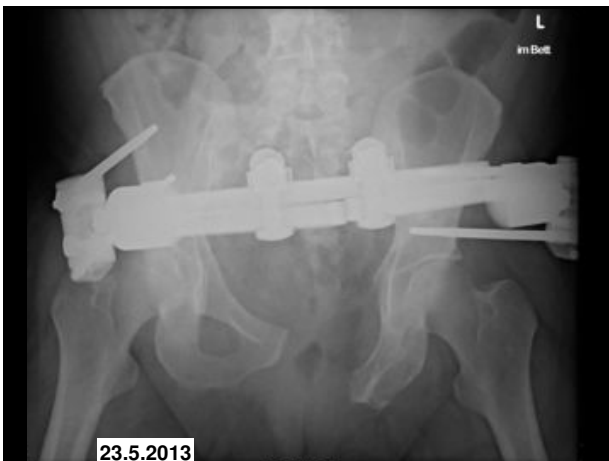
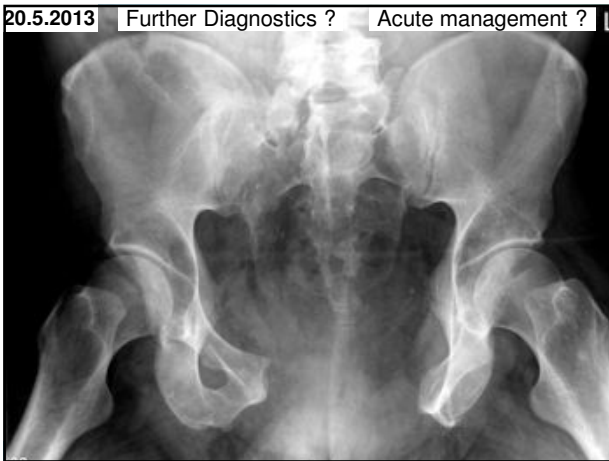


## Unusual and Tricky Trauma Cases

Session 8 Tough trauma cases: The experts' decisions  
 Experts panel: Prof. Dr. A. B. Peitzman, Pittsburgh, USA, Prof. Dr. S. Teperman, New York, USA, Prof. Dr. H. C. Pape, Aachen, Germany, Prof. Dr. A. Platz Zürich, Prof. Dr. J. Osterwalder, St. Gallen, PD Dr. B. Schüniger, Bern, Dr. T. Lustenberger, Frankfurt, Germany

Prof. Marius JB Keel, MD, FACS  
 Vice-Chairman  
 General, Trauma and Orthopedic Surgeon - EBSO Traumatology  
 Head for Trauma, Pelvic and Spinal Surgery  
 Department of Orthopedic and Trauma Surgery  
 University Hospital Bern, INSELSPIITAL  
 Bern, Switzerland

**Case 1**  
 48 y, male, motorcycle accident  
 Jihlava - Czechia



### Volume Reduction and Closed Reduction of Fracture

1. Internal rotation and hip flexion
2. Pelvic Binder - Traumatic Pelvic Orthotic Device (T-POD)

*DeAngelis et al. OTA 2003 Poster*

- 12 human cadaveric specimens (type B1)
- Injury symphyseal diastasis 39.3mm
- Sheet 17.4mm
- T-POD 7.1mm

### Pelvic Binder and Results

- External pelvic fixation (n=93) vs
- Trauma pelvic orthotic device (T-POD; n=93)
  - Severe retroperitoneal hematoma, open book or vertical shear
  - SBP: 102 vs 113 mm Hg
  - Base excess: -8.5 vs -7.2 meq/L
  - ISS: 38.6 vs 33.6 pts.
  - Laparotomy rate: 28% vs 23%



• 24h transfusions:	17.1	4.9*
• 48h transfusions:	18.6	5.6*
• Pelvic angiogram	23%	23%
• Ventilator assoc. pneumonia	33%	10%*
• Mortality	37%	26%

