NHTSA

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

CIREN Pedestrian Pilot Study Preliminary Cases

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Human Injury Research Division

Background

- Current program for occupant investigations began in 2017
  - Five enrolling sites and four engineering review centers
  - Emphasis remains on in-depth review of injury causation of motor vehicle occupants
  - Overview presented at this meeting in 2018
- CIREN pedestrian pilot study began in late 2018
  - Emory University (enrolling at Grady Memorial Hospital in Atlanta, GA)
  - Wake Forest/Virginia Tech (enrolling at Wake Forest Baptist Medical Center in Winston-Salem, NC)
  - Additional engineering support from Medical College of Wisconsin

EMORY UNIVERSITY SCHOOL OF MEDICINE

MEDICAL COLLEGE OF WISCONSIN

Wake Forest School of Medicine

Virginia Tech Wake Forest University
School of Biomedical Engineering and Sciences

Pilot Study Objective and Goals

- Revisit prior investigative protocols (PCDS and Honda Inova CIREN) and update for current and future research needs
- Test new scene and vehicle documentation techniques
- Assess feasibility of fast-response case capture and compare with follow-on investigation approach
- Adapt injury causation coding (BioTab) for pedestrian crashes
- Develop data collection tools and database
- Acquire data for nine (9) pilot cases total

Updated Investigative Protocols

Crashworthiness and injury causation

Crash avoidance and behavioral

Scene Documentation

New tools for scene data capture

- 3D photogrammetry allows rapid and detailed scene (and vehicle) data collection
- Preserves more scene evidence for future use

Injury Causation Coding (BioTab)

BioTab is the NHTSA standard for crash injury coding

- Minor adaptations to existing injury causation coding (BioTab) required
  - Need to associate the injury causation with the specific phase (conflict) within the pedestrian's kinematics

Traffic Injury Prevention, 12:256–265, 2011

ISSN: 1538-9588 print / 1538-957X online
DOI: 10.1080/15389588.2011.560500

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BioTab—A New Method for Analyzing and Documenting Injury Causation in Motor-Vehicle Crashes

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Pedestrian Kinematics Classification

Hard-coding of pedestrian interactions

- Kinematic Trajectory
  - Chronological order of pedestrian conflicts – the overall pedestrian experience
  - Classified according to Ravani 1981 grouping
- Discretized Conflicts
  - Isolate different phases of the overall pedestrian experience
  - Grouped by plane of vehicle or environment
- Documented and Inferred Contacts
- Other Supporting Evidence
- Confidence

