

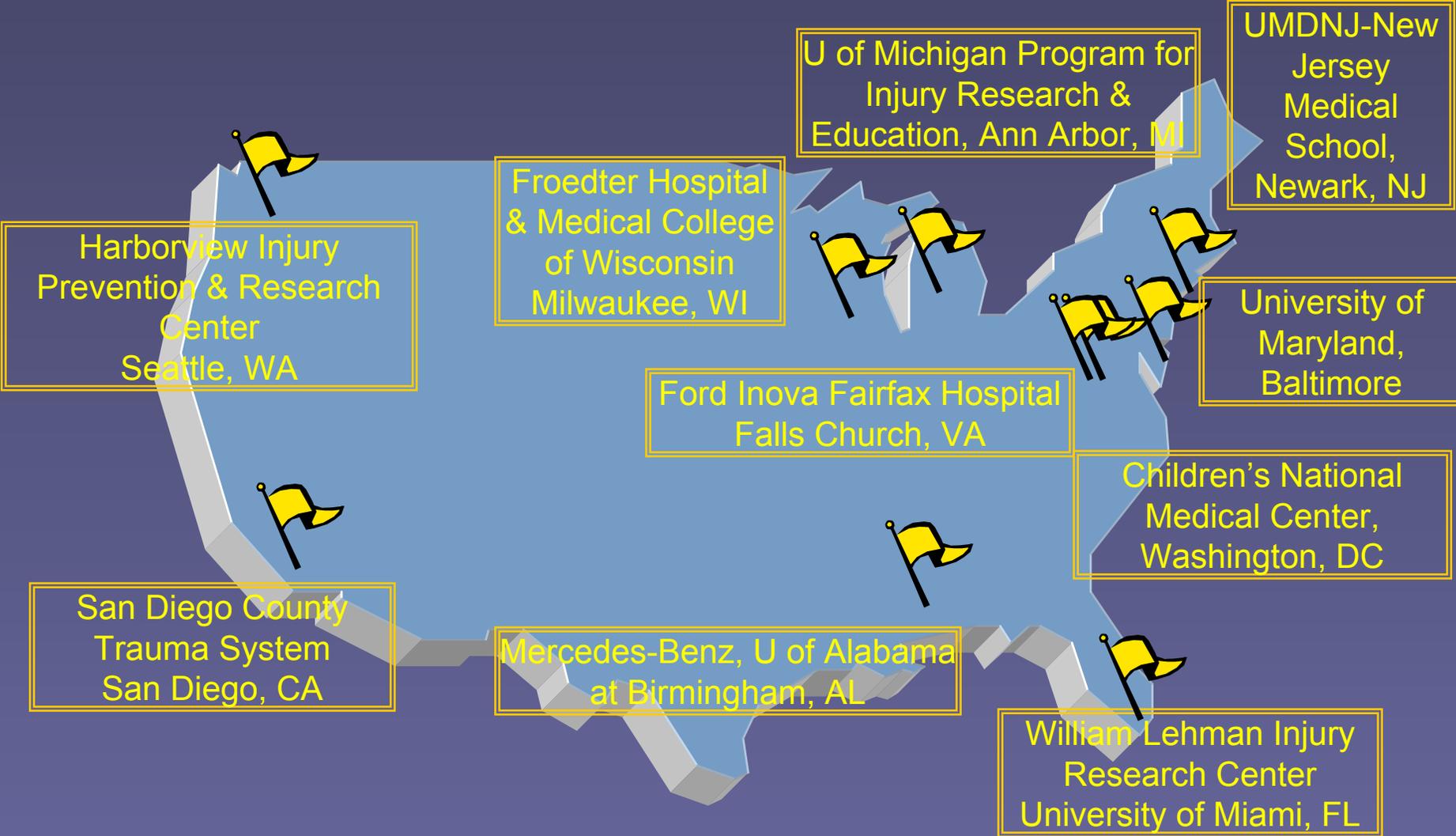


OCCULT BOWEL INJURIES

**CIREN San Diego
Washington DC.
December 5, 2002**



CIREN Network





San Diego CIREN Centers

Children's Hospital

Palomar Medical Center

Scripps Memorial Hospital

Scripps Mercy Hospital

Sharp Memorial Hospital

University of California, San Diego Medical Center

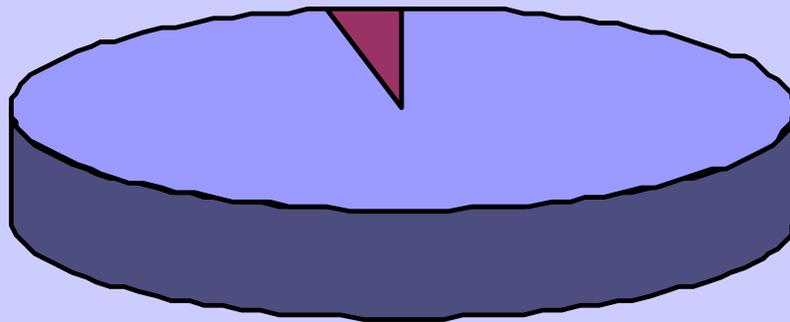
San Diego County Emergency Medical Services

Presenters / Contributors

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 - Crash Investigator
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 - Assistant Project Manager

