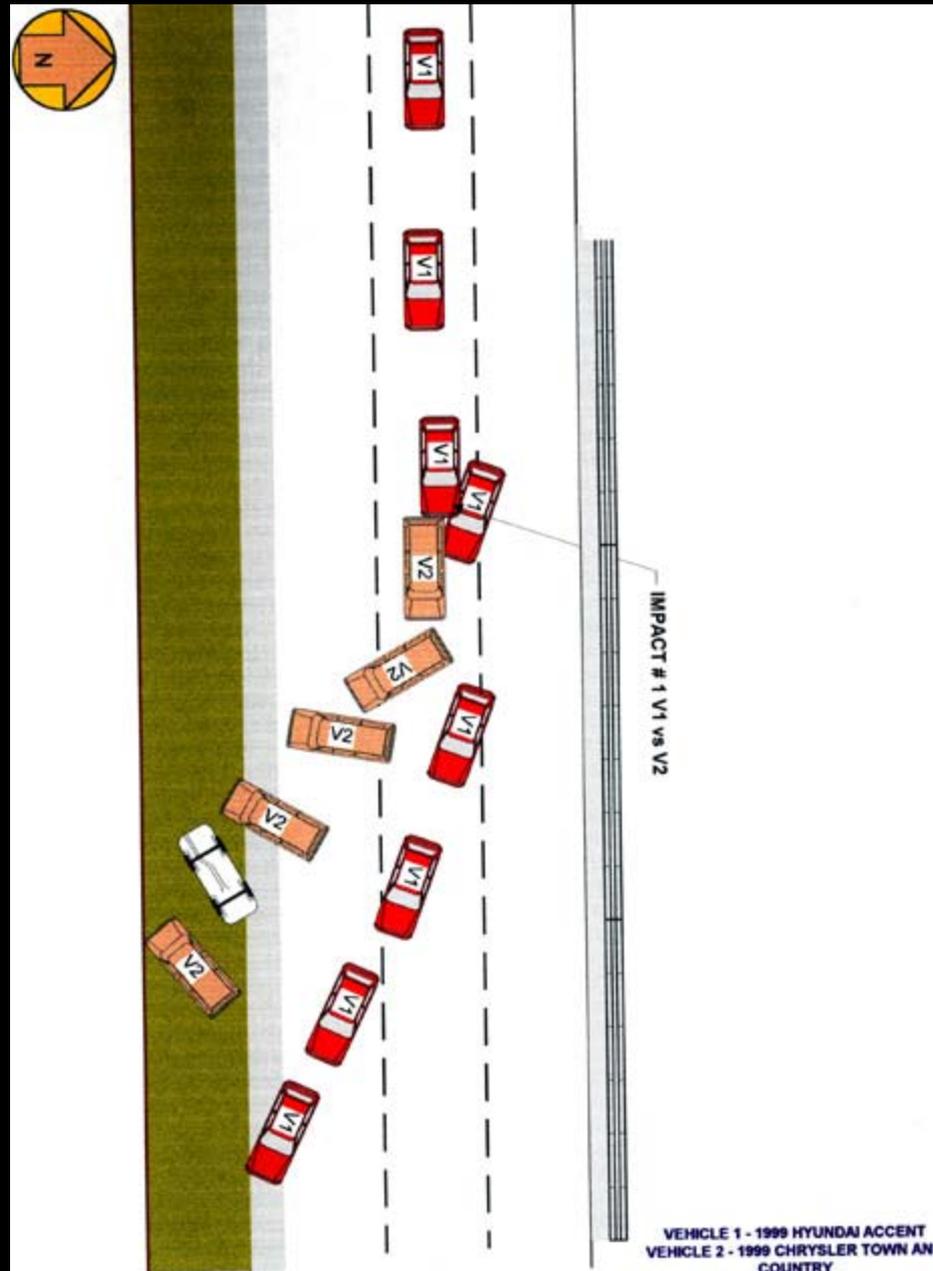
- 42 year old male unrestrained driver
- Weight = 78 kg (172 lbs)
- Height = 170 cm (5' 7")
- Airbag deployed
- Survivor

*Racing heedlessly to love...*

*...his small chariot collided with an elephant at high speed*

- V1 = 1999 Hyundai Accent (953 kg)
  - Delta V = 46 kph
  - Energy dissipated = 74,186 joules
  - Max crush = 45 cm at C6
- V2 = 1999 Chrysler Town and Country Minivan (1643 kg)

*Scene diagram*





*Scene photo*



*Subject vehicle*



*Airbag deployment*



*Facial contact with airbag*



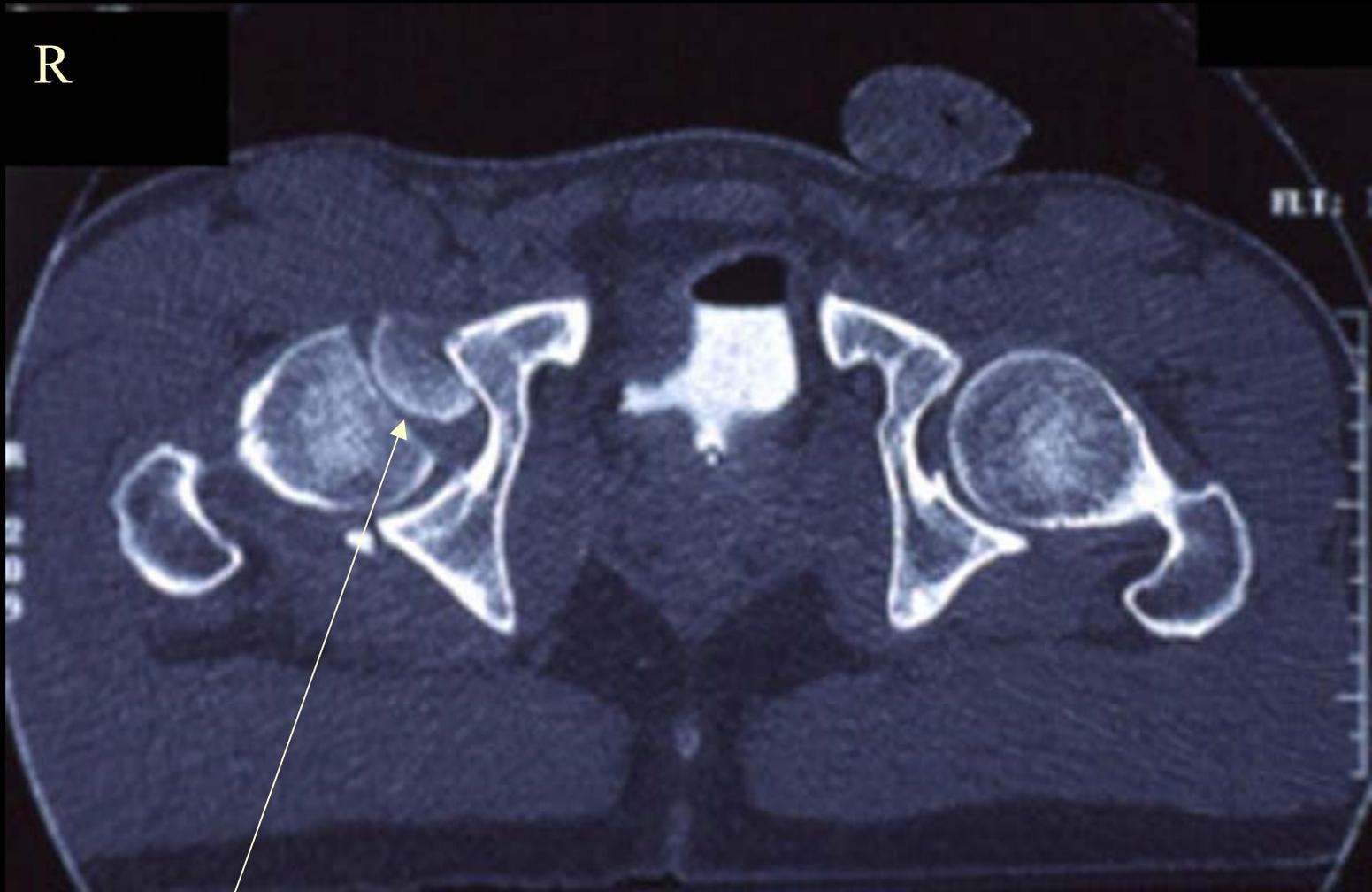
*Toe pan intrusion*

R

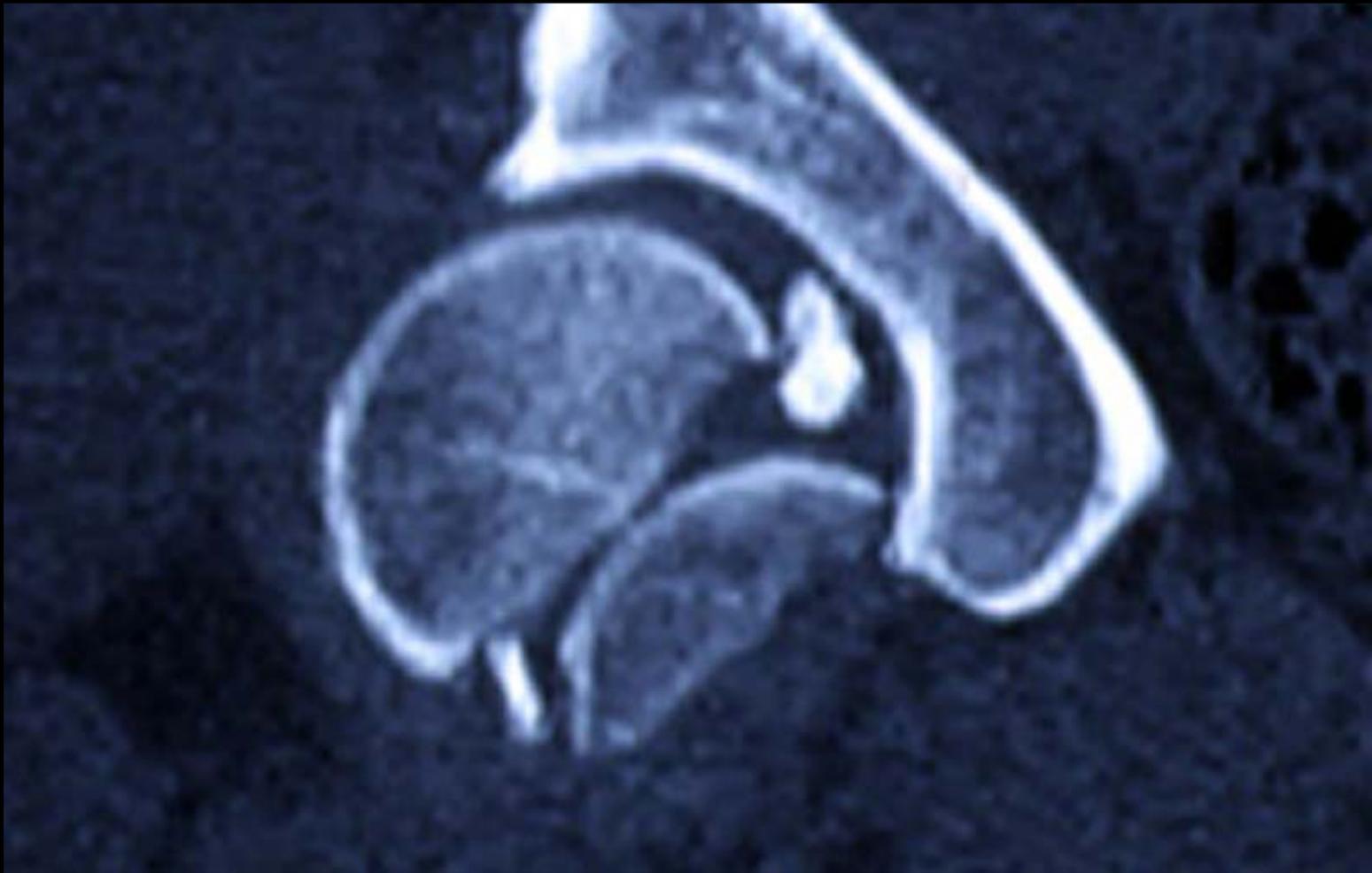


*Right hip fracture and dislocation*

R



*Head of femur fracture*



*Head of femur fracture*



*Repair of femoral head*

R



*Right tibial plateau fracture*

# Injury List

INJURY	SOURCE
Right cheek laceration	Airbag cover
Right wrist lacerations	Instrument panel
Right knee abrasions	Instrument panel
Right hip posterior dislocation	Instrument panel
Right femoral head fracture with intra-articular fragment	Instrument panel
Right acetabulum fracture	Instrument panel
Right tibial plateau fracture	Instrument panel