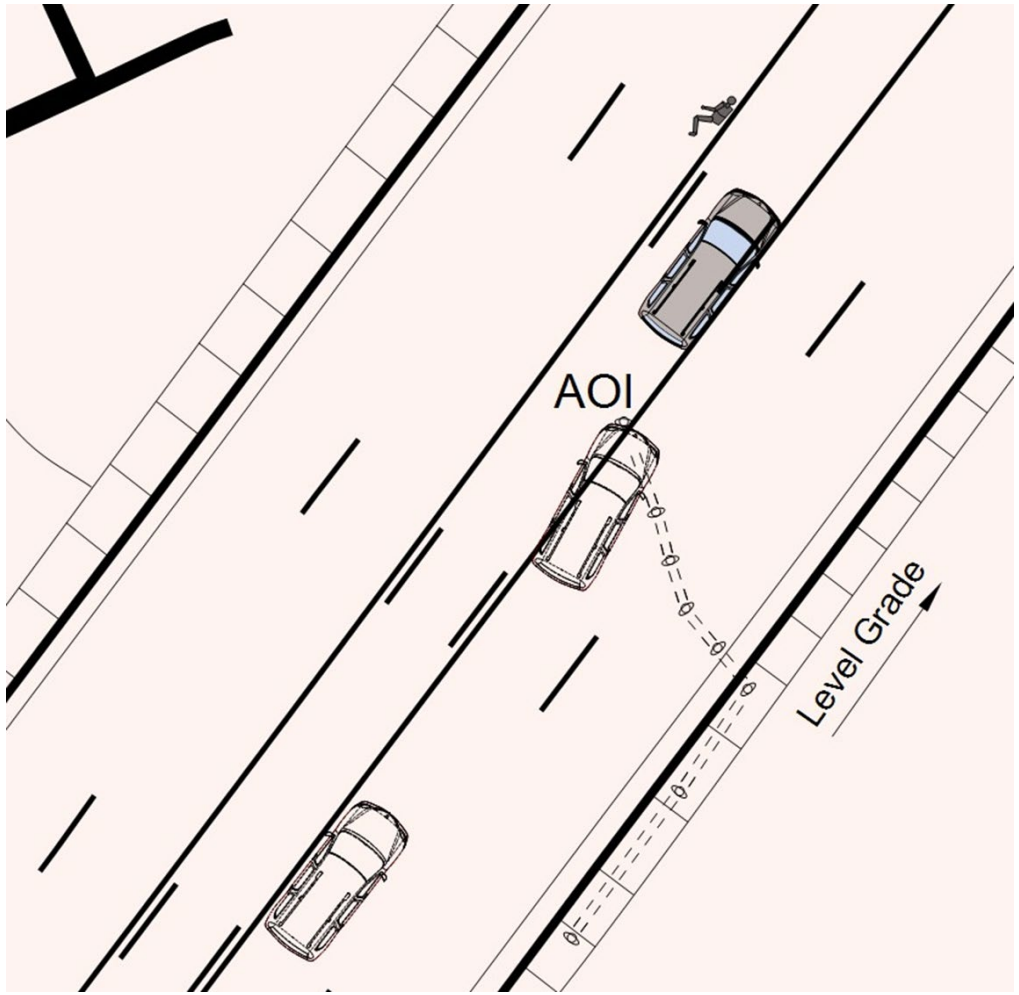
Case Screening

- Wake Forest/Virginia Tech (enrolling at Wake Forest Baptist Medical Center in Winston-Salem, NC)
  - 137 pedestrian-struck admissions screened
  - 34 qualified based on study criteria
  - 2 cases reviewed through CIREN process
- Emory (enrolling at Grady Memorial Hospital in Atlanta, GA)
  - >600 pedestrian-struck admissions screened
  - Many are discharged before crash details can be obtained
  - 1 case reviewed through CIREN process (4 waiting for completion)

Case #1

13 year old male struck by 2014 GMC Terrain

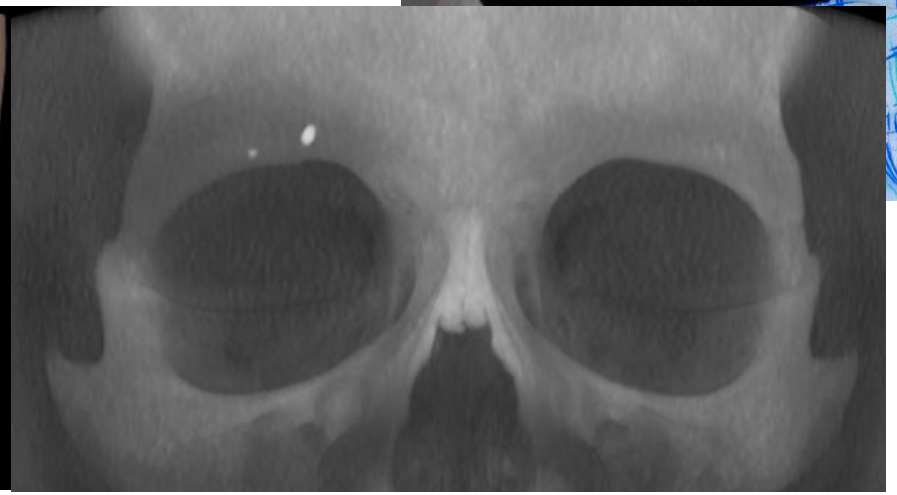
- 160 cm (5’3”), 54 kg (120 lbs)
- Dark, raining, lighted roadway



Case #1

13 year old male struck by 2014 GMC Terrain

- Closed fracture of the right wrist
- Periorbital contusion of the right eye with foreign body
- Multiple skin abrasions (right wrist and hand, bilateral knees, right eyebrow, nose, lip)