Bowel Injuries in CIREN Database

**Patients with bowel
injuries 3% (55)**



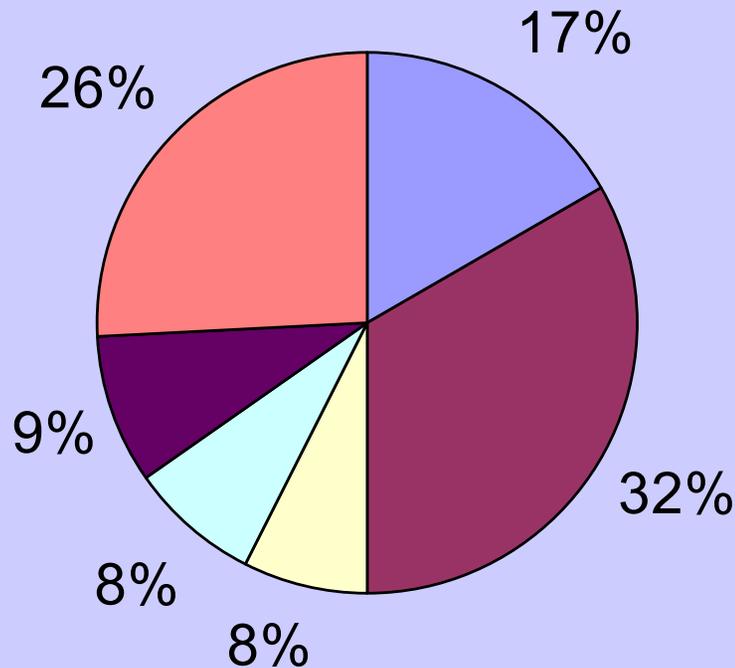
Total CIREN cases

1725

**Source: CIREN Database
1997- November 2, 2002**

Bowel Injuries by Type

n = 75 injuries in 55 patients



- Colon Contusion
n=11
- Colon laceration
n=22
- Duodenum contusion
n=5
- Duodenum laceration
n=5
- Jejunum-ileum contusion
n=6
- Jejunum-ileum laceration
n=26

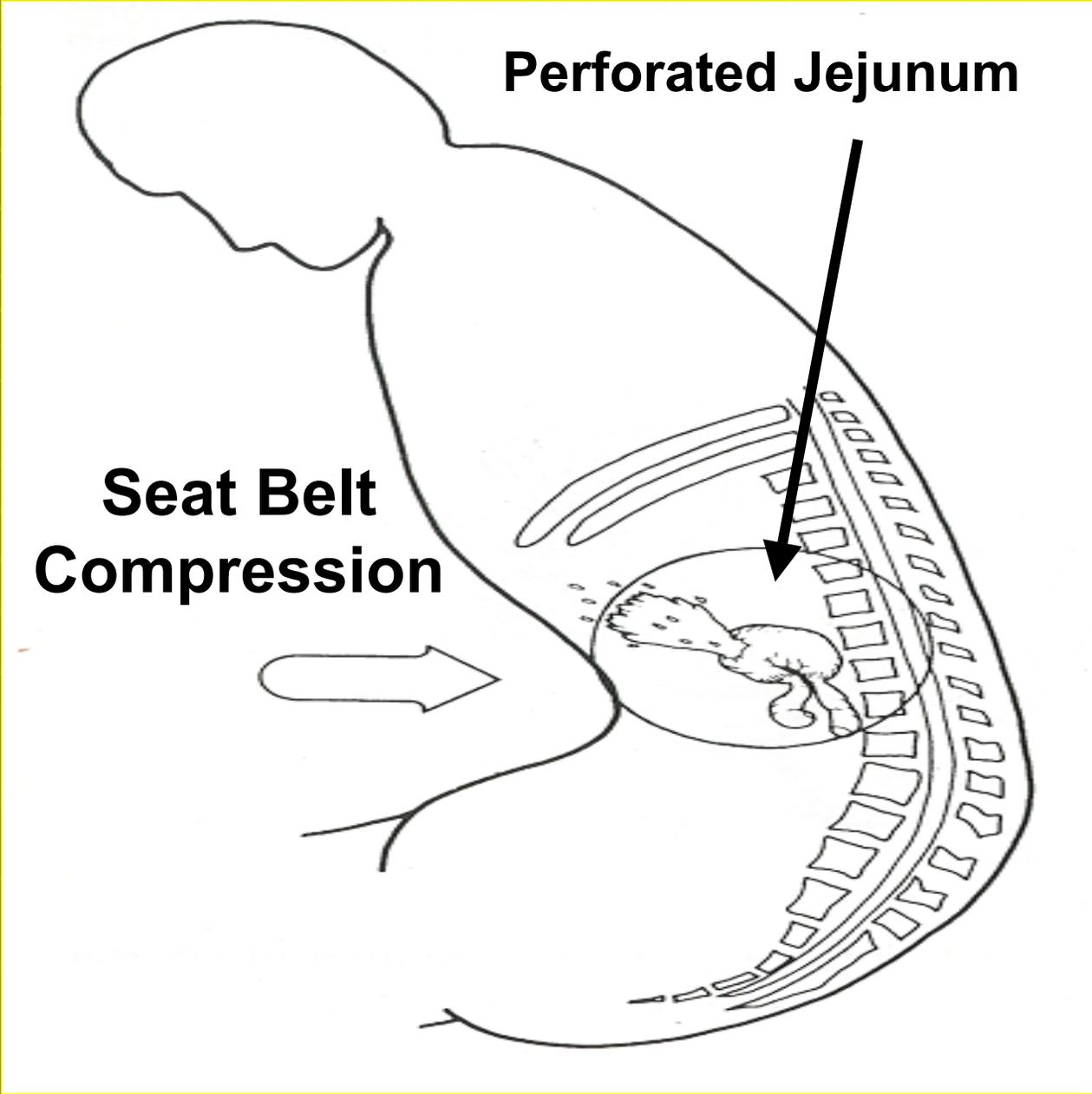
Pathophysiology Blunt Abdominal Trauma With Bowel Injury