# Mature Anthony

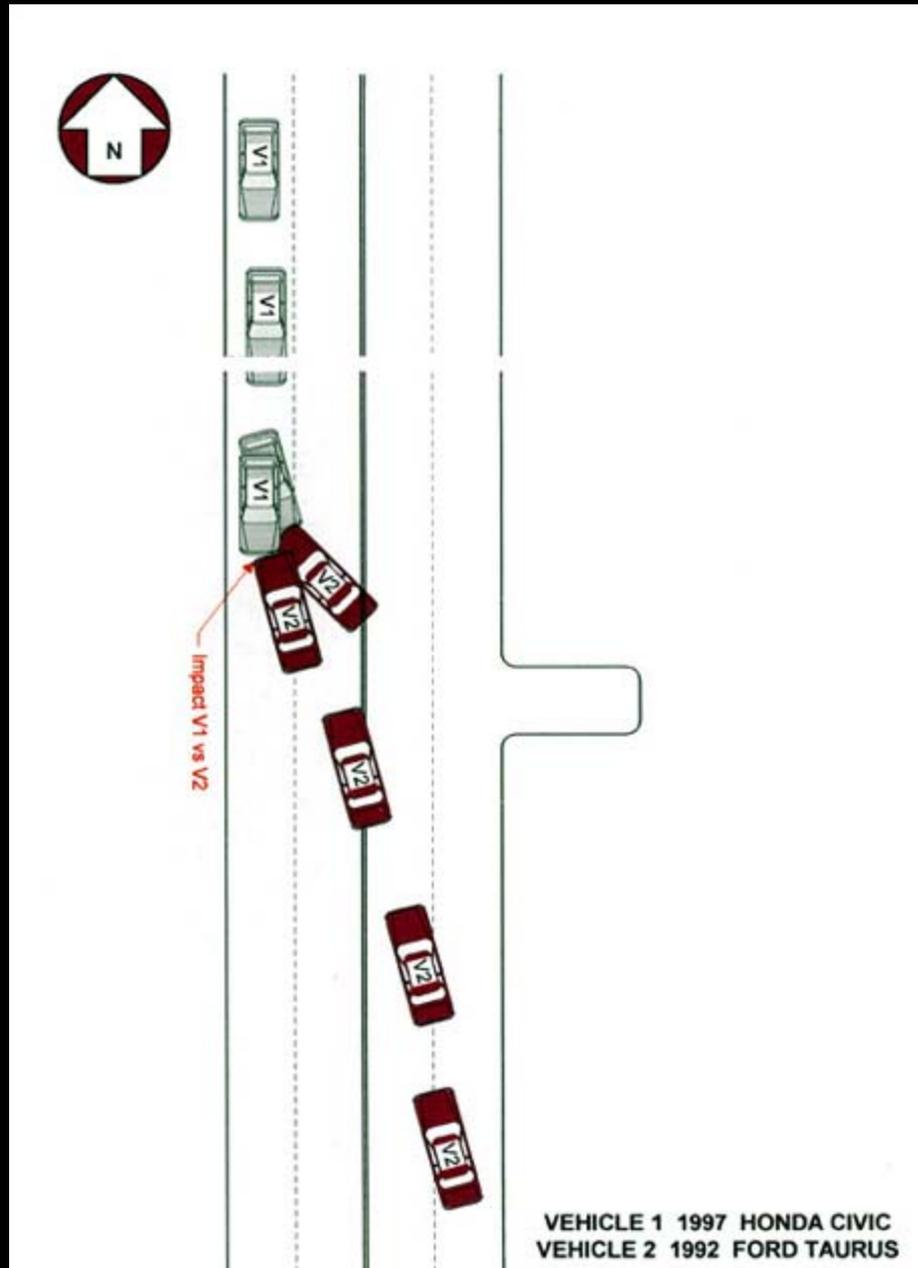
- 53 year old male unrestrained driver
- Weight = 70 kg (154 lbs)
- Height = 170 cm (5' 7")
- Airbag deployed
- Survivor

*The battle lost: love is at an end...*

*...high speed desperation in a better chariot*

- V1 = 1997 Honda Civic (1064 kg)
  - Delta V = 63.4 kph
  - Energy Dissipated = 178,365 joules
  - Max crush = 45 cm at C1
- V2 = 1992 Ford Taurus (1430 kg)
  - Delta V = 47 kph
  - Energy dissipated = 125,071 joules