Case #1

13 year old male struck by 2014 GMC Terrain

Case #1

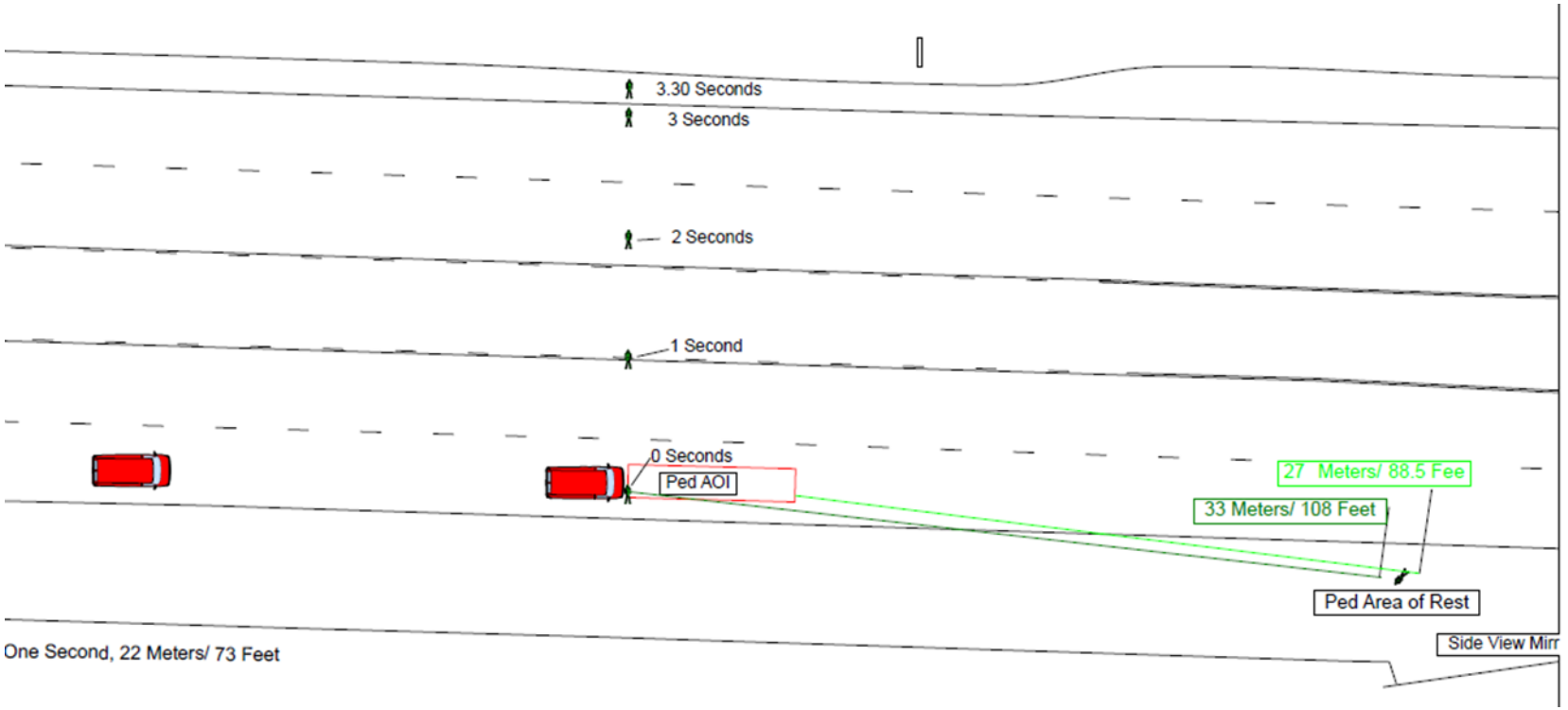
13 year old male struck by 2014 GMC Terrain

- Pedestrian Kinematics
  - Frontal projection (child carried by front of vehicle then thrown to ground)
  - Pedestrian center of mass at height of upper grille
- Most, if not all, injuries associated with ground contact
  - Left side of pedestrian interacted with vehicle