- **COMPRESSION**
- **DECELERATION**

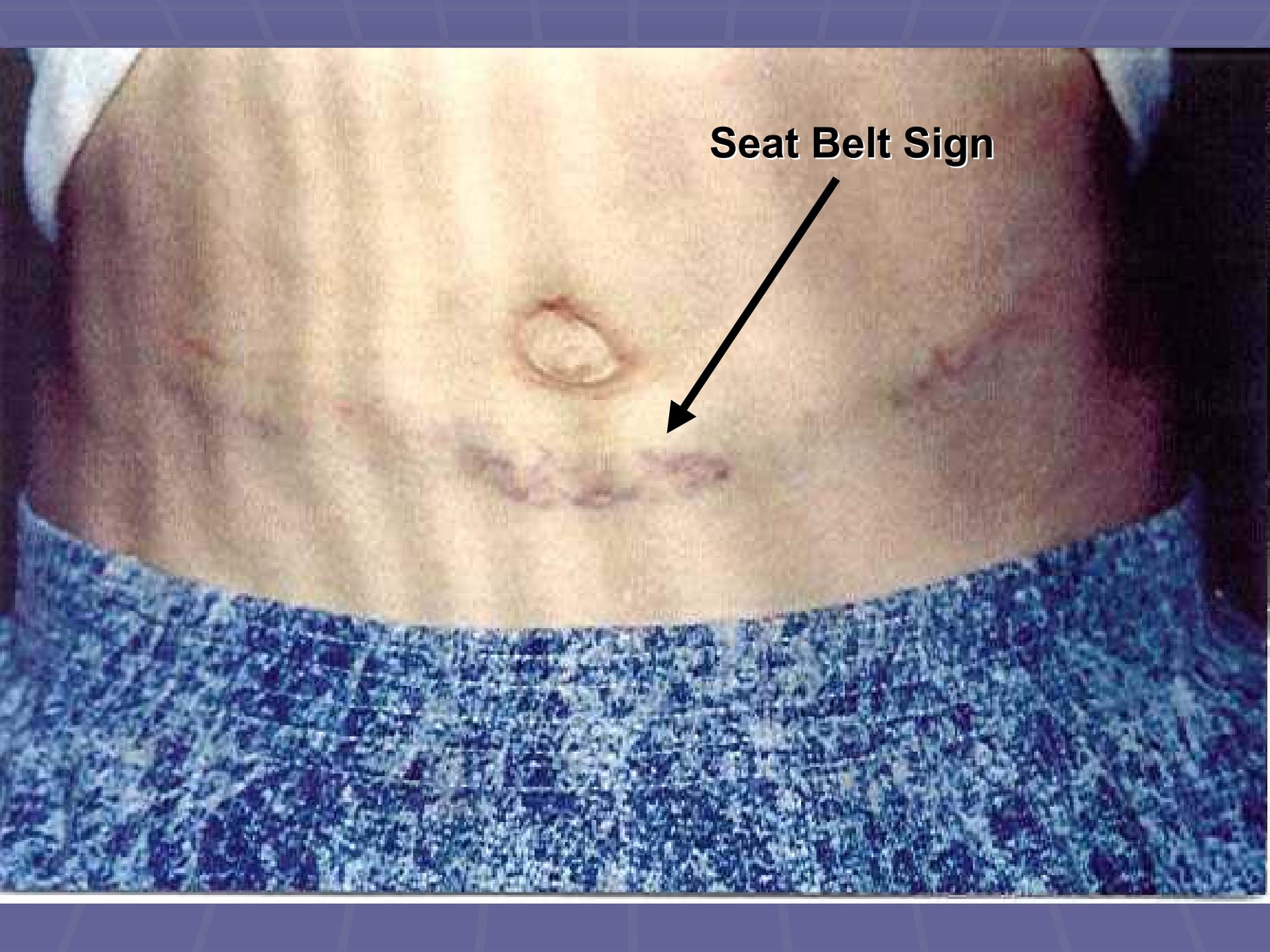
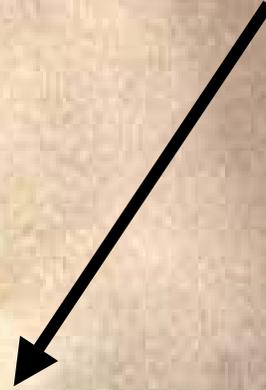
Pathophysiology