Croce et al. J Am Coll Surg 2007;204:935-42

### Pelvic Binder: Effectiveness on Posterior Pelvic Ring ?



**23.5.2013**

**Case 1**

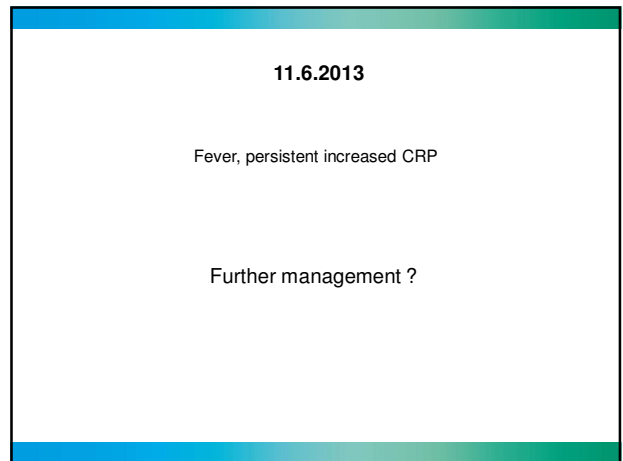
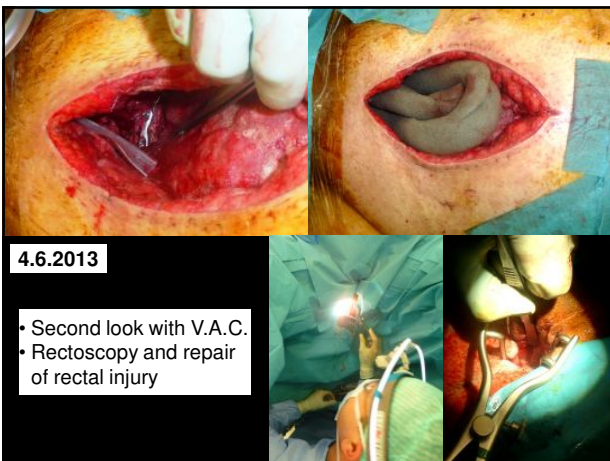
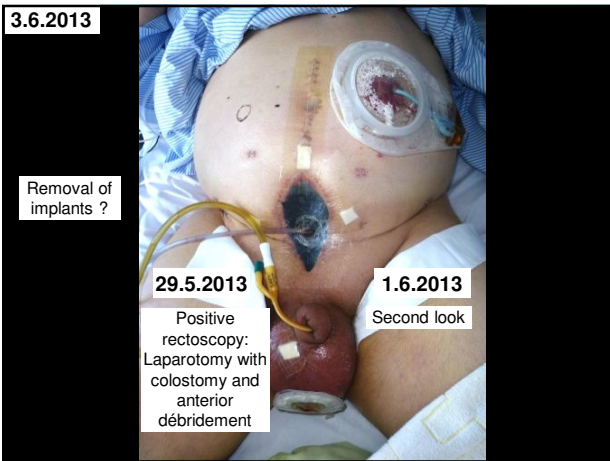
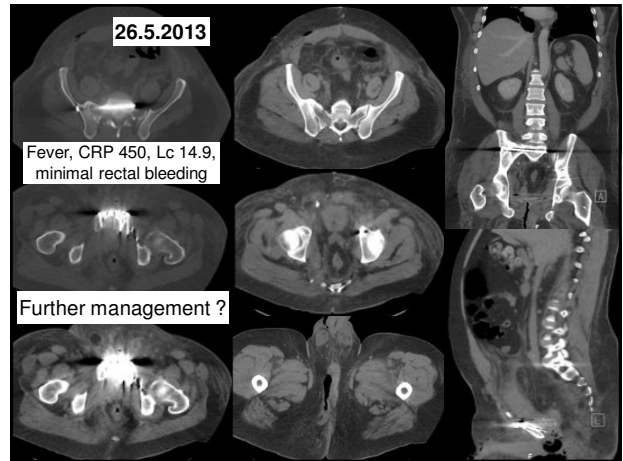
- Secondary Survey - E:
  - No open wounds
  - No pin tract infection
  - Uneventful digital rectal examination