Case #2

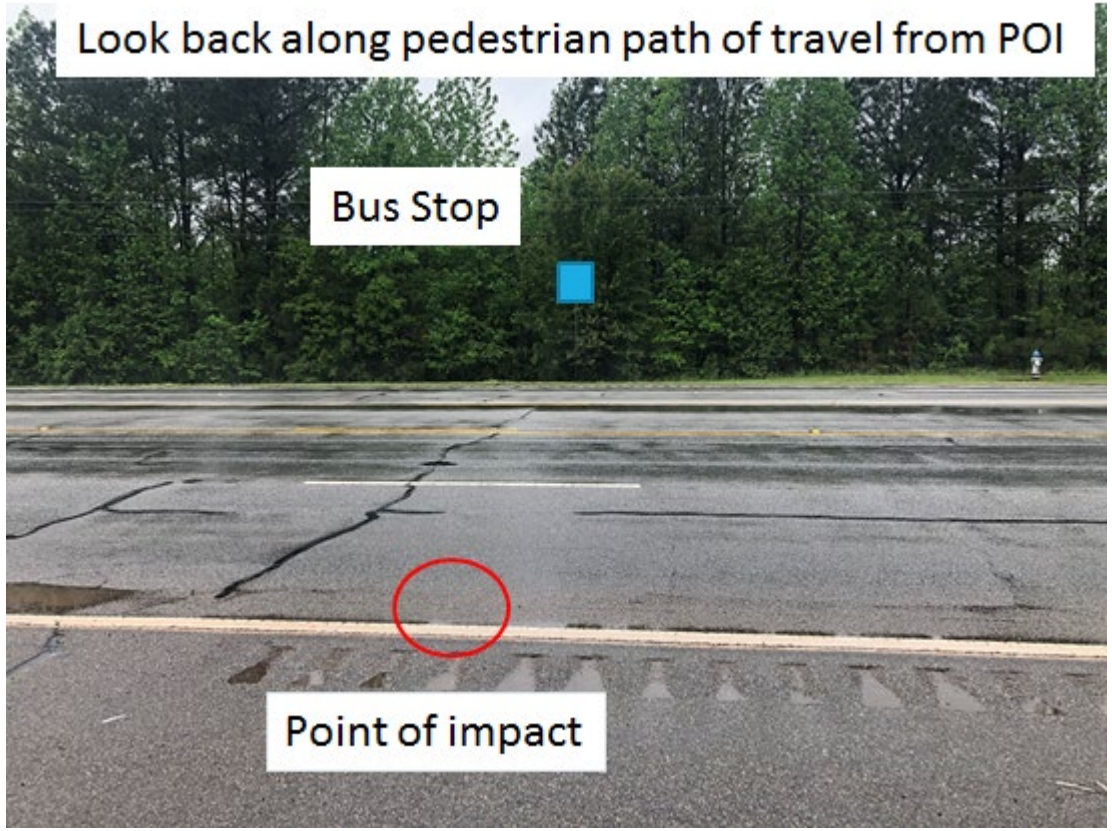
Adult male struck by 2004 Chevrolet Venture

- 170 cm (5’7”), 78 kg (173 lb)
- Dark, dry, not lighted roadway



Case #2

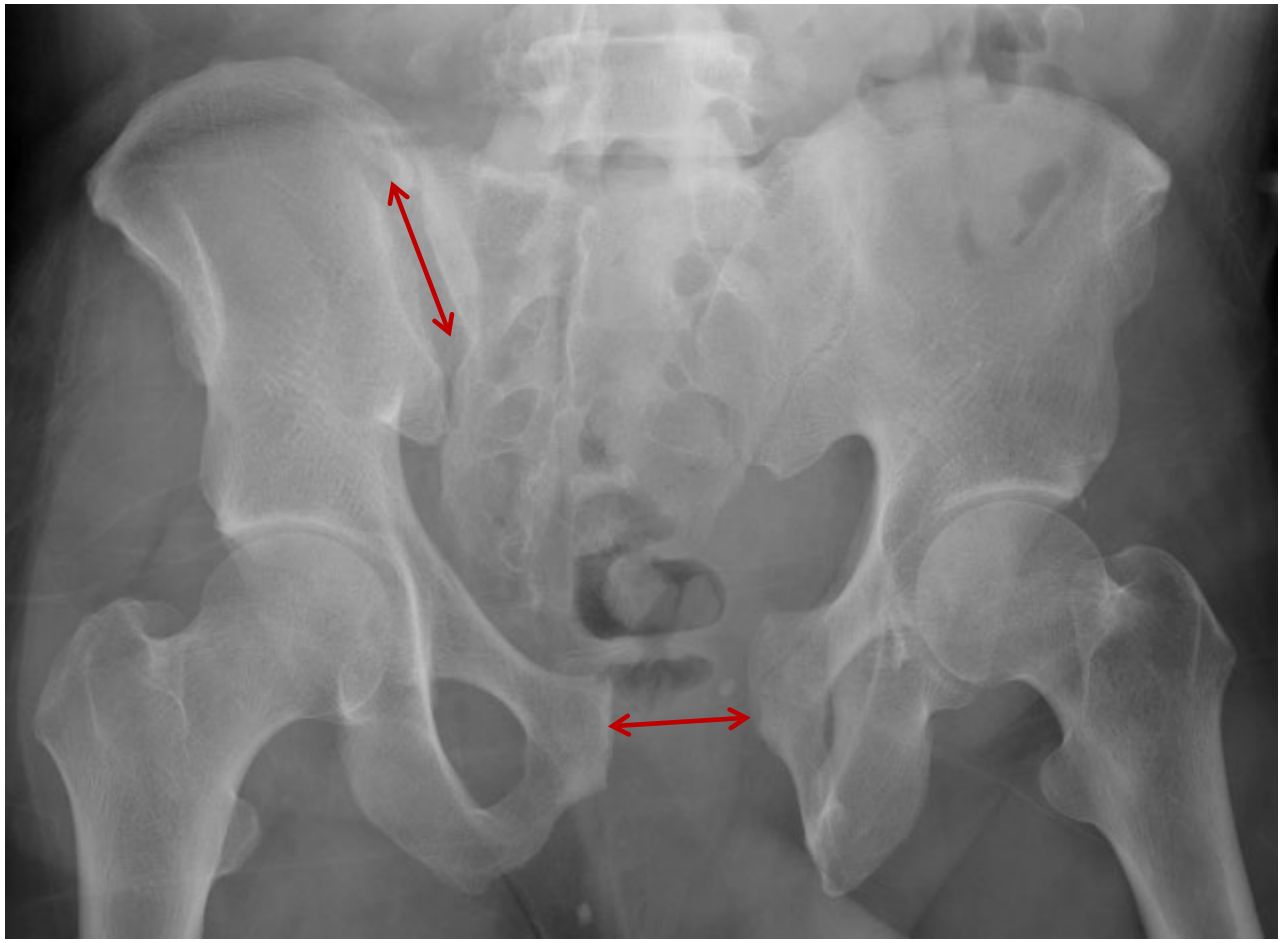
Adult male struck by 2004 Chevrolet Venture