*Scene diagram*





*Scene photo*



*Subject vehicle*



*Airbag deployment (no seat belt)*

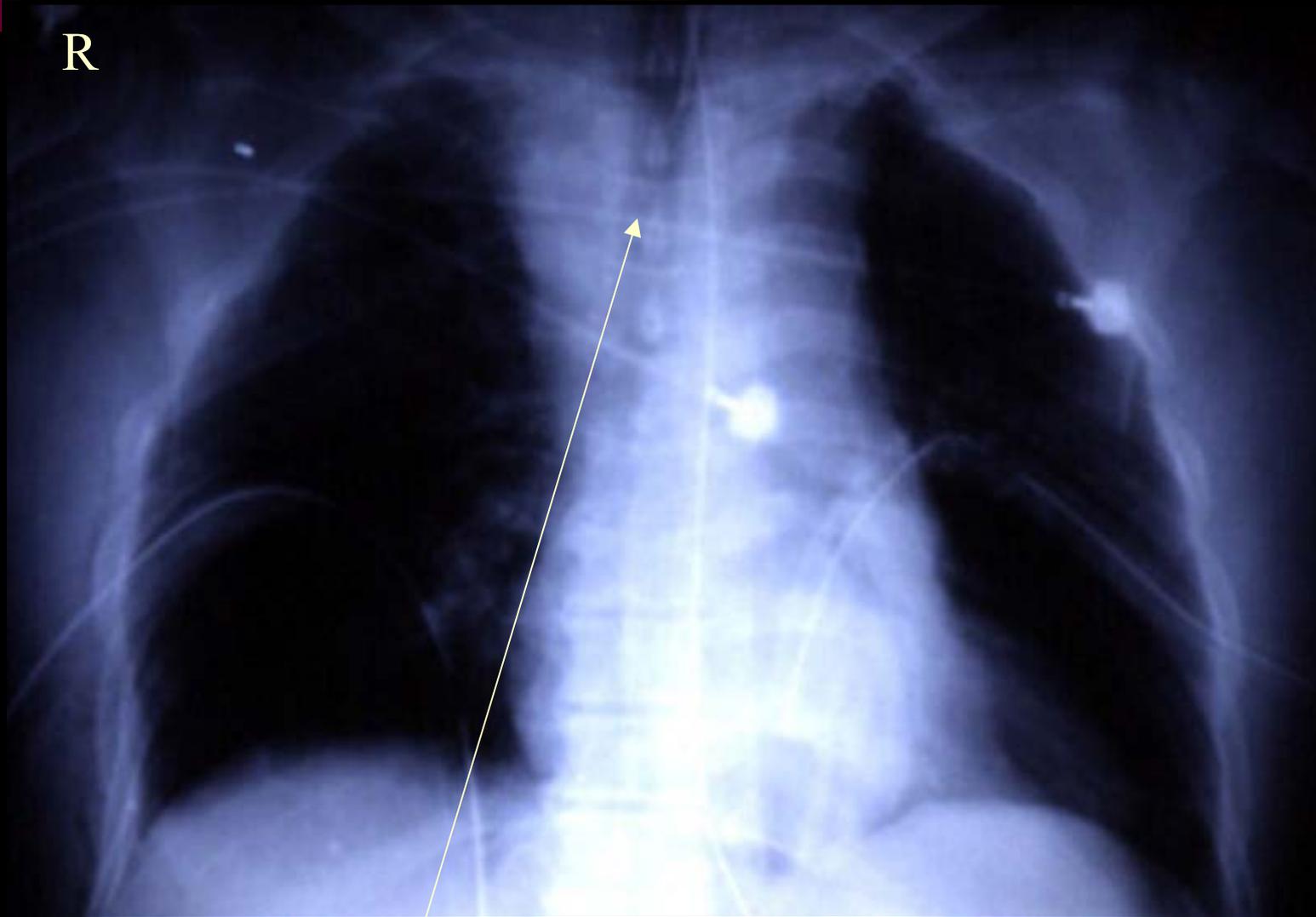


*Bent steering wheel*

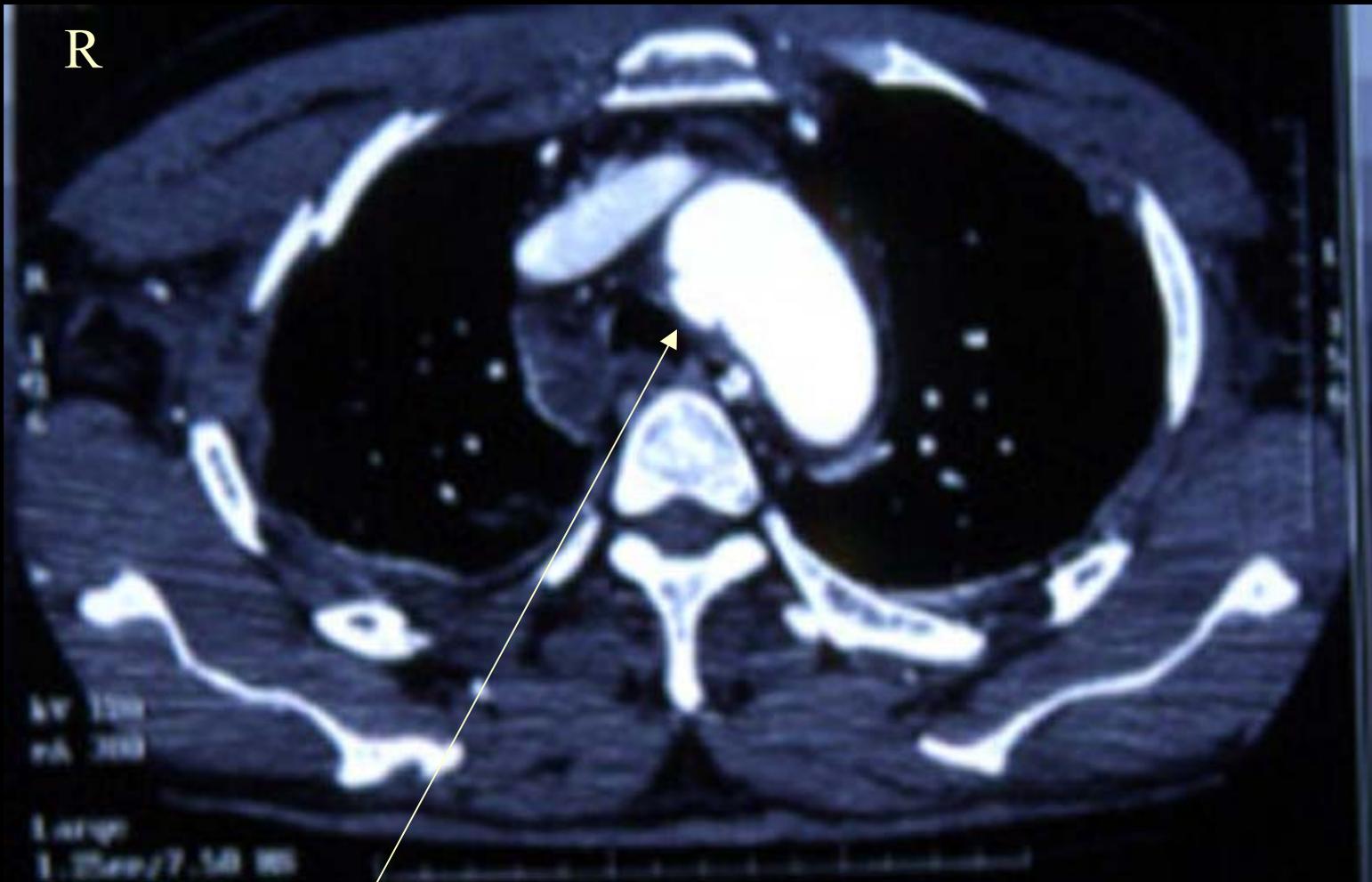


*Impact sites with instrument panel*

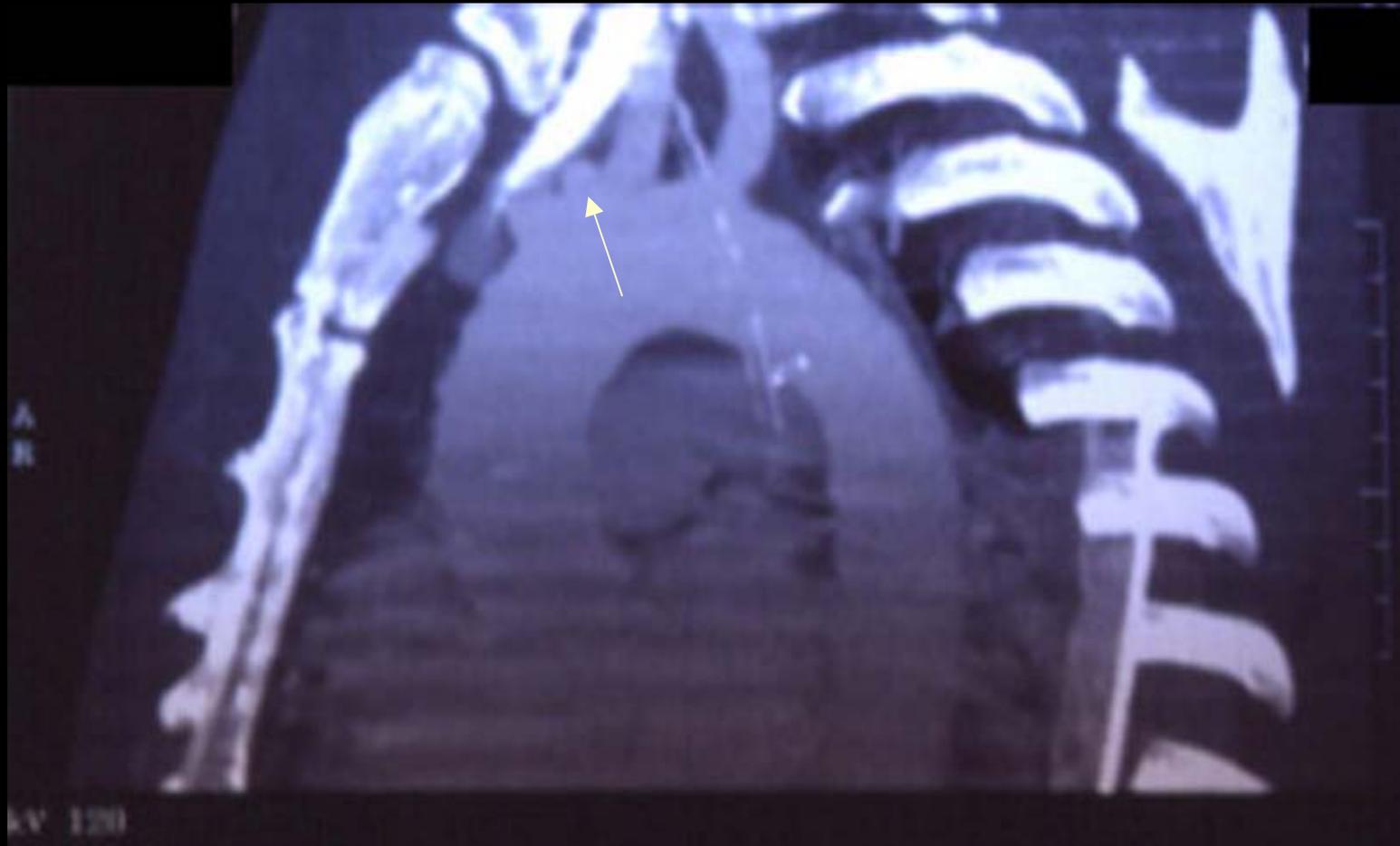
R



*Widened mediastinum*



*Aortic arch pseudoaneurysm*



*CT reconstruction of aortic arch pseudoaneurysm*



*Axial loading fractures of left femur and left patella*

# Injury List

INJURY	SOURCE
Massive chest contusion	Airbag
Sternum fracture	Steering wheel
Bilateral rib fractures (inc. 1 & 2)	Steering wheel
Aortic arch laceration	Steering wheel
Liver laceration (gr II)	Steering wheel
Right clavicle fracture	Steering wheel
Left open midshaft femur fracture	Steering column
Left intertrochanteric femur fracture	Instrument panel
Left comminuted patella fracture	Instrument panel
Right open tibia/fibula fracture	Toe pan
Left foot fractures	Toe pan

# ABRAHAM



*Aged patriarch*

# SARAH



*Aged mother*

# Abraham

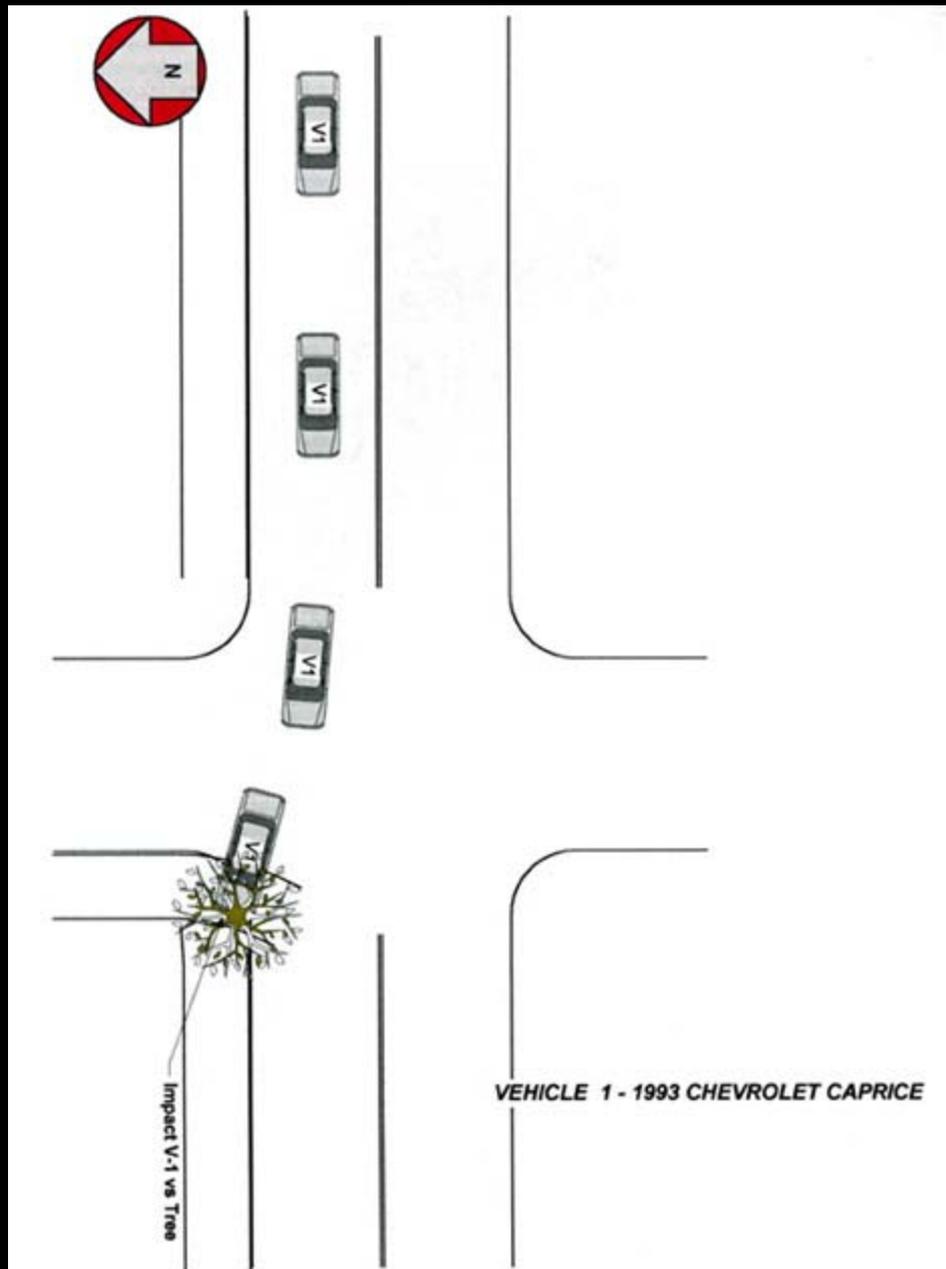
- 71 year old male unrestrained driver
- Weight = 85 kg (187 lbs)
- Height = 170 cm (5' 7")
- Airbag deployed
- Survivor

*Contemplating eternal truth, falls asleep at the wheel...*

*...and has a serious impact with the Tree of Life*

- V1 = 1993 Chevrolet Caprice (1839 kg)
  - Delta V = 66 kph
  - Energy Dissipated = 324,351 joules
  - Max crush = 115 cm at C3
- V2 = tree

*Scene diagram*





*Scene photo*



*Unfortunate tree*



*Subject vehicle*



*Driver compartment intrusion*



*Airbag deployment (no seat belt)  
Seat far forward on impact*



*Seat belt inactivated by driver*



*Brake and gas pedals deformed*



*Airbag cover injury to chin and jaw, with brain contusion*



*Left bimalleolar fractures*



*Left bimalleolar fractures*

# Injury List

INJURY	SOURCE
Left parietal SAH	Airbag cover
Left frontal lobe contusion	Airbag cover
Chin contusion	Airbag cover
Upper neck, chest abrasion	Airbag cover
Left knee, ankle abrasion	Instrument panel
Left bimalleolar fracture	Toe pan