Blunt Abdominal Trauma with Bowel Injury

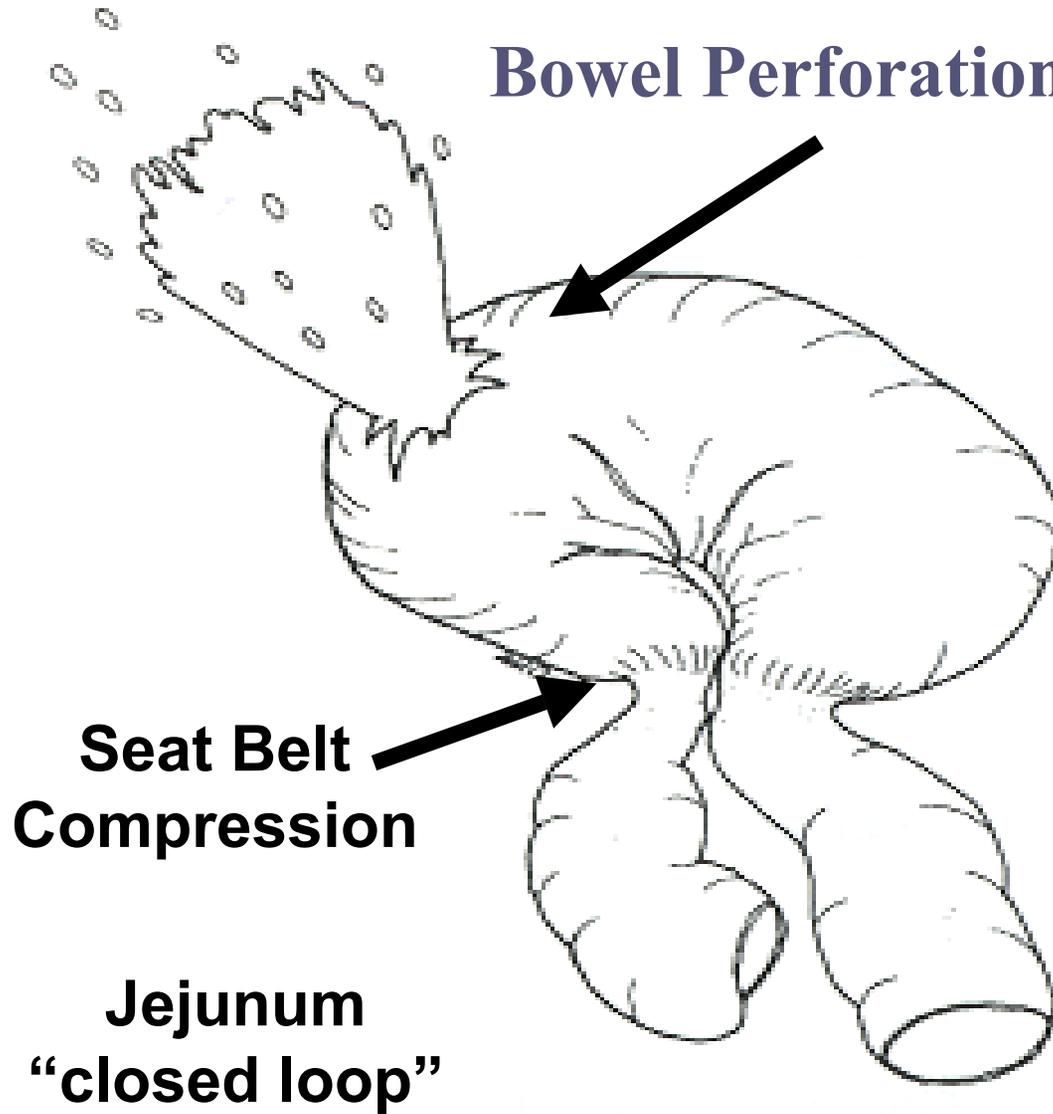
- **Compression** – increasing intraluminal pressure or compressing fluid-filled bowel against solid structures (eg, duodenal compression on the spine)



Seat Belt Sign

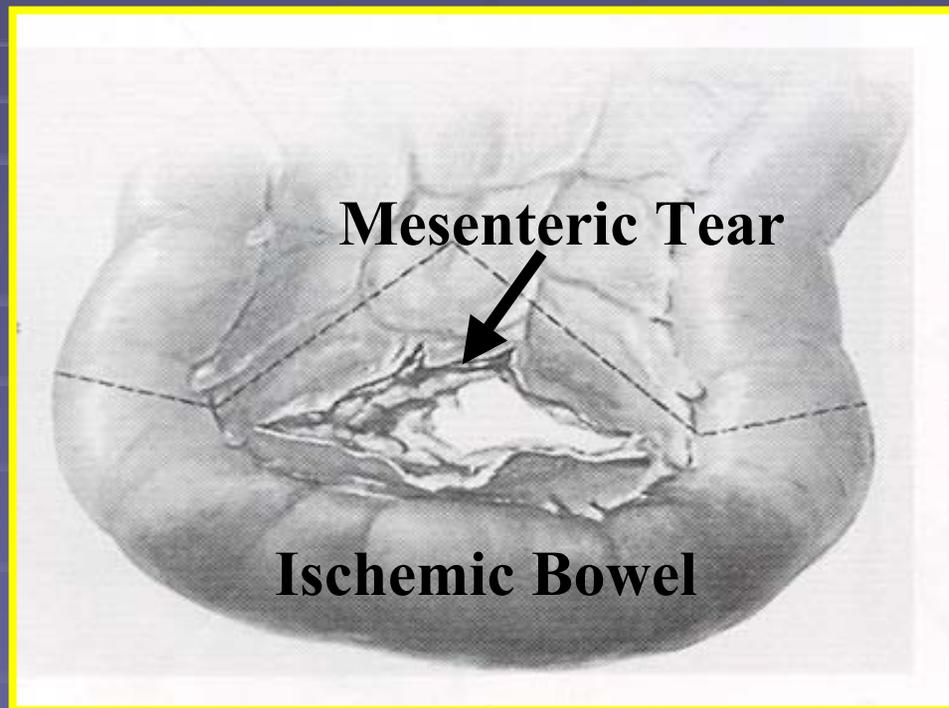


Bowel Perforation



PATHOPHYSIOLOGY OF BLUNT ABDOMINAL TRAUMA WITH BOWEL INJURY

Deceleration – stretching and tearing of bowel loops and mesentery at points of fixation (eg, Lig of Treitz)





Mid-sigmoid serosal tear, Grade II

Small bowel mesenteric tear, 4 x 6 cm

Avulsion of 26 x 6 cm of fat and partial fascia of lower abdominal wall

OCCULT BOWEL INJURIES

Clinical Significance

- Abdomen is 3rd most commonly injured body region
- 10% of trauma deaths from abdominal injuries
- Deaths:
 - Hemorrhage from mesenteric vessels
 - Bowel rupture
 - Uppot, eMedicine, 2002
- GI Injuries are the predominant cause for delay in laparotomy for blunt trauma (60%)
 - Sorenson, AAST Webnet

CT FINDINGS in BOWEL INJURY

Raul N Uppot, MD, E-medicine, 2001

- **Free intraperitoneal air**
- **Free intraperitoneal fluid**
- **Focal areas of bowel wall enhancement**
- **Visualization of oral contrast extravasation**
- **Mesenteric infiltration suggestive of vascular injury**

Blunt Abdominal Injury

Free Fluid On CT Without Solid Organ Injury

Livingston, Fabian, et al, Am J Surg, 2001

- Presence of free fluid a conundrum for the surgeon
- Late dx of bowel injury vs neg lap
- Blunt bowel injury uncommon
- Fluid does not mandate lap
- Must admit and observe
 - Lap if :
 - Increasing abd pain
 - Leukocytosis
 - Fever