Case #2

Adult male struck by 2004 Chevrolet Venture

- Pelvic injuries (APC III)
  - Widened/dislocated right sacroiliac joint
  - Offset pubic symphysis



Case #2

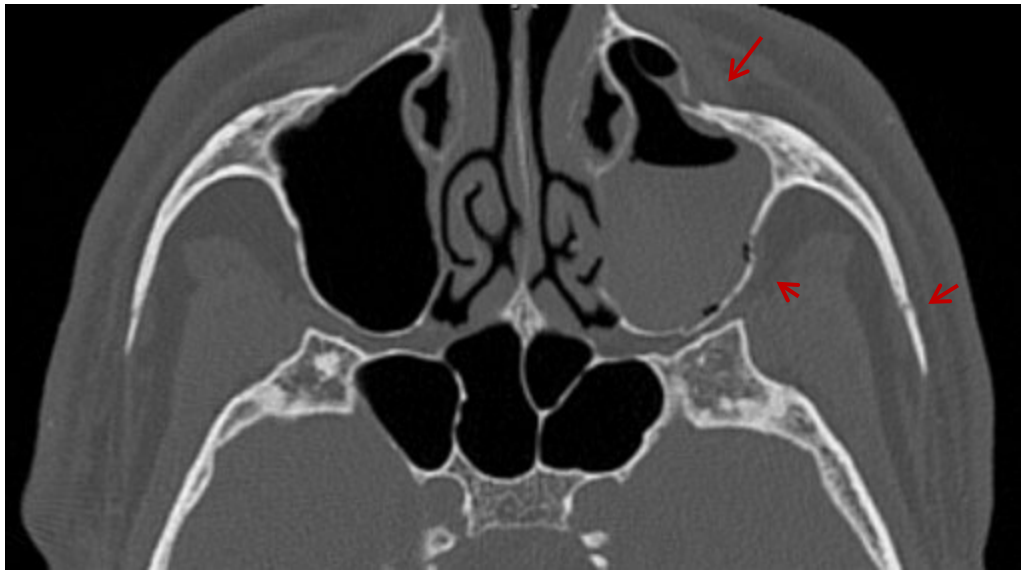
Adult male struck by 2004 Chevrolet Venture

- Open right tibia and fibula fractures

Case #2

Adult male struck by 2004 Chevrolet Venture

- Multiple facial fractures
  - Left lateral and inferior orbital wall
  - Left maxillary sinus wall
  - Left zygomatic arch