# Sarah

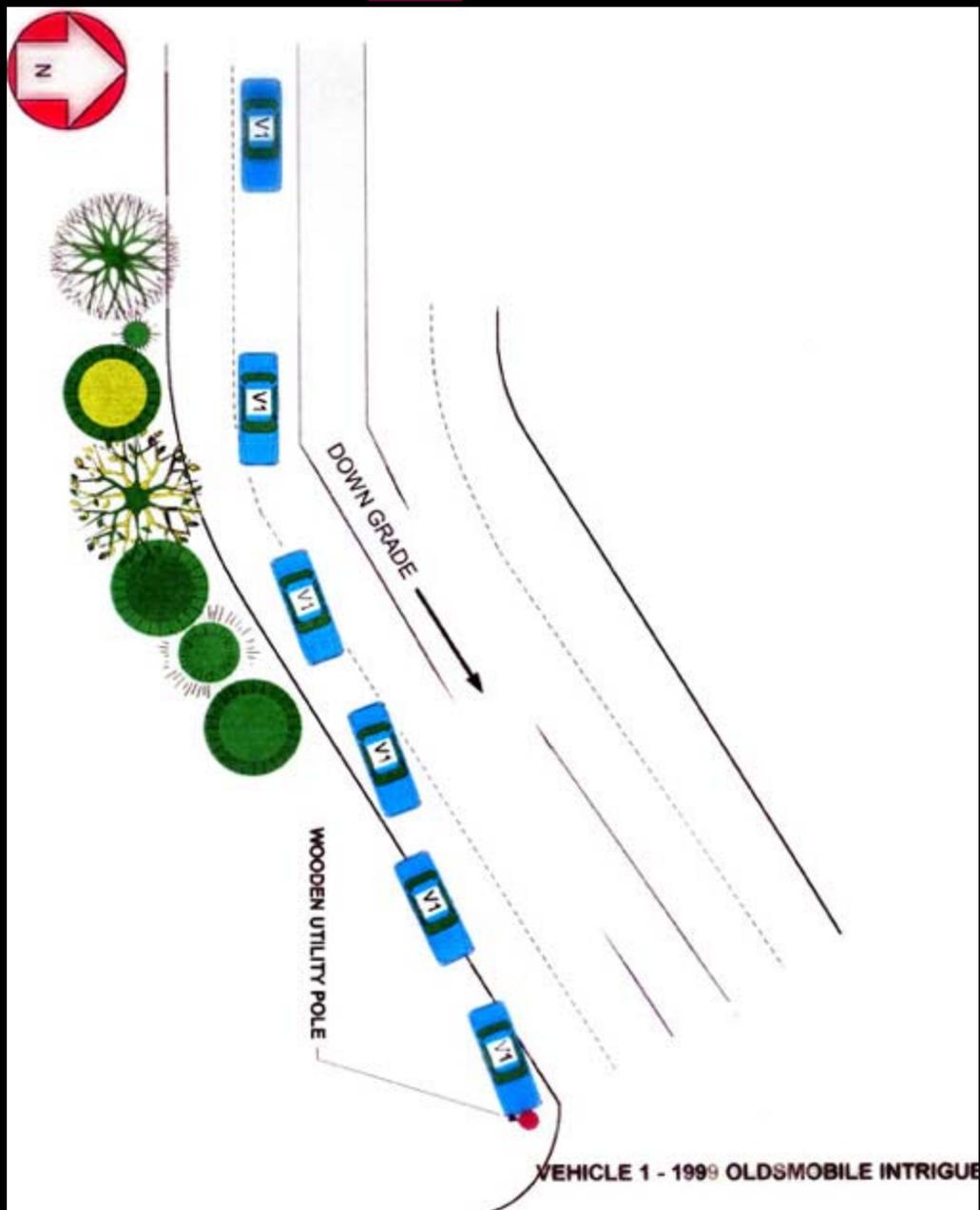
- 73 year old female restrained driver
- Weight = 79 kg (174 lbs)
- Height = 160 cm (5' 3")
- Airbag deployed
- Survivor

*Revered mother daydreaming of beloved children and grandchildren...*

*...awakens to find pole bearing down on vehicle*

- V1 = 1999 Oldsmobile Intrigue (1594 kg)
  - Delta V = 51.3 kph
  - Energy Dissipated = 168,226 joules
  - Max crush = 82 cm at C4
- V2 = pole

*Scene diagram*





*Scene photo*



*Subject vehicle*

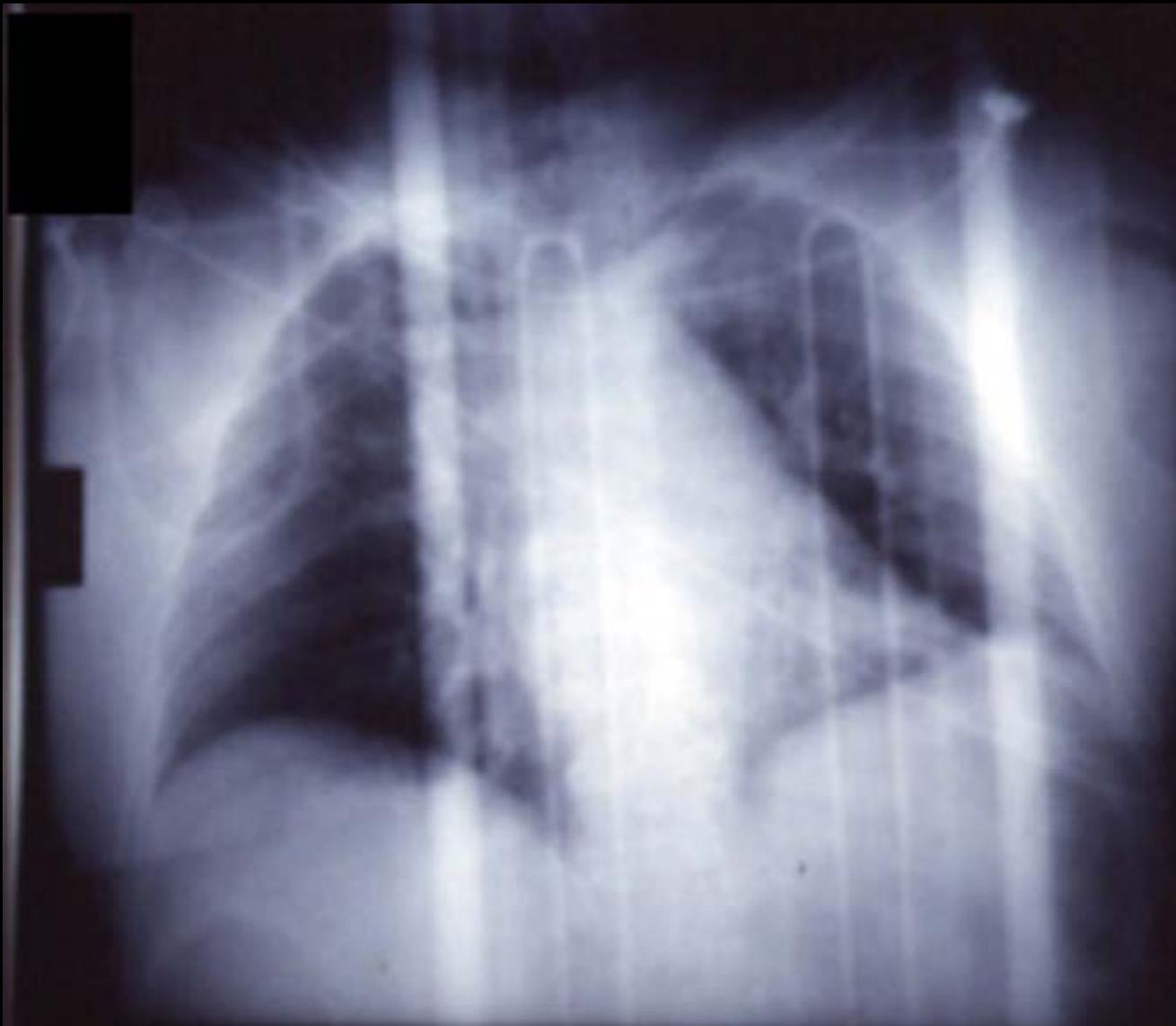


*Pole impact*



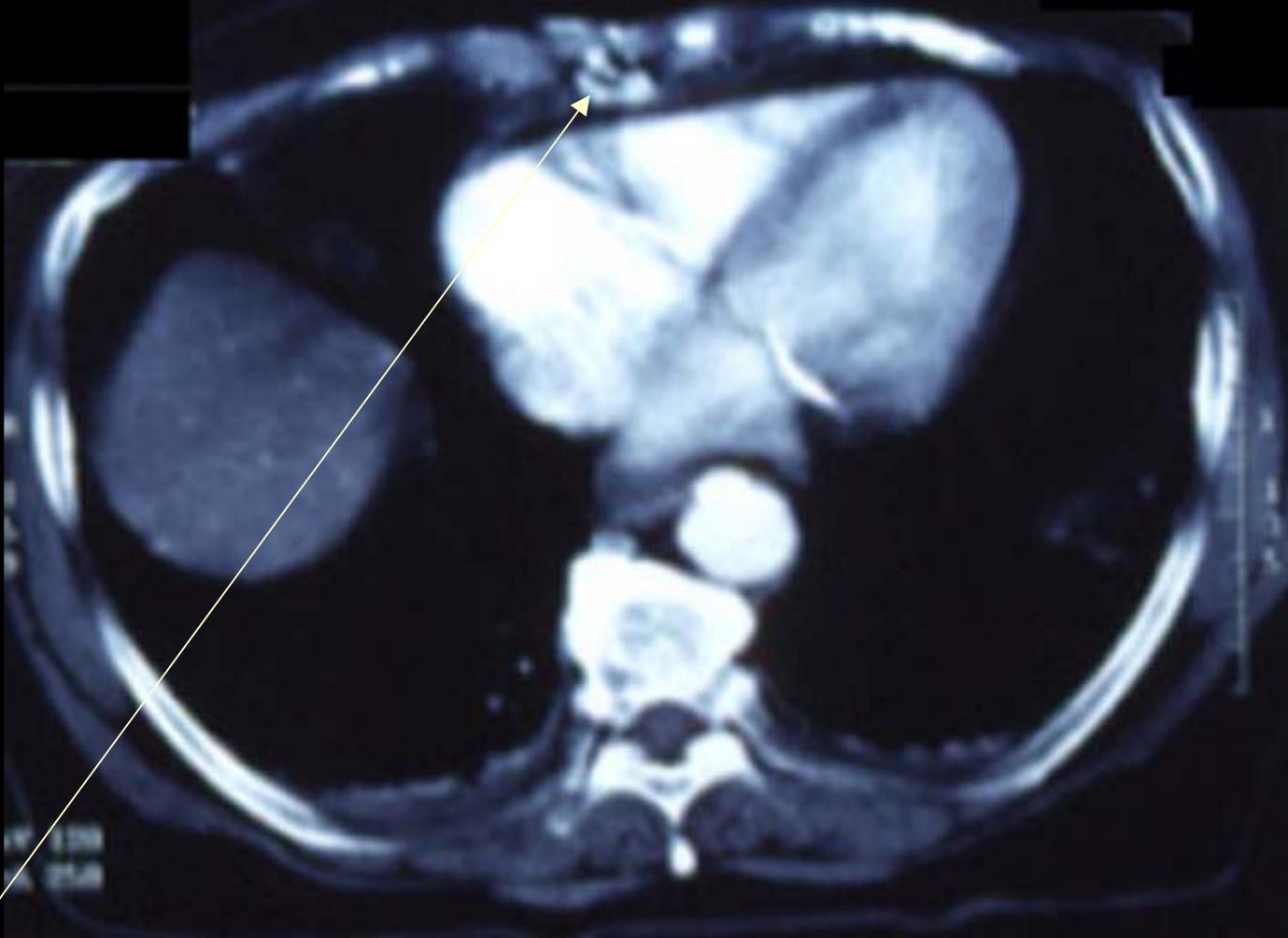
*Airbag deployment (seat belt restrained)*