Helical CT Of Bowel and Mesentery

Killeen, J Trauma, 2001

- **Sensitivity**
 - 94% - bowel injury
 - 96% - mesentery injury
- **Surgical cases correctly differentiated in 64 of 74 cases (86%)**

- **NB – CT invented in 1971**
- **Advanced Technology**
 - 3 Dimensional Reconstruction of colon possible today (CT colonography)
 - Potential 3-D Reconstruction for entire GI tract to detect bowel trauma

Occult Bowel Injury

- 21 year old female
 - Restrained back seat passenger
 - CC – abdominal pain
 - Exam – seat belt sign, tender
 - CT – no evidence of bowel injury, complex L-2 fracture
 - Admitted/Observed
 - Increasing abd pain, leukocytosis
 - X-Lap (3 days post injury) – ruptured mid jejunum – Repair jejunum

Occult Bowel Injury

- **14 year old female**
 - Restrained (lap belt) rear seat passenger
 - CC – no pain
 - Exam – seat belt sign
 - CT – L12 subluxation fracture (unstable)
 - Admit/Observe
 - Increasing abdominal pain
 - X-Lap (24 hours post admission) – Ischemic necrosis ascending colon, rupture descending colon, ruptured jejunum
 - R Hemicolectomy, repair jejunum, repair descending colon, Fusion/rodding of spine fx

Occult Bowel Injury

- 18 year old female
 - Restrained driver, hit tree
 - CC – abdominal pain
 - Exam – seat belt sign
 - CT – No evidence of bowel injury
 - Admit/Observe
 - Increasing abdominal pain, leukocytosis
 - X-Lap (48 hours post admission) – ruptured jejunum distal to Lig of Treitz

Occult Bowel Injury

- **79 year old male**
 - **Restrained passenger, vehicle hit wall at high speed**
 - **CC – No abdominal pain**
 - **Exam – “severe seat belt contusion”, non-tender abdomen**
 - **CT – Minimal free fluid around liver**
 - **Admit/Observe**
 - **Increasing abdominal pain**
 - **X-Lap (12 hours post admission) – Ischemic distal jejunum with rupture, mesenteric tear – resection ischemic bowel**

The Crash

- ✓ 1999 Saturn vs. Large Boulder
- ✓ 98 cm direct damage, left of center
- ✓ 77 cm max. crush
- ✓ 31.6 mph W/Smash Barrier Run

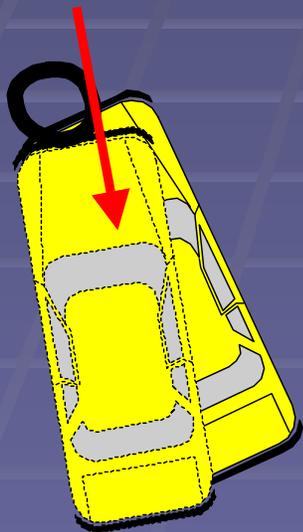
Like Vehicle



Occupant #1

- ✓ Right front seat passenger
- ✓ 59 y/o male, 6', 180 lb
- ✓ Subject reclined and sleeping
- ✓ Lap & shoulder belt use
- ✓ Air bag deployed
- ✓ Zero degree PDOF

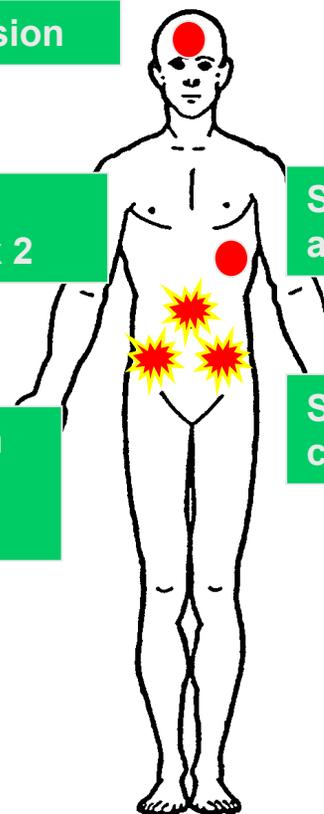
Major Injuries:



Concussion

Small bowel perforations x 2

Deserosalization injury to ascending colon

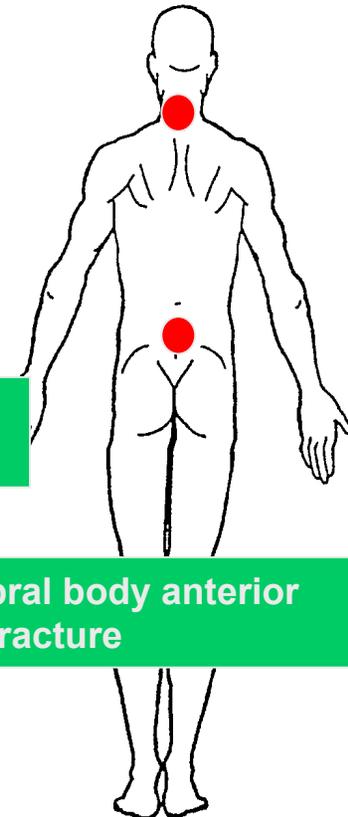


Splenic tip avulsion

Sigmoid colon contusion

C7 facet fracture

L2 vertebral body anterior column fracture



59 year old restrained passenger. Fell asleep and hit a boulder. Was transferred from a rural hospital with abdominal pain. ? Dx (ie OCCULT)

- **Abdominal tenderness**
- **Laparotomy –**
 - **two small bowel perforations (200 and 215 cm from the Ligament of Treitz)**
 - **Serosal tears in ascending colon**