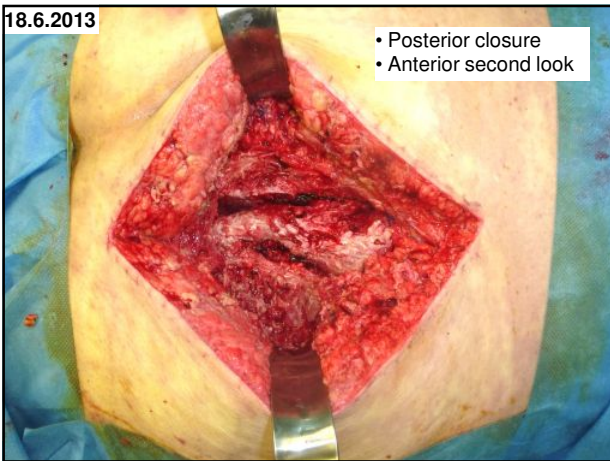
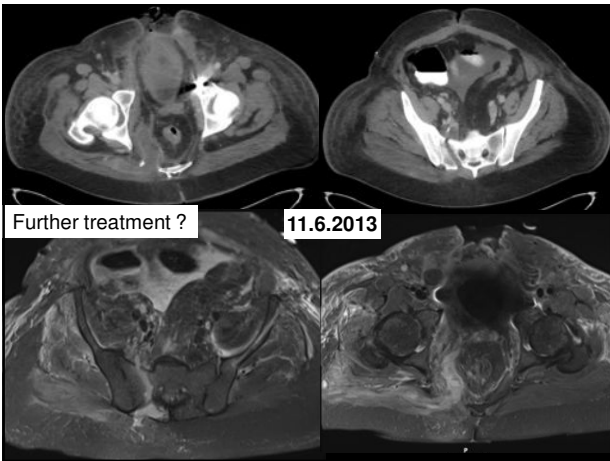
Transfer to Bern



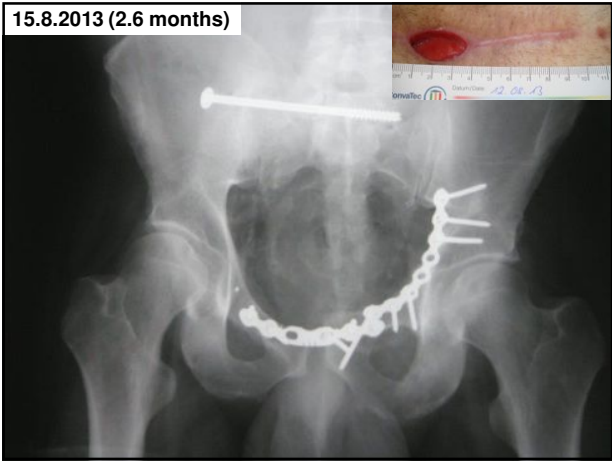
**24.5.2013**

- ORIF symphysis
- Percutaneous S1
- Abdominal wall repair (mesh)



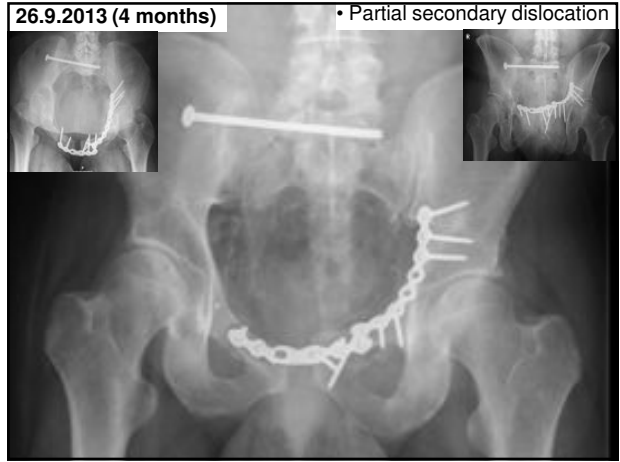


15.8.2013 (2.6 months)