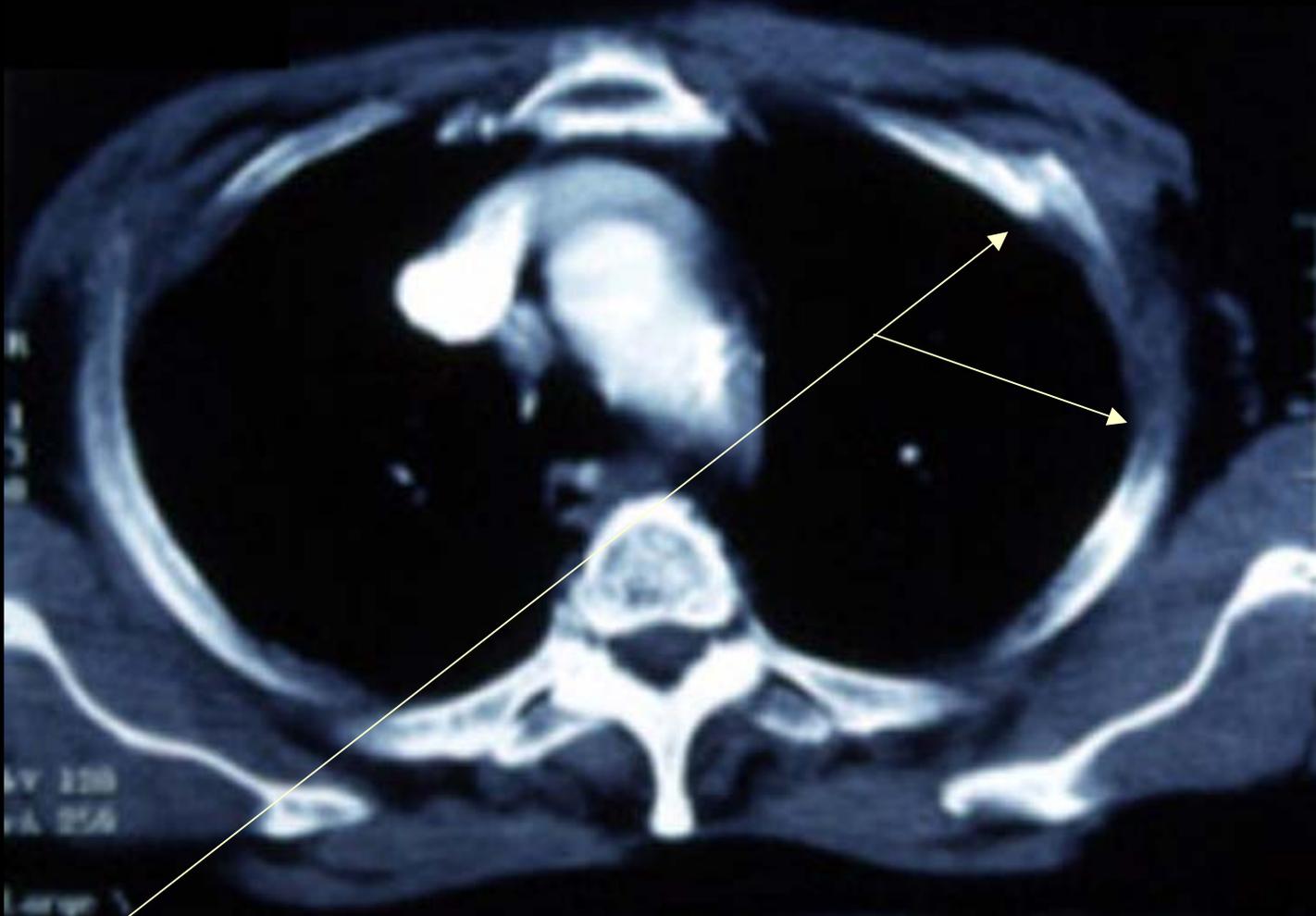
*Pulmonary contusions*

R



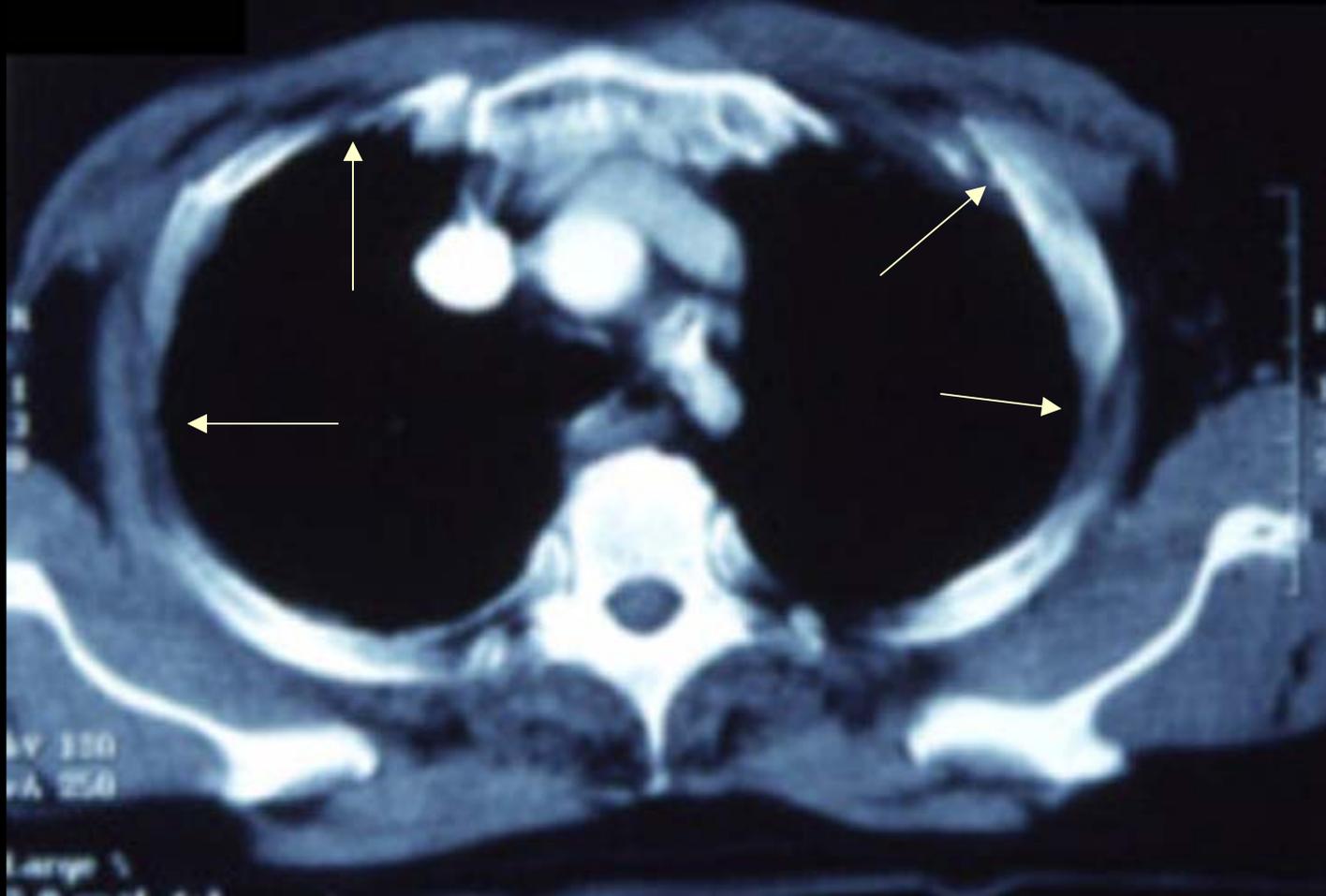
*Sternal fracture*

R



*Rib fractures*

R

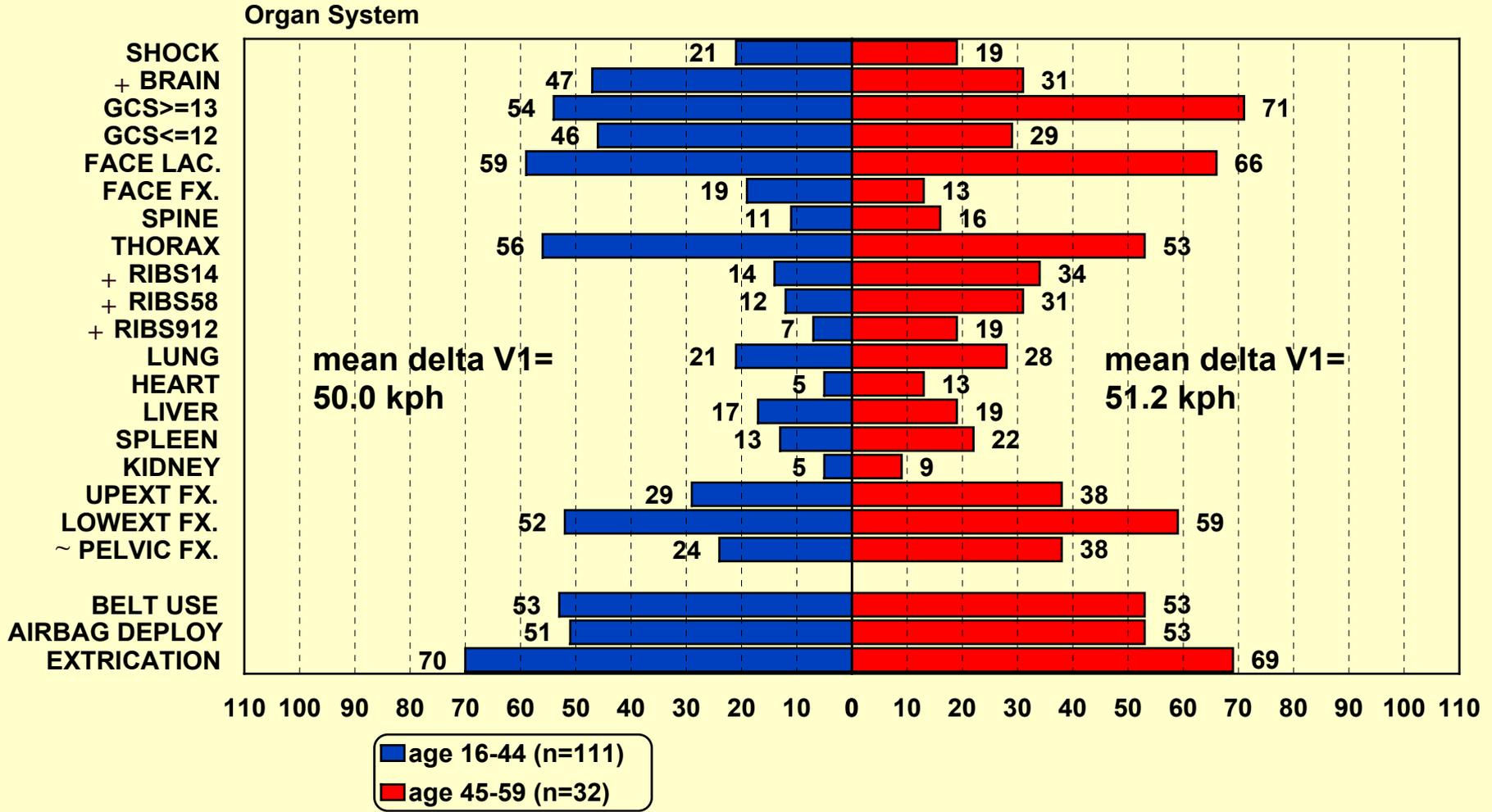


*Multiple rib fractures*

# Injury List

INJURY	SOURCE
Left chest wall contusion	Airbag
Sternum abrasion	Airbag/cover
Bilateral rib fractures	Airbag/cover
Sternum comminuted fracture	Airbag/cover
Bilateral knee abrasions	Instrument panel
Bilateral lower leg contusions	Foot pedals