Case #2

Adult male struck by 2004 Chevrolet Venture

Case #2

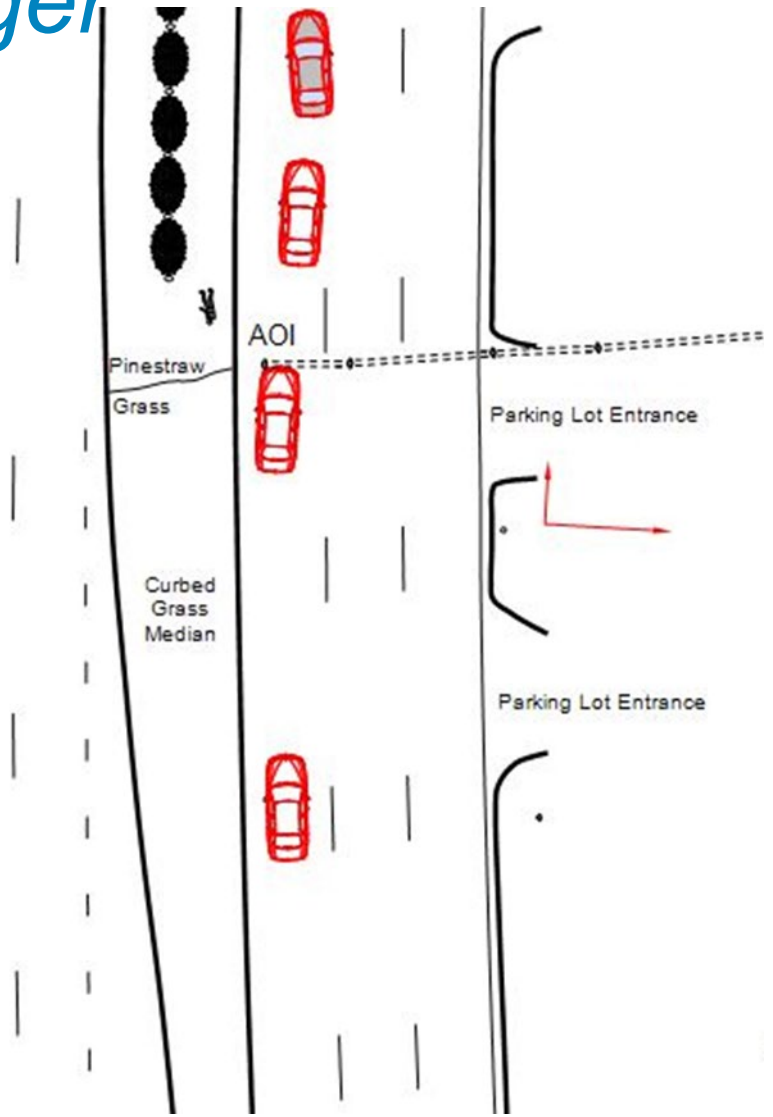
Adult male struck by 2004 Chevrolet Venture

- Pedestrian Kinematics
  - Fender vault (partially wrapped over hood and fell to ground)
  - Right foot on ground, right leg struck, rotated pedestrian to present pelvis anterolaterally
  - Pedestrian center of mass at or just above hood leading edge
- Right leg fractures associated with bumper contact
- Pelvic injuries associated with front corner contact
- Facial fractures probably from mirror contact
- Road rash on pedestrian's back

Case #3

Adult male struck by 2019 Dodge Charger

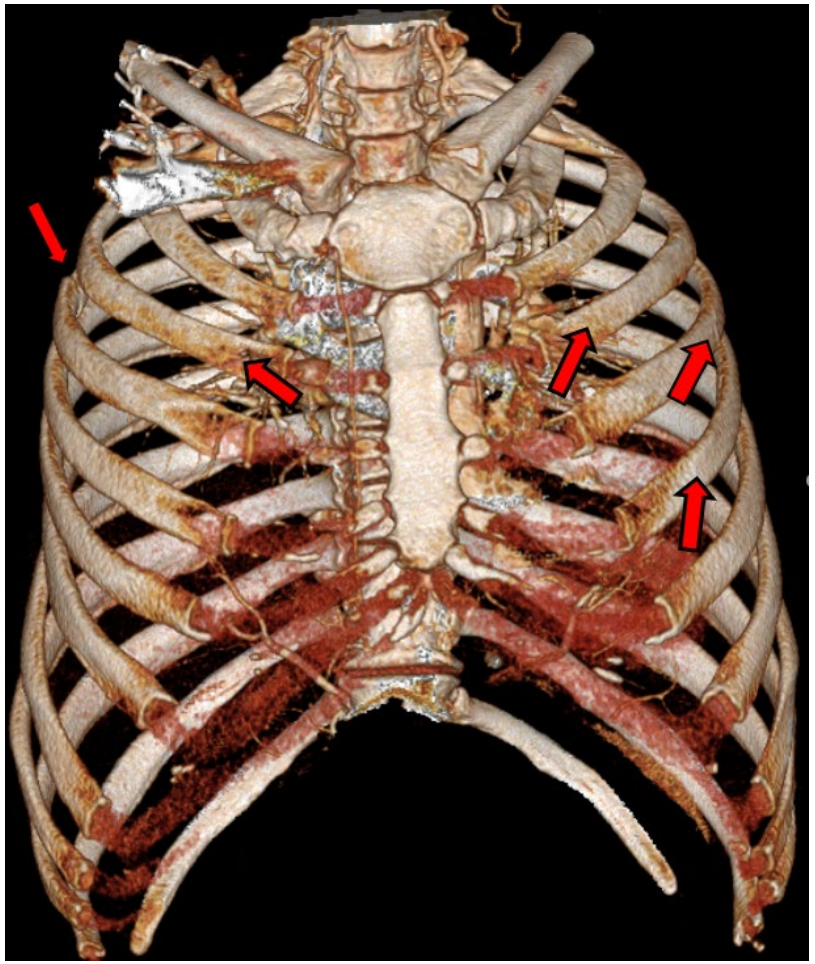
- 163 cm (5’4”), 100 kg (220 lbs)
- Dark, dry, lighted roadway
- Running across to median