Intrusion:

Center dash - 5 cm longitudinal

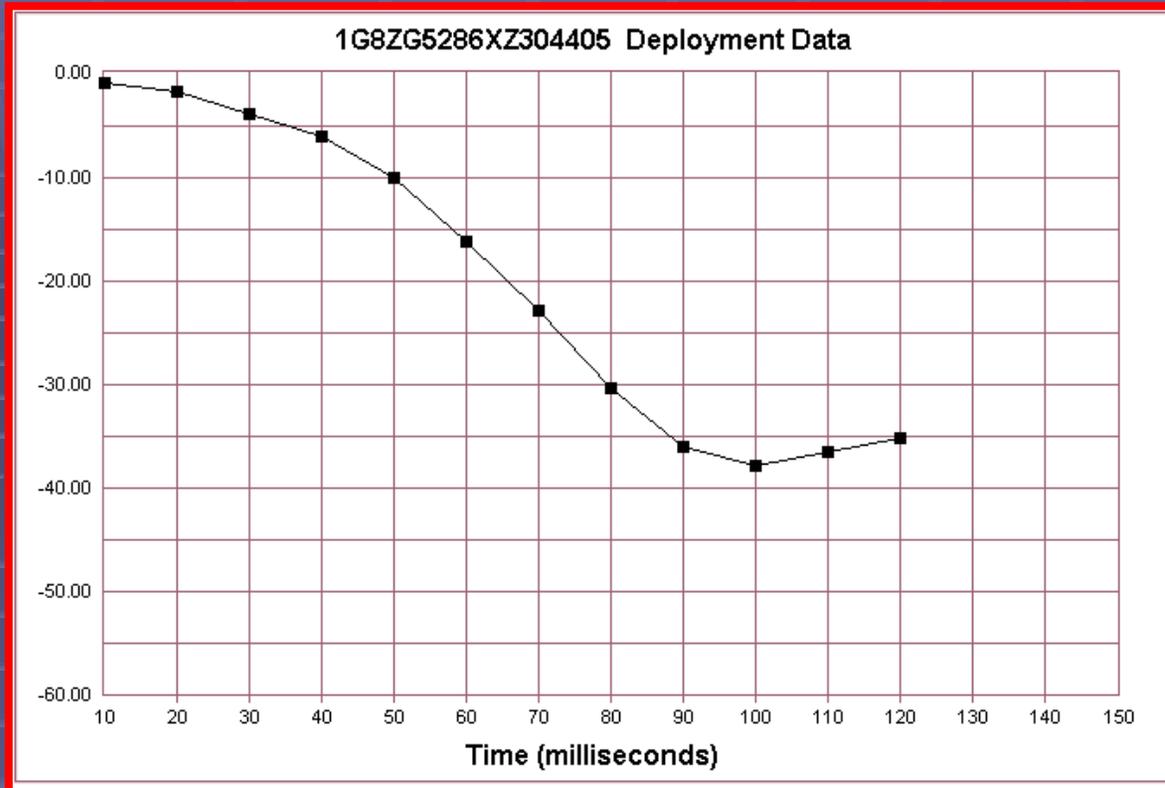
Contact:

Lower right dash scuffed

Center dash/console fx'd



Vetronix
CDR output



1G8ZG5286XZ304405 System Status At Deployment														
SIR Warning Lamp Status	OFF													
Driver's Belt Switch Circuit Status	UNBUCKLED													
Passenger Front Air Bag Suppression Switch Circuit Status	Air Bag Not Suppressed													
Ignition Cycles At Deployment	5324													
Time Between Near Deployment And Deployment Events (sec)	.3													
Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140
Adjusted Algorithm Velocity Change	-0.88	-1.76	-3.95	-6.14	-10.09	-16.24	-22.82	-30.28	-35.98	-37.74	-36.42	-35.10	N/A	N/A



Positive indication of belt use

Restraints



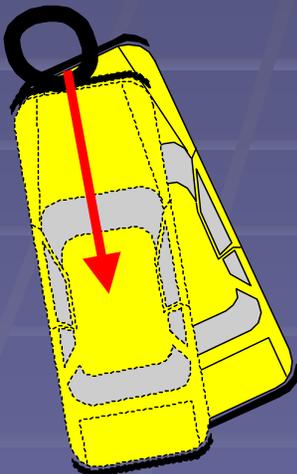
Pretensioner equipped/locked. Abrasion @ "D" ring
1 small brown spot on bag

Occupant # 2

- ✓ Center rear seat passenger
- ✓ 5 year old male, unknown height, 58 lb
- ✓ Sleeping but upright position
- ✓ Lap belt used
- ✓ Zero degree PDOF

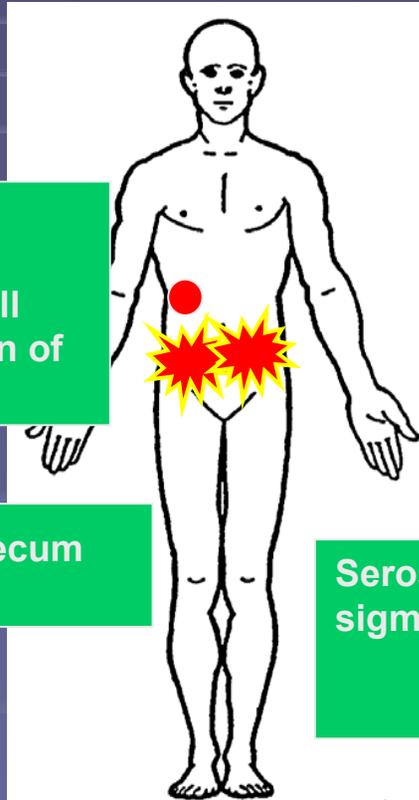
Child Restraint System ???

