

Atlanto-Occipital Dislocation in Side Impact

**Department of Neurosurgery
Medical College of Wisconsin
and VA Medical Center**

Case Occupant

- Driver
- 51-year-old female
- 165 cm (5'5"), 101 kg (222 lb)
- 3-point belt worn
- Driver airbag not deployed



Case Occupant History

- GCS 15 at scene
- GCS 15 when admitted on 4th floor
- Moved to SICU due to change in respiratory status (Day 2)
- Move to NICU post-operatively (Day 3)



Case Occupant Injuries

CASE NO.: 13-02

CASE VEHICLE: 1997

TYPE: Oldsmobile Acheiva

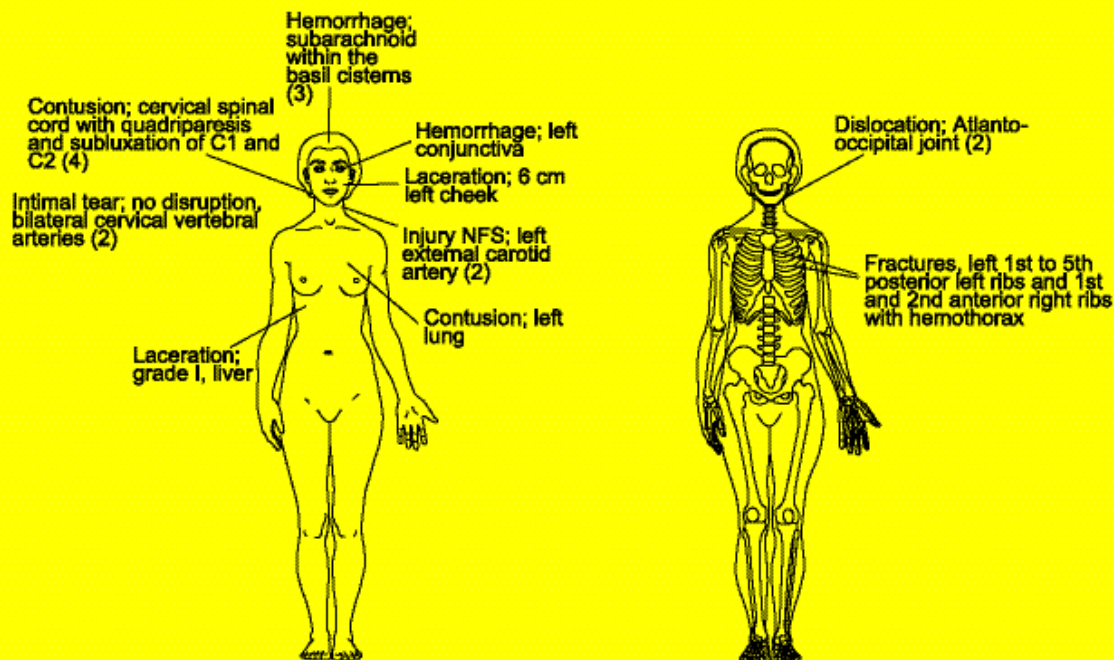
OCCUPANT: Driver:

STATURE: 165 cm

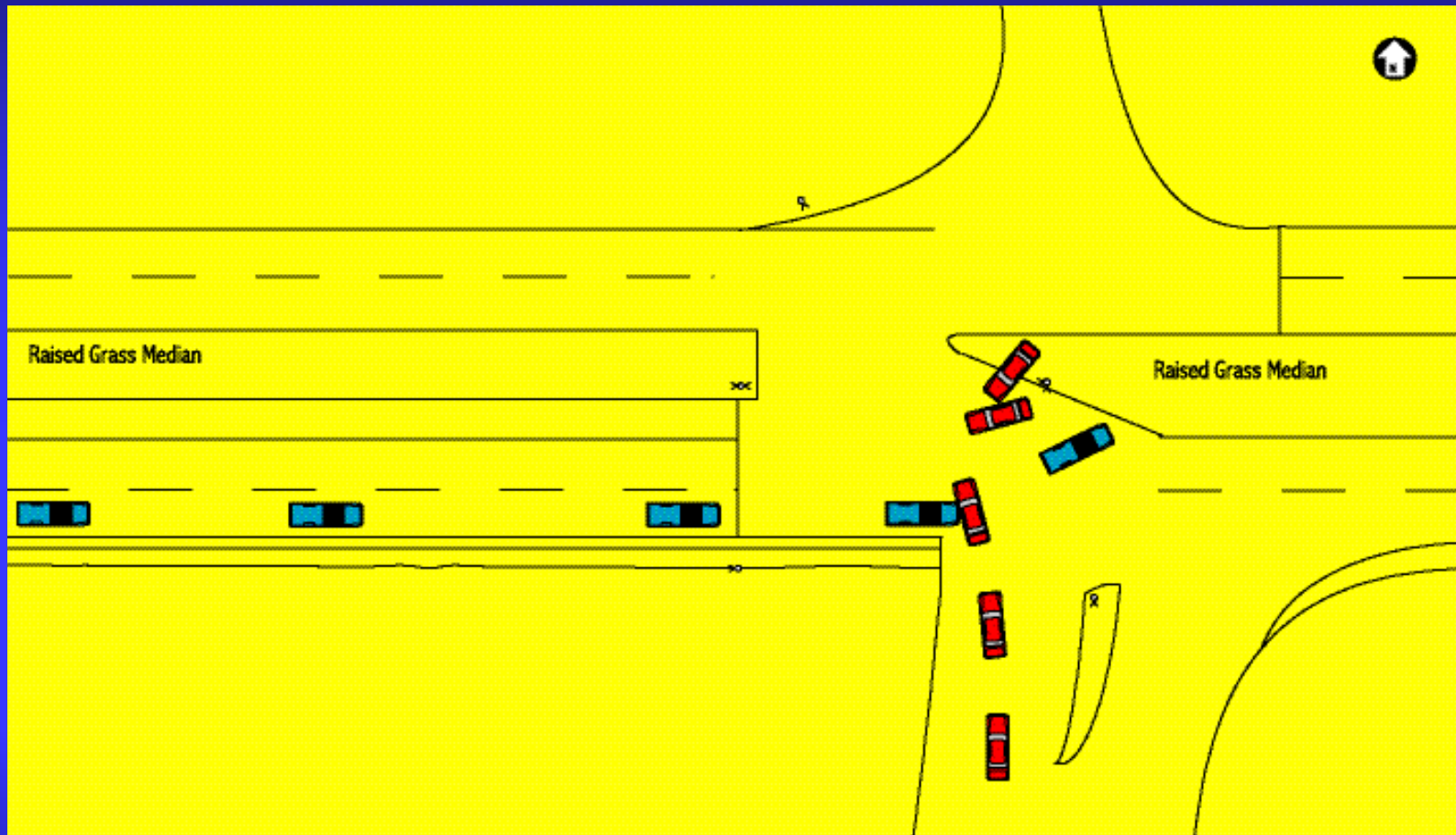
MASS: 101 kg

RESTRAINTS: 3-point belt worn

SEVERITY: MAIS - 4 : ISS - 36



Crash Overview



The case vehicle was stopped at the controlled intersection in the left-turn lane of a off-ramp from a divided highway and four-lane divided roadway.

Scene Photo



Vehicle two was traveling east in the outside lane approaching the intersection. As the driver of the case vehicle began a left turn, vehicle two entered the intersection and struck the case vehicle on the left-side doors.



Scene Photo



The impact caused the case vehicle to rotate counterclockwise. The case vehicle came to rest with its rear wheels on the gore of the median, facing south west.



Scene Photo



Vehicle two rotated slightly counterclockwise and came to rest facing east in the inside lane.