Case #3

Adult male struck by 2019 Dodge Charger

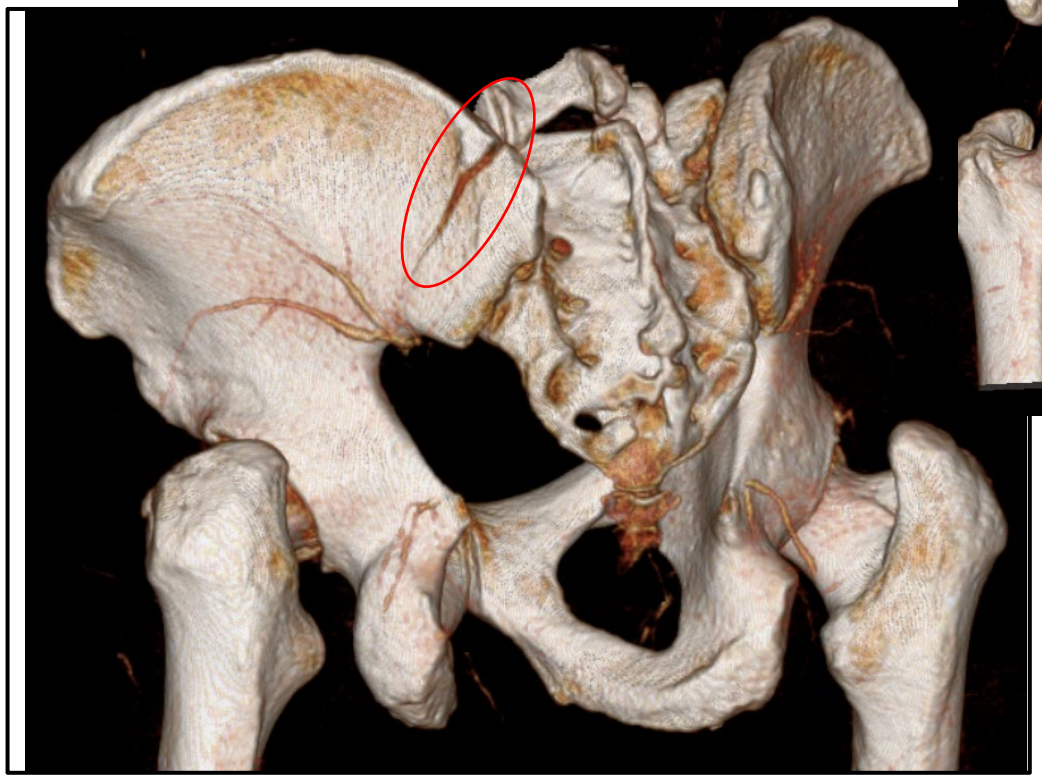
- Multiple bilateral rib fractures
- Open left ulna fracture
- Left elbow joint dislocation
- Distal radioulnar joint dislocation

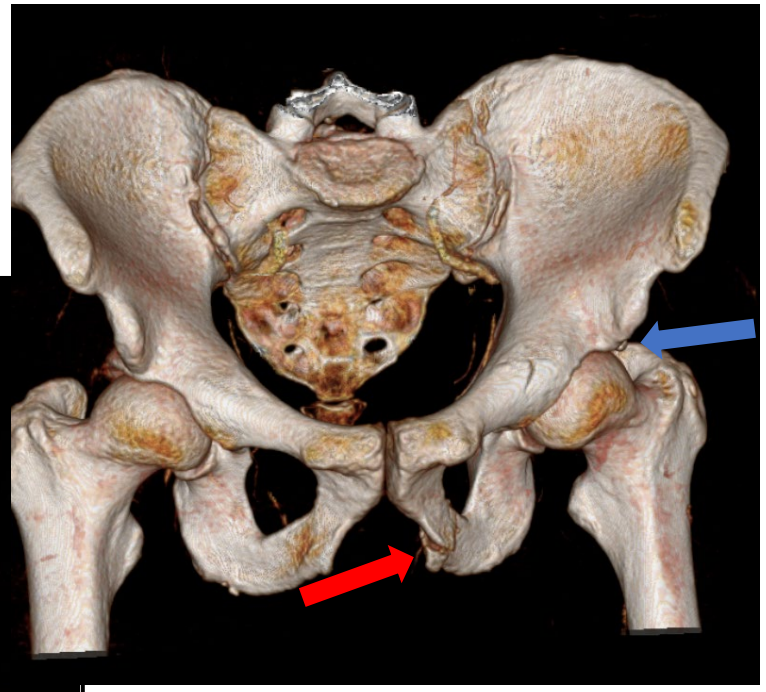


Case #3

Adult male struck by 2019 Dodge Charger

- Pelvic fractures (LC2)
  - Left ischiopubic ramus
  - Left superior pubic root
  - Left iliac crescent
  - Left sacral ala