Major Injuries:

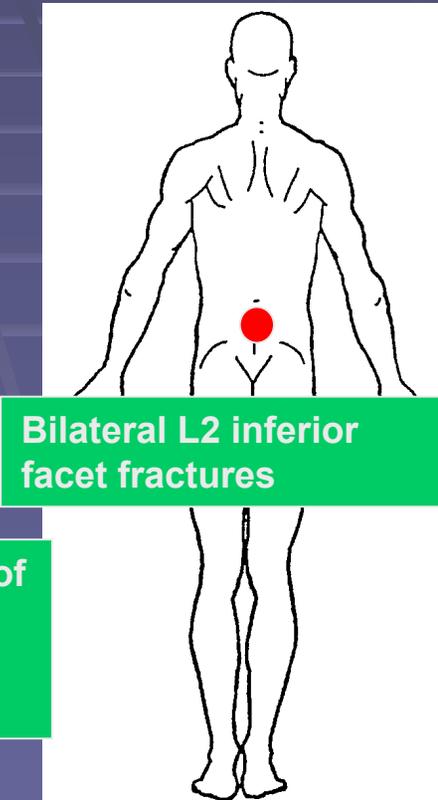


Traumatic disruption of abdominal wall with herniation of bowel

Necrosis of cecum



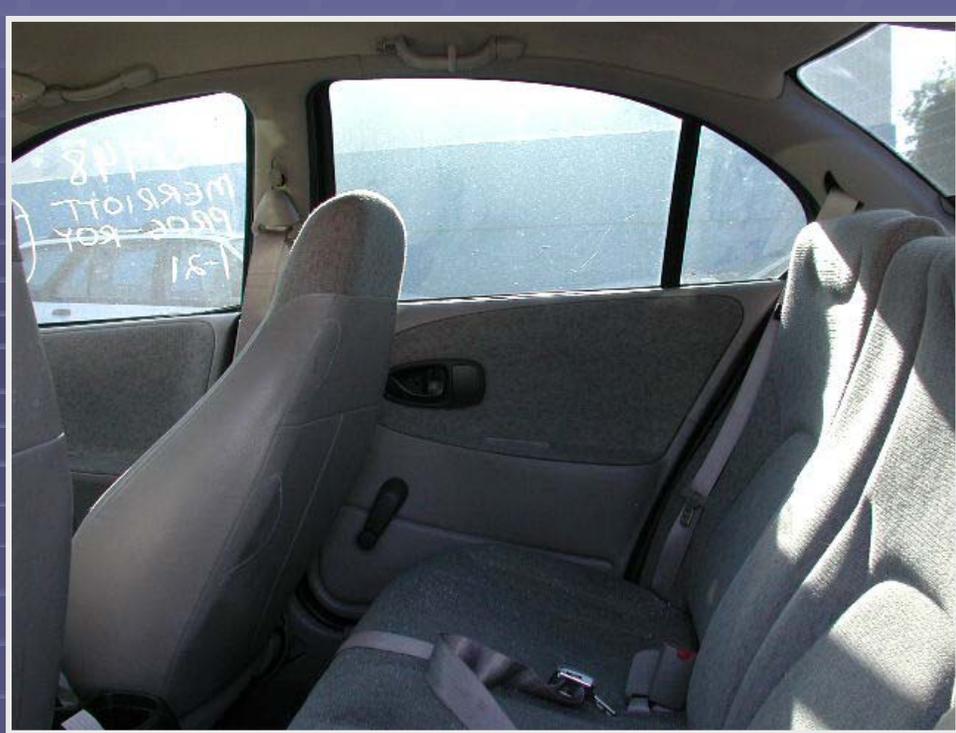
Serosal tears of sigmoid colon



Bilateral L2 inferior facet fractures

CRS in the Trunk !!





- No Intrusion
- Contact – right front seat back: scuffed @ lower level, black transfer @ upper
- Front seat/seat back from 2nd row cushion edge: 23 cm @ base, 10 cm @ scuff, -5 cm @ top





Center rear lap belt

Indication of belt use

Post Op Abdomen with Spica Cast



The Crash

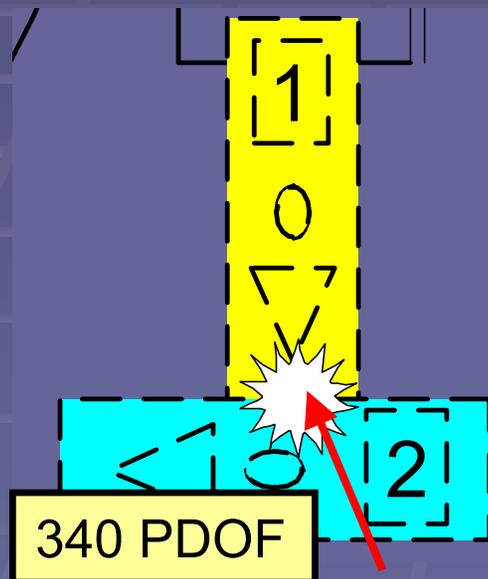
- ✓ Front, to side of opposing vehicle (1998 Chevrolet Stake bed)
- ✓ 85 cm max. crush
- ✓ Direct damage entire front
- ✓ 65 kmph (40 mph)

Like
Vehicle



The Subject

- ✓ Driver
- ✓ 22 y/o male, 5'6", 152 lb
- ✓ 3-point manual; lap & shoulder belt use
- ✓ Air bag deployed
- ✓ Up right posture



Major Injuries:

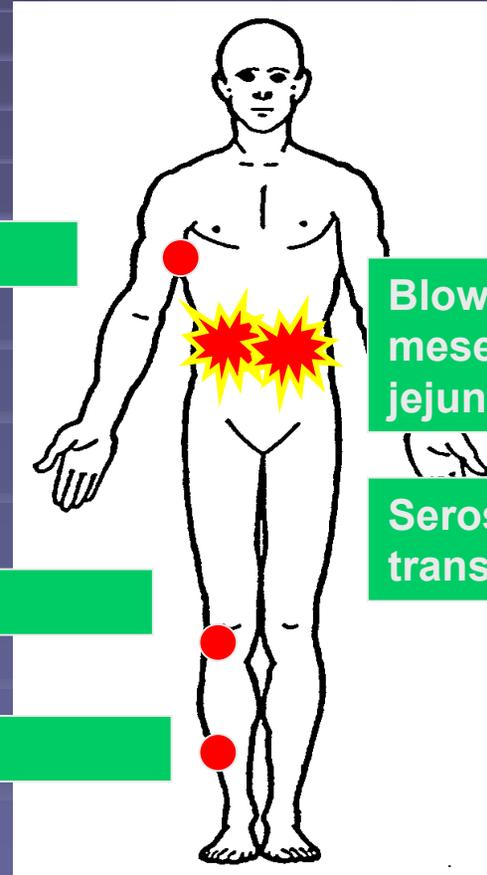
Right rib fractures

Right patella fracture

Right tib/fib fracture

Blow out anti-mesenteric border jejunum

Serosal tear transverse colon



**22 year old male restrained passenger.
High energy MVC. Transferred from rural
hospital. ??Dx (ie OCCULT)**

- **Abd tenderness**
- **Laparotomy:**
 - **Serosal tear transverse colon**
 - **Blow out of the antimesenteric border of the jejunum (20 cm distal to the Ligament of Treitz)**



Left side intrusion: Dash 23 cm, toe pan 27 cm, steering assembly 17 cm longitudinally



Positive indication of belt use



The Crash

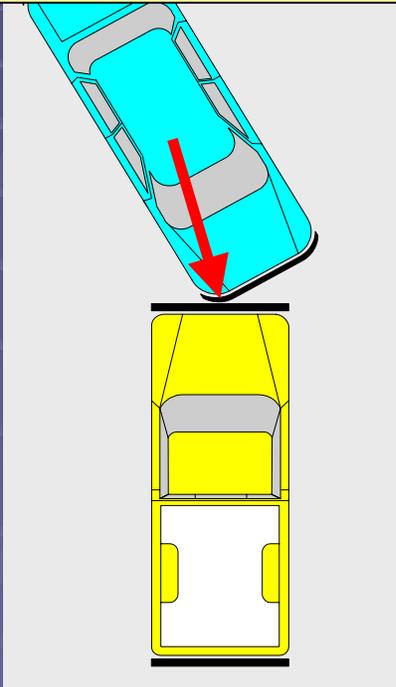
- ✓ 1995 Toyota SWS Pick up vs. 1995 Ford Taurus
- ✓ 98 cm direct damage, left of center
- ✓ 14 cm max. crush (@ center)
- ✓ 13 kmph (8 mph) W/Smash Barrier Run



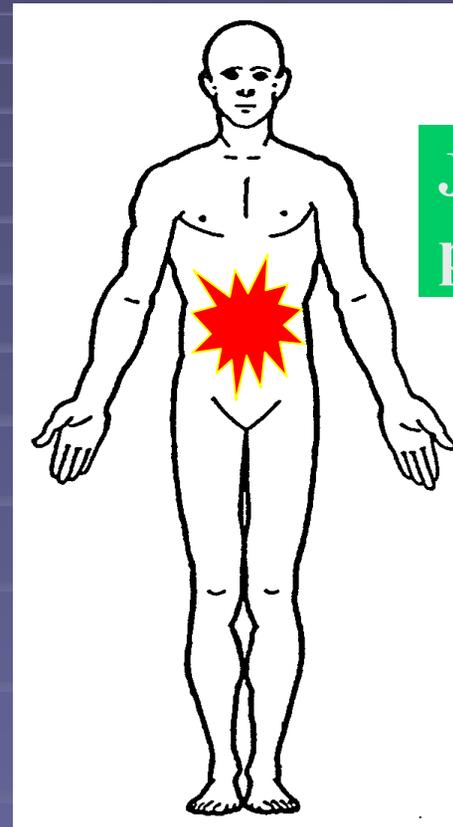
The Subject

- ✓ Right front seat passenger
- ✓ 56 y/o female, 5'7", 118 lb
- ✓ Lap & shoulder belt use

350 degree PDOF



Major Injuries:



Jejunal perforation

56 year old female MVC with increasing abdominal pain, ?? Dx (ie Occult) – upgraded to a trauma activation

- **Increasing abdominal pain**
- **CT Scan:**
 - **No free air**
 - **Some free fluid**
 - **Thickened small bowel**
- **Laparotomy**
 - **Cloudy intraperitoneal fluid**
 - **Perforation of jejunum distal to the lig of Treitz**

56 year old female MVC with increasing abdominal pain, ?? Dx (ie Occult) – upgraded to a trauma activation

- Increasing abdominal pain
- CT Scan:
 - No free air
 - Some free fluid
 - Thickened small bowel
- Laparotomy
 - Cloudy intraperitoneal fluid
 - Perforation of jejunum distal to the lig of Treitz



Indication of belt use

Does this Patient have a Bowel Injury?

Yes



Perforated
Jejunum

Does this Patient have a Bowel Injury?

Yes



Mid-sigmoid serosal
tear and small
bowel mesenteric
tear

Does this Patient have a Bowel Injury?



No

**Abdominal
wall
contusion**

CONCLUSIONS

OCCULT BOWEL INJURIES

- **High correlation with seat belt injuries**
- **Helical CT (3-D) is the best diagnostic tool**
 - **Free fluid**
 - **Free air**
 - **Abnormal bowel wall**
 - **Abnormal mesentery**
- **However some patients only diagnosed by observation and serial exams (occult)**
- **CIREN – critical to correlate crash data with these occult injuries**
- **CIREN - ? Seat belt design**