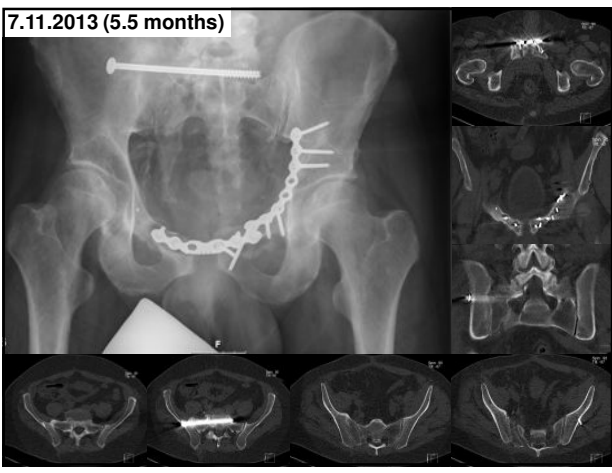


26.9.2013 (4 months)

• Partial secondary dislocation



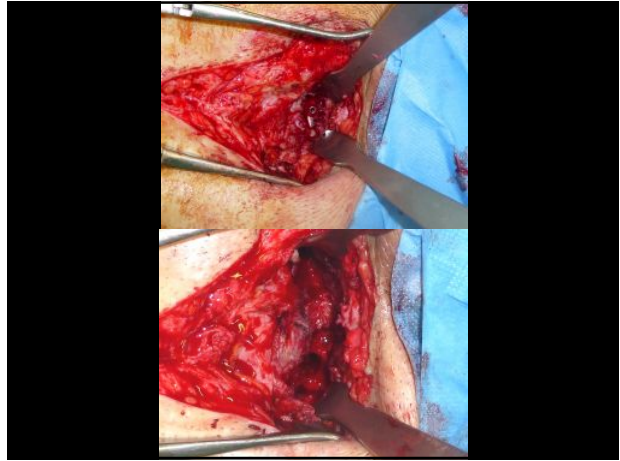
7.11.2013 (5.5 months)

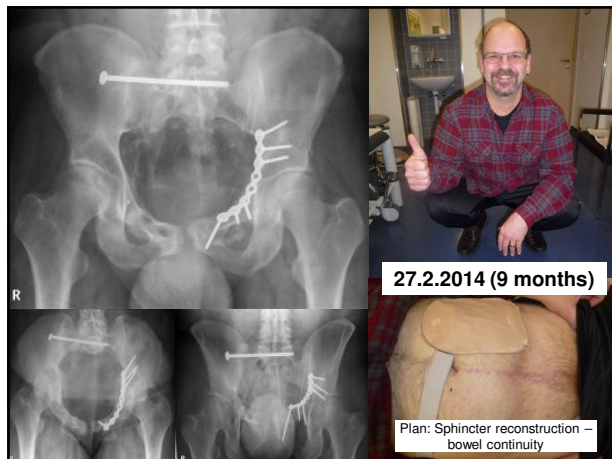


• No abdominal wall hernia  
• Chronic osteitis



17.12.2013 (6.5 months)





### Poor Test Characteristics for the Digital Rectal Examination in Trauma Patients

Shlamovitz et al. *Ann Emerg Med.* 2007;50:25-33

- 1401 patients
- Composite sensitivity /specificity (any abnormal finding): 22.9% - 94.7%
- Spinal cord injury: 37% - 96%
- Bowel injury: 5.7% - 98.9%
- Rectal injury: 33.3% - 99.8%
- Pelvic fracture: 0% - 99.8%
- Urethral disruption: 20% - 99%
- Digital rectal examination should **not** be used as a **screening tool** for detecting injuries in trauma patients