# Males Age 16-44 vs Age 45-59 in Frontal Crashes

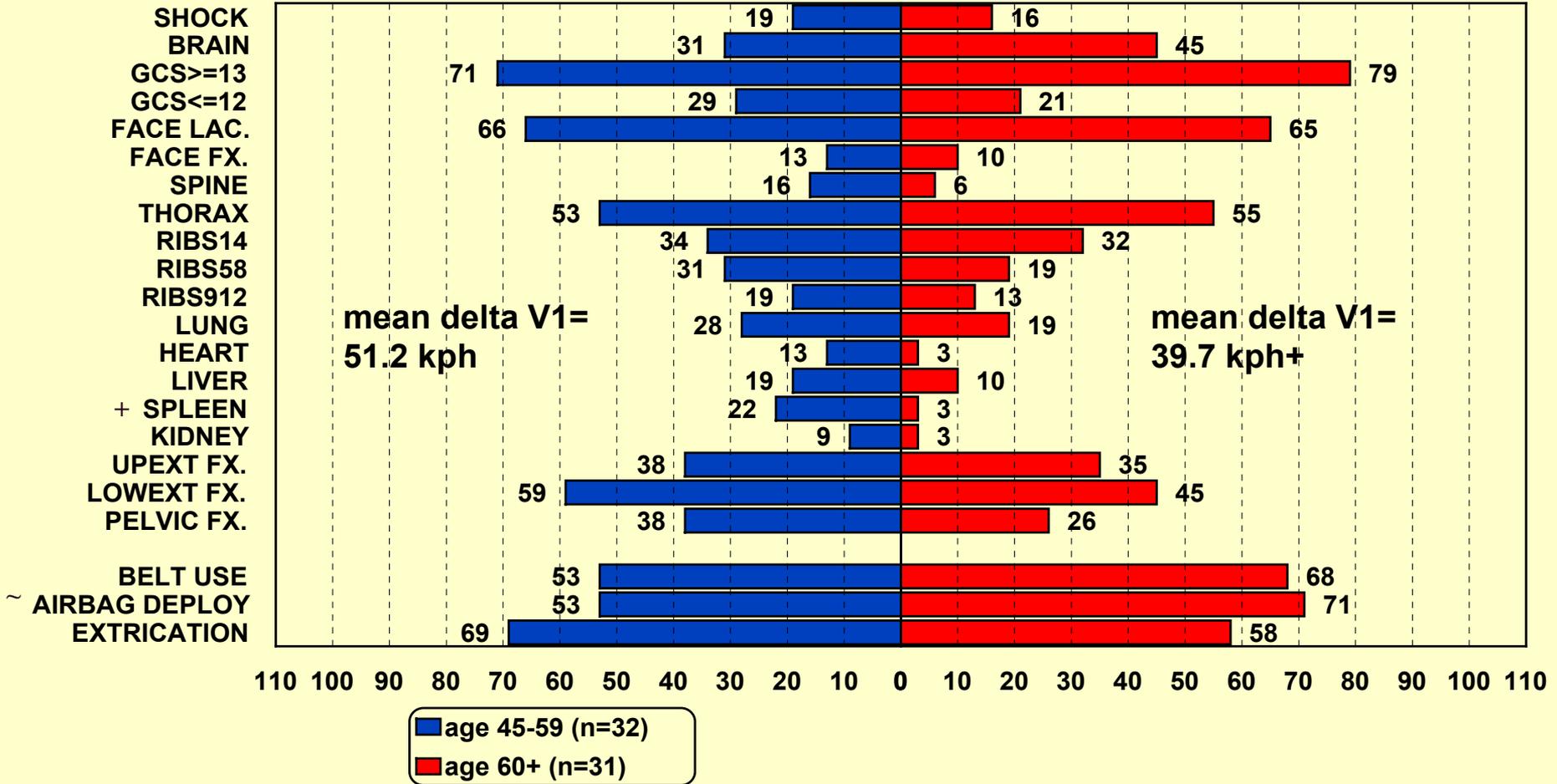


+ = p<0.05

~ = not quite significant

# Males Age 45-59 vs Age 60+ in Frontal Crashes

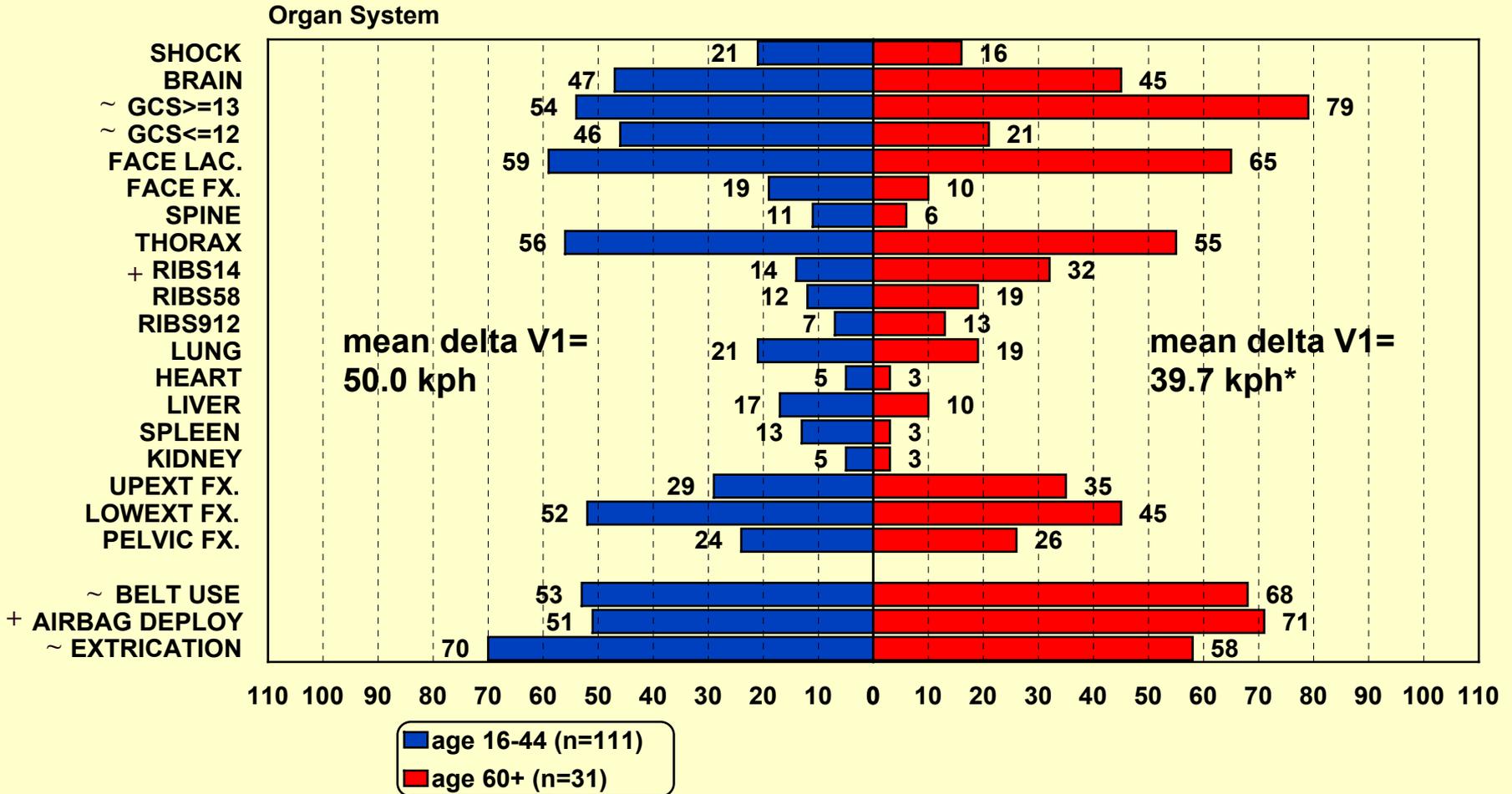
Organ System



+ = p<0.05

~ = not quite significant

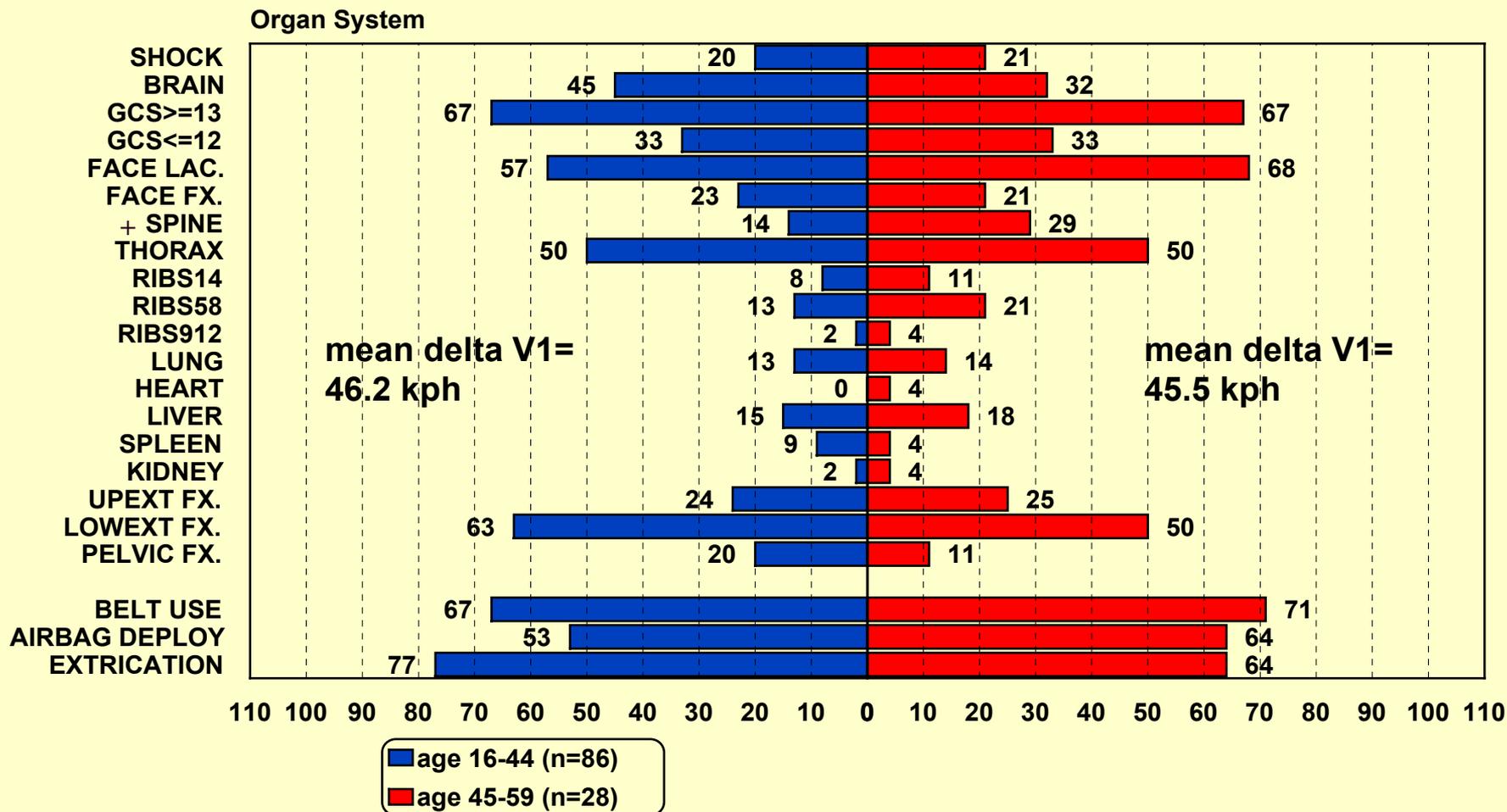
# Males Age 16-44 vs Age 60+ in Frontal Crashes