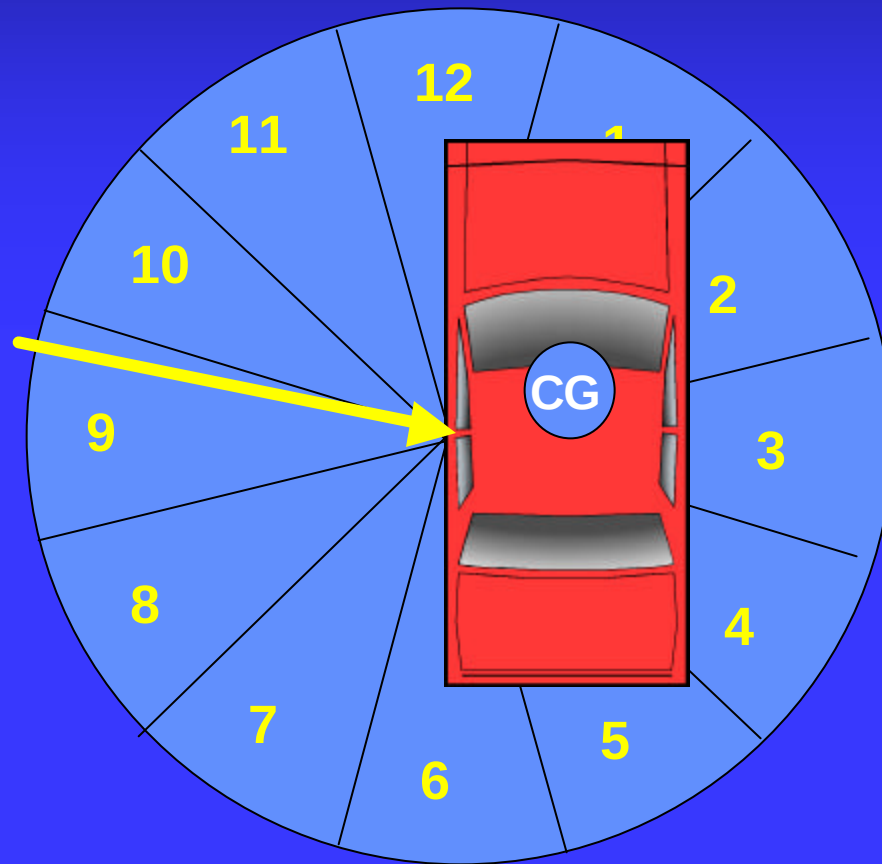
Path of Case Vehicle



Path of Vehicle Two



09 o'clock PDOF CDC 09-LZAW-4



1997 Oldsmobile Achieva 4 door



21 mph ?V
Missing Vehicle
Algorithm



1997 Oldsmobile Achieva 4 door



1997 Oldsmobile Achieva 4 door



Crashed
Vehicle



Exemplar
Vehicle



1997 Oldsmobile Achieva 4 door



Crashed & Exemplar Oldsmobile Achieva



1997 Oldsmobile Achieva 4 door



Exemplar Oldsmobile Achieva



1997 Oldsmobile Achieva 4 door – Interior



1997 Oldsmobile Achieva 4 door – Interior



1997 Oldsmobile Achieva 4 door – Interior



48 cm estimated B-pillar intrusion
46 cm estimated door intrusion



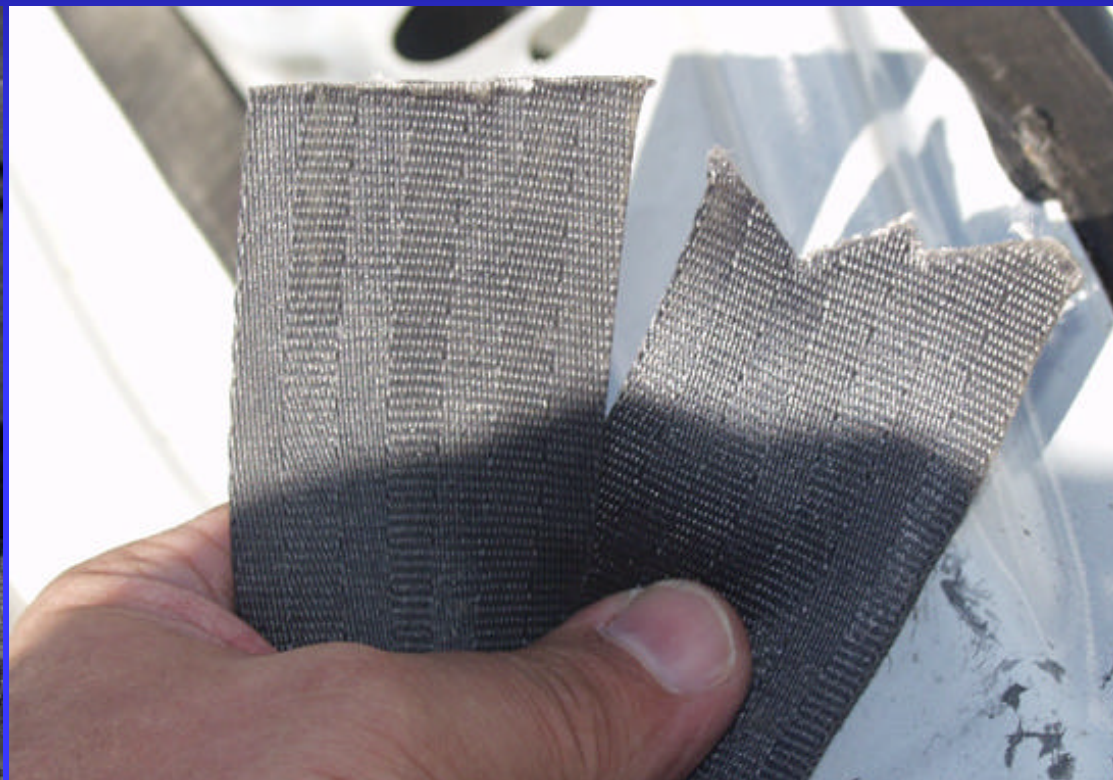
1997 Oldsmobile Achieva 4 door – Interior