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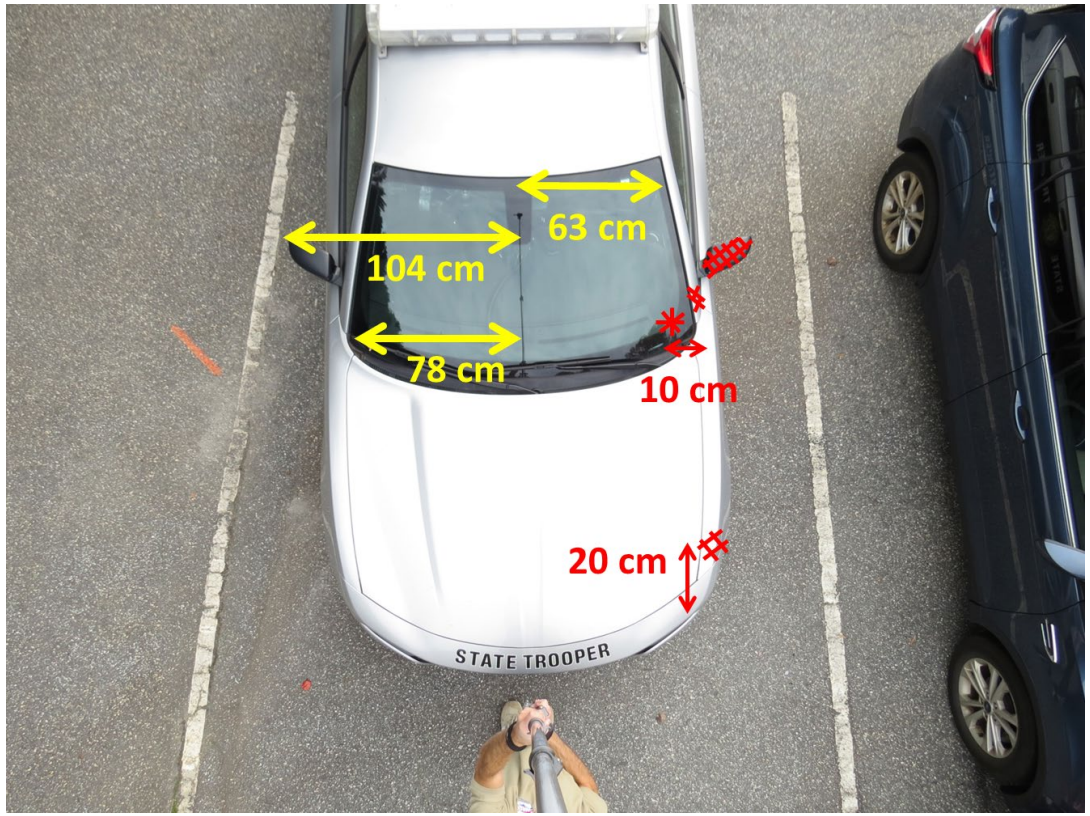

Case #3

Adult male struck by 2019 Dodge Charger

- Pedestrian Kinematics
  - Fender vault (partially wrapped over hood and fell to ground)
  - Pedestrian center of mass at or just above hood leading edge
  - Proximity to rounded corner deflected pedestrian, possibly initiated spin
- Pelvic injuries associated with front corner contact
- Left arm injuries associated with windshield and a-pillar contact
- Rib fractures probably from mirror contact, possibly from ground contact
- Absence of thigh, knee, leg injuries (aside from abrasions) suggests legs were mostly unloaded (potential impact during double float period)

Conclusion

Pilot study concludes in mid-2020

- Pedestrian and trafficway environment are of increased importance for crash causation/avoidance
- Discretizing crash sequence to aid analysis from component test perspective
- Treat the pedestrian as a column with eight sides – biomechanical assessment of radiology provides better insight regarding positioning
- Law enforcement cooperation is critical – on-scene response by investigator may not be necessary
- Computational modeling will play a role