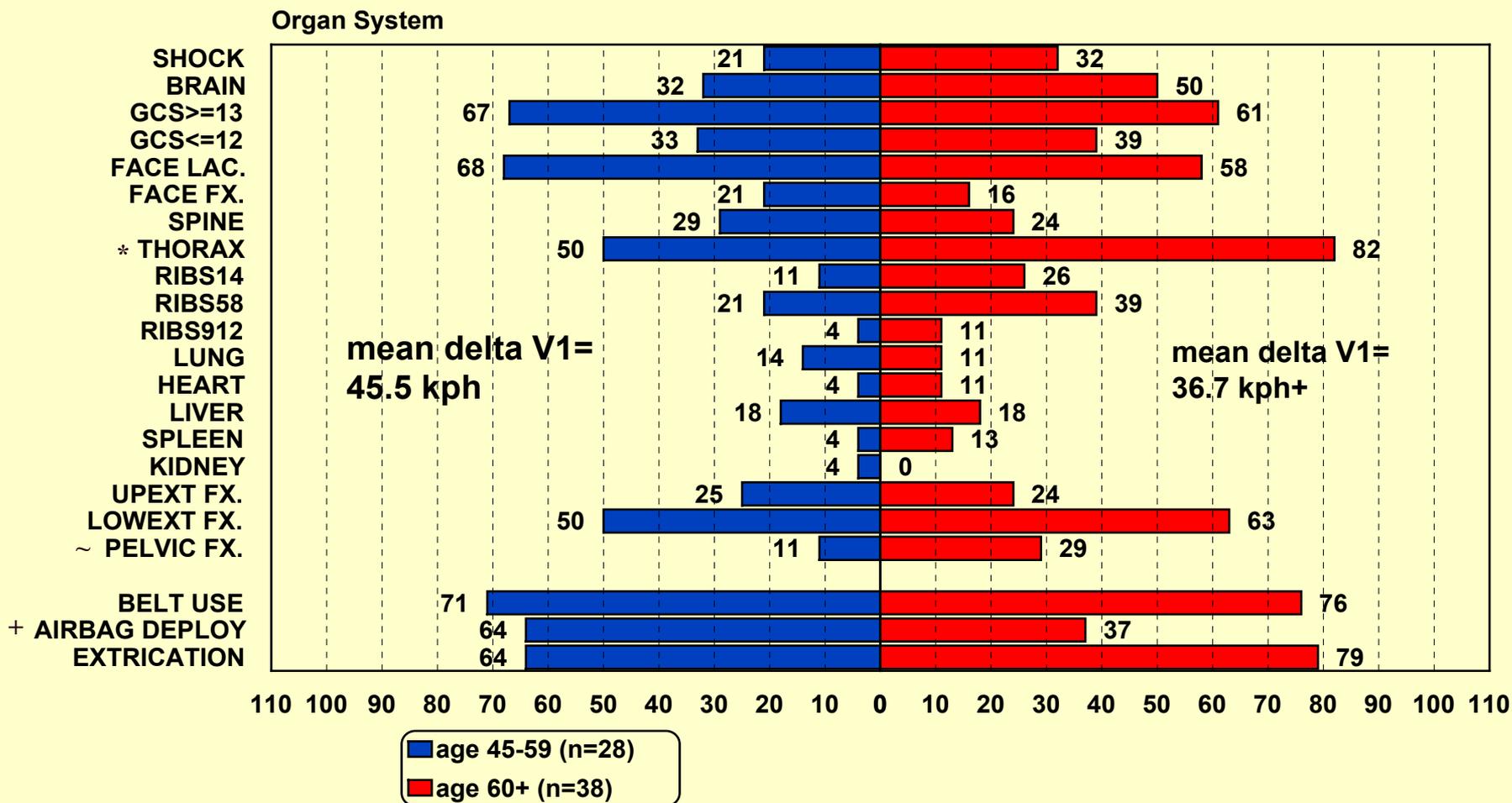
+ = p < 0.05

~ = not quite significant

# Females Age 16-44 vs Age 45-59 in Frontal Crashes



# Females Age 45-59 vs Age 60+ in Frontal Crashes



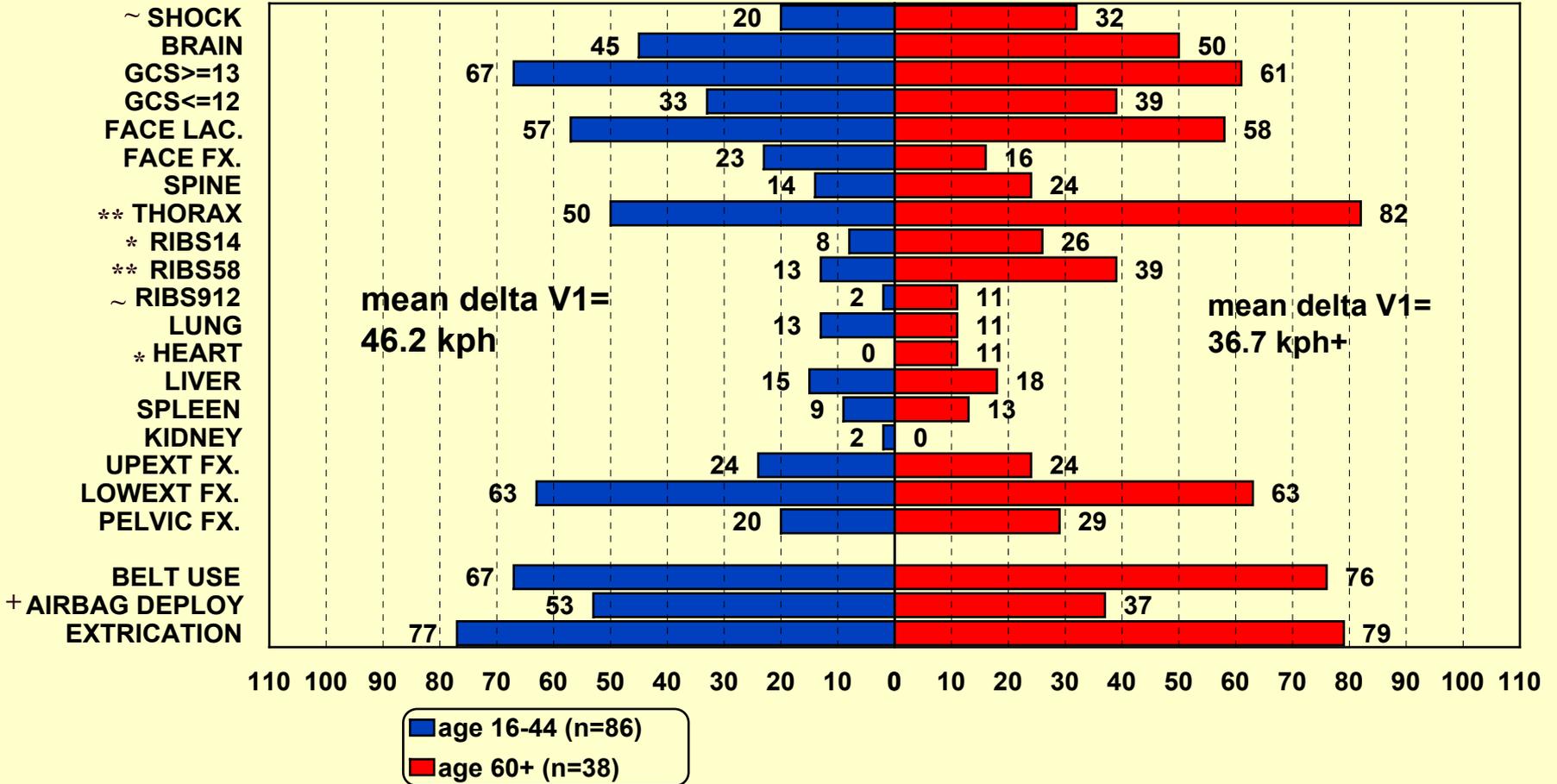
+ = p < 0.05

\* = p < 0.01

~ = not quite significant

# Females Age 16-44 vs Age 60+ in Frontal Crashes

Organ System

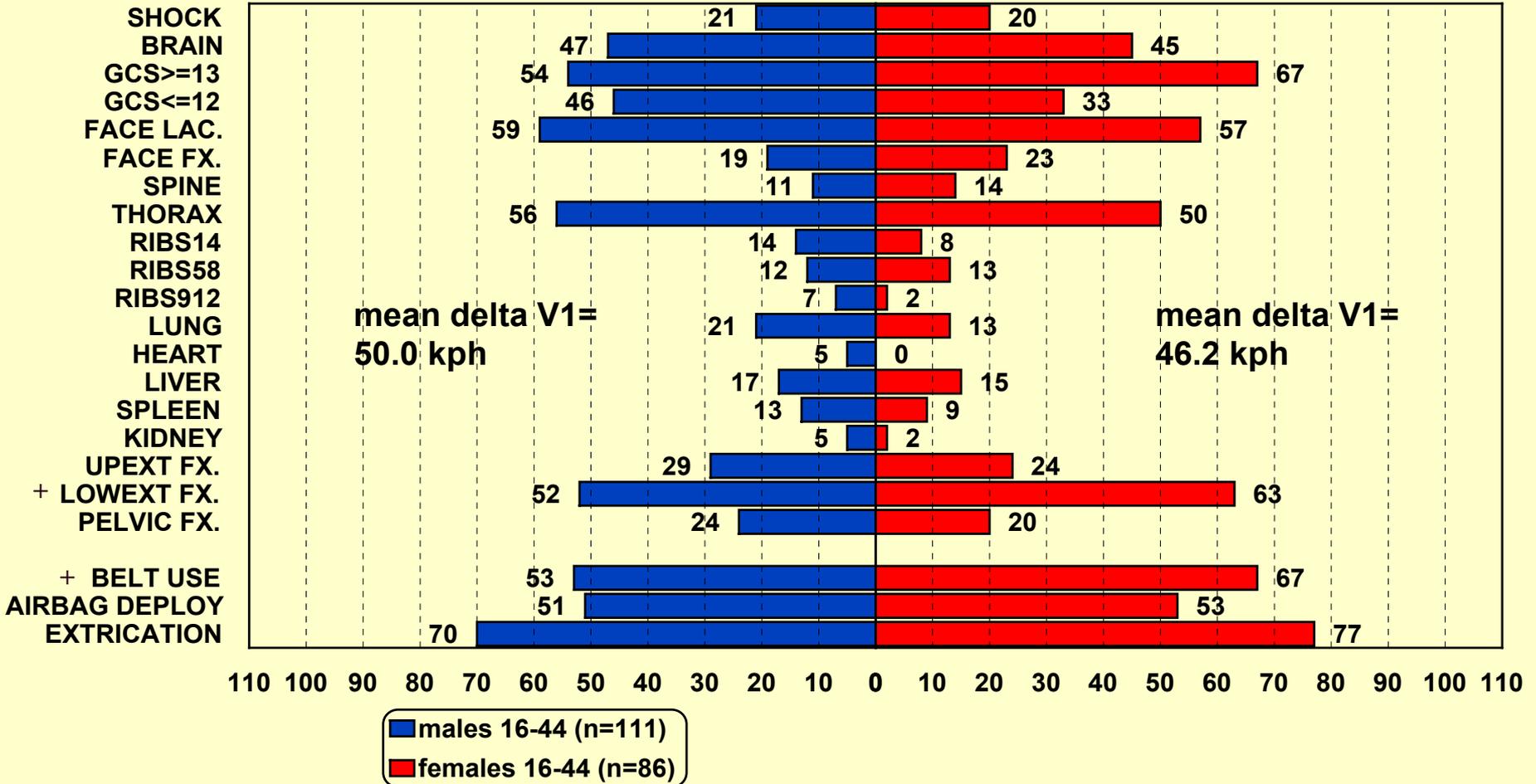


+ = p<0.05  
 \* = p<0.01

\*\* = p<0.001  
 ~ = not quite significant

# Age 16-44 Males vs Females in Frontal Crashes

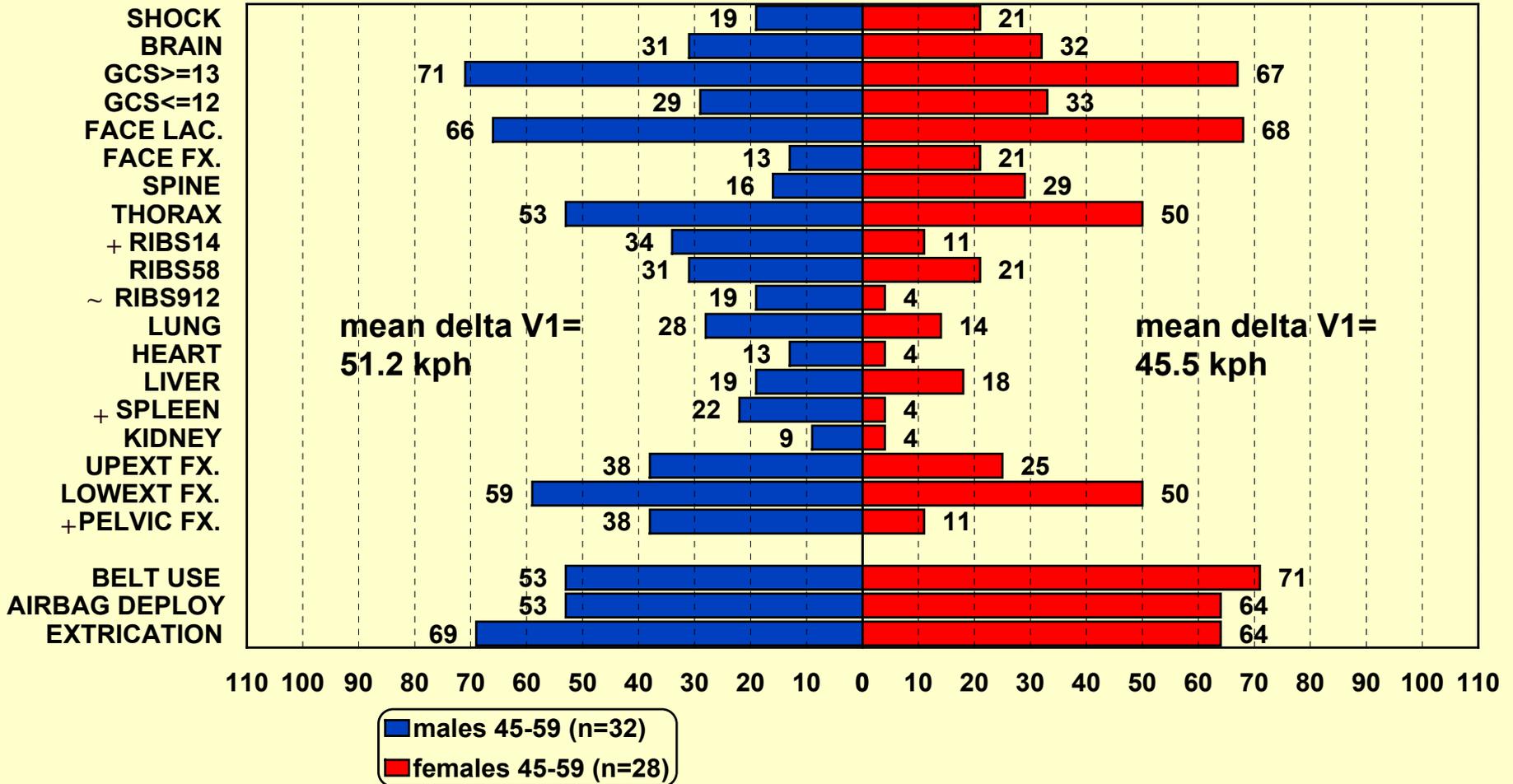
Organ System



+ = p < 0.05

# Age 45-59 Males vs Females in Frontal Crashes

Organ System

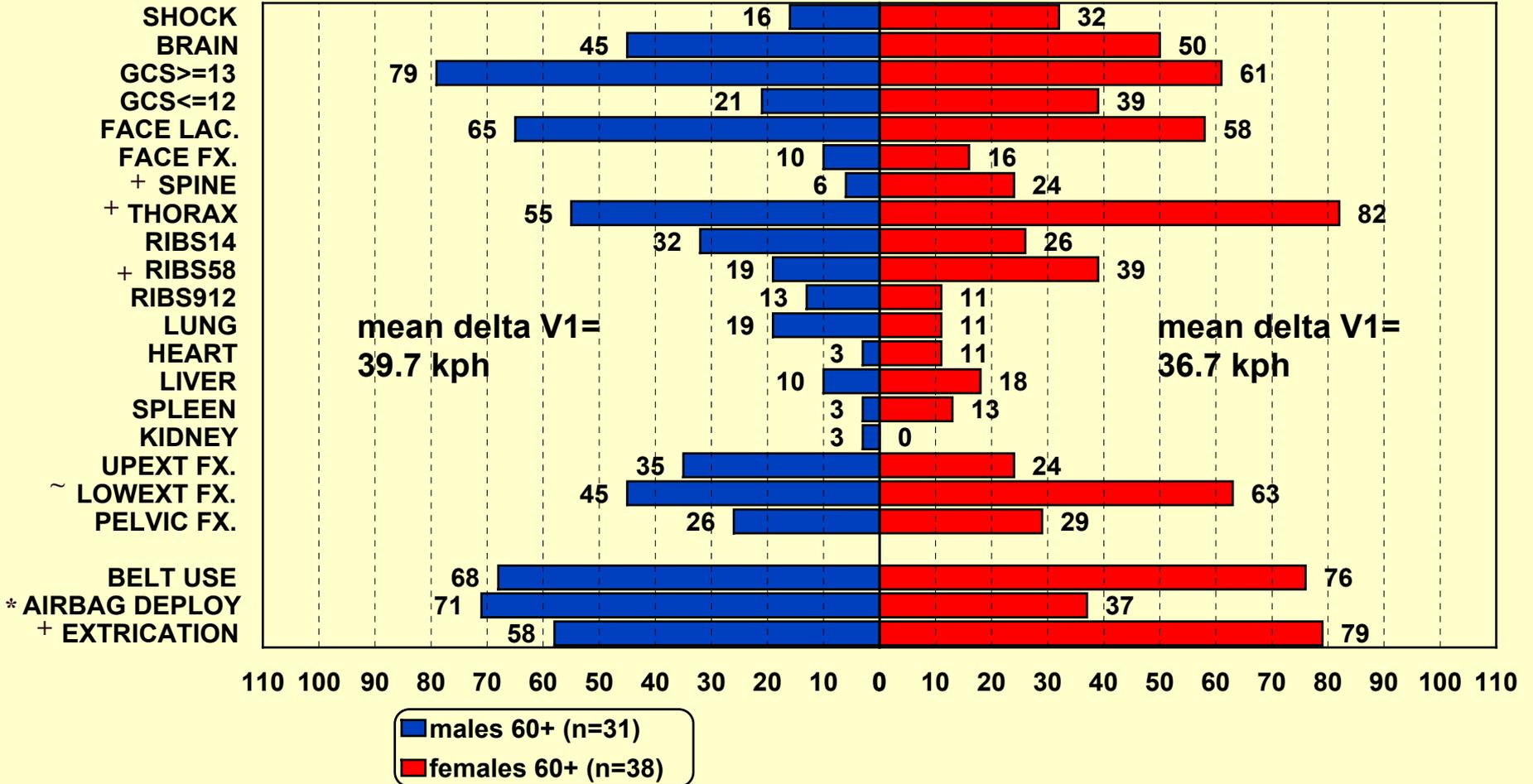


+ = p < 0.05

~ = not quite significant

# Age 60+ Males vs Females in Frontal Crashes

Organ System



+ = p<0.05

\* = p<0.01

~ = not quite significant

# Conclusions

- Women tend to be shorter and lighter than men in general. However, there is no difference within gender by age groups.
- Females and males over age 60 tend to have crashes with lower  $\Delta V$ s, spend more time in the hospital, have more intensive care days and a significantly lower survival rate than younger individuals of the same gender. This is especially true for females.

# Conclusions (cont.)

- Thorax and rib injuries are the major difference between young and aged females, with elderly women having a significantly greater incidence of both. Cardiac injury and shock are also increased in elderly women.
- A comparison between men aged 60 and over and women aged 60 and over reveals that the increased susceptibility of elderly women to thorax and spine injuries is not simply due to age, and may be due to increased loss of bone mass in elderly women as opposed to elderly men.

# Recommendations

Given the fact that the population is aging and larger numbers of persons, especially women, survive into the eighth and ninth decade, specific modifications in restraint and airbag aggressivity may have to be provided for this group of patients. There may also have to be modifications in foot pedal lengths as well as adjustments in seat and steering wheel location so older females, who tend to be shorter, can be seated effectively further from the steering wheel, without compromising their ability to see the road.