1997 Oldsmobile Achieva 4 door



1997 Oldsmobile Achieva 4 door



System Status At Near Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Front Air Bag Suppression Switch Circuit Status	Air Bag Not Suppressed
Ignition Cycles At Near Deployment	8053
Ignition Cycles At Investigation	8054
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	68.75
Maximum SDM Recorded Velocity Change (MPH)	-4.8268

Shoulder belt cut
with scissors and
seat belt cutter



Vehicle Two 1998 Dodge Dakota Club Cab 4x4



Probable source of C-spine injury and facial laceration

Exemplar 1997 Oldsmobile Achieva with Mock-up of a Dodge Dakota



A subarachnoid brain hemorrhage within the basil cisterns, a dislocation of the atlanto-occipital joint, a contusion of the cervical spinal cord with a subluxation of C1 and C2, with resulting motor deficit, an intimal tear without disruption of the bilateral cervical vertebral arteries and an injury to the left external carotid artery were probably caused by the left shoulder being loaded in and down by the intruding door as it was loaded by V2 and the trapping of the driver's head by the hood/grille of V2, which resulted in a distraction of the head-neck complex.

1997 Oldsmobile Achieva 4 door



Probable source of left rib fractures and left lung contusion



Case Occupant



Possible source of liver laceration



Atlanto-Occipital Injuries: Clinical Case Perspective and Review



Scene Photo



Mechanism of Injury

- Tension-Extension
 - Most Common
 - Injury to Tectorial Membrane
 - Airbag injury most common
 - Supported by high incidence of facial lacerations and mandibular fractures



Exemplar 1997 Oldsmobile Achieva with Mock-up of a Dodge Dakota



Exemplar 1997 Oldsmobile Achieva with Mock-up of a Dodge Dakota



Intraoperative Findings

- Complete ligamentous disruption at Oc-C1
- Small Epidural Hematoma
- No evidence of fracture



Mechanism of Injury

- Hyperflexion
 - ➔ More unusual
 - ➔ Associated with posterior element fractures



Mechanism of Injury

- Rotation/Lateral Flexion
 - Very rare
 - Alar Ligaments very strong in adults
 - Usually results in occipital condyle fractures



Clinical Presentation

- Few specific symptoms
- Diagnosis based on constellation of
 - Associated Injuries
 - ◆ Facial abrasions/lacerations
 - ◆ Mandibular fractures
 - Radiological features
 - High index of suspicion in the proper situations



Clinical Presentation

- Major Head Injury
 - Traumatic contusions
 - Posterior Fossa SAH
 - Intraventricular hemorrhage



Clinical Presentation

- Cardiorespiratory Abnormalities
- Cranial Nerve Palsies
 - Sixth most common
 - Lower Cranial Nerve Palsies



Clinical Presentation

- Asymmetric Motor Deficits
 - Hemiparesis and Decerebration
 - Spinal cord Injury from Subluxation
 - ◆ Direct SCI
 - ◆ Hematoma
 - Vascular Injury leading to Brainstem Infarction



Radiology

- Frank skeletal dislocation or severe malalignment rare
- Swelling of the retropharyngeal space
- Associated cervical fractures
- Diagnosis is often delayed for days



Referenced Research Papers

- Kaufman et al: Occipital Condyle-Superior facet of atlas (Longitudinal AOD)
- Dublin et al: Atlas arch-Post mandibular cortex
- Wholey et al: Tip of Odontoid-Basion
→ >5mm abnormal



Radiology

- Powers Ratio

- BC/OA

- ◆ (Basion- Post arch/Ophisthion-Ant arch)
 - ◆ Normal 0.77 ± 0.09
 - ◆ <0.9 -normal; >1.0 OAD
 - ◆ $0.9-1.0$; Gray Area (7% of normal, none in AOD)
 - ◆ Useful if abnormal, indicates need for neck stabilization



Radiology

- None of these measurements are completely reliable
- CT scan is conclusive
- CT indicated if
 - High clinical suspicion
 - Retropharyngeal Swelling



Radiology

- MRI

- Details ligamentous injury
- Highlights associated spinal cord injury
- Useful to diagnose associated hematoma



Treatment

- Immediate: Cervical Immobilization: Collar/Halo
- Traction Dangerous: Can worsen Deficits
- Definitive Treatment
 - ➔ Halo Immobilization
 - ➔ Internal Fixation (Occiput to Upper Cervical Spine)



Case Occupant Outcome

- Currently lives independently, on disability
- Residual right hemiparesis, mild
- Left 6th nerve palsy



Summary

- OAD is a rare but often lethal injury
- Diagnosis requires a high degree of suspicion
- Hitherto most commonly described from hyperextension injuries from airbag deployment
- Based on this case, clinical suspicion should be widened to side impact injury



Thank You for your attention