### Fracture Locations Influence the Likelihood of Rectal and Lower Urinary Tract Injuries in Patients Sustaining Pelvic Fractures

Rie Aihara, MD, Joseph S. Blansfield, RN, MS, Frederick H. Millman, MD, FACS, Wayne W. LaMorte, MD, PhD, MPH, and Erwin F. Hirsch, MD, FACS *J Trauma* 2002;52:205-209

- 362 patients: 8 rectal and 24 lower urinary tract injuries
- Multivariate analysis (primary and independent predictors): **rectal injury, widened symphysis; bladder injury, widened symphysis and SI joint; urethral injury, widened symphysis and fracture of the inferior pubic ramus**
- Predictive values of these radiologic findings were low: **5% to 9%** for **urethral** and **rectal** injuries to **20%** for **bladder** injuries

### Diagnosis of Blunt Intestinal and Mesenteric Injury in the Era of Multidetector CT Technology—Are Results Better?

Akpofofe Peter Ekeh, MD, MPH, FACS, Jonathan Saxe, MD, FACS, Mbagwa Watusimbi, MD, FACS, Kathryn M. Tchorz, MD, FACS, Randy J. Woods, MD, FACS, Harry L. Anderson, III, MD, FACS, and Mary C. McCarthy, MD, FACS *J Trauma* 2008;65:354-359

- 82 BBMI recognized in OR between Nov 2000 and Dec 2006
- 4 slice CT Nov 2000-July 2005; 16 slice CT July 2005-Dec 2006
- Rectal injuries and serosal tears excluded
- 25 pat. directly to OR for laparotomy (positive diagnostic peritoneal lavage, a positive focused abdominal sonogram or other injury)
- 57 pat. who underwent CT: findings indicating **possible BBMI** in 46 pat. (80.7%; **free fluid without solid organ injury** (50.9%), **free air** (10.5%), **active mesenteric bleeding** (10.5%), and **bowel swelling** (5.3%).
- 11 pat. (19.3%) had **delayed BBMI** with diagnosis ultimately made by repeat CT or in the OR (1-10 days)

### Pelvic Fractures: Epidemiology and Predictors of Associated Abdominal Injuries and Outcomes

Demetrios Demetriades, MD, PhD, FACS, Marios Karaiskakis, MD, Konstantinos Toutouzas, MD, Kathleen Alo, RN, George Velmahos, MD, PhD, FACS, Linda Chan, PhD *J Am Coll Surg* 2002;195:1-10

- 16,630 trauma registry patients with blunt trauma - 1,545 (9.3%) pelvic #
- Overall mortality 13.5% - only 0.8% died as direct result of pelvic fracture
- Risk factor for mortality ISS≥25 pts.

Table 3. Associated Abdominal or Urogenital Injuries by Severity of Pelvic Fractures

Injured organ	All pelvic fractures (n = 1,545)		Pelvic fractures AIS ≥ 4 (n = 137)		Pelvic fractures AIS ≤ 3 (n = 1,408)		p Value
	n	%	n	%	n	%	
Liver	94	6.1	14	10.2	80	5.7	0.04
Spleen and stomach	90	5.8	20	14.6	70	5.0	<0.001
Spleen	80	5.2	8	5.8	72	5.1	0.68
Diaphragm	33	2.1	5	3.6	28	2.0	0.21
Small bowel	31	2.0	12	8.8	19	1.3	<0.001
Colon	18	1.2	3	2.2	15	1.1	0.21
Rectum	14	0.9	2	1.5	12	0.9	0.36
Pancreas	6	0.4	0	0	6	0.4	1
Stomach	4	0.3	1	0.7	3	0.2	0.31
Duodenal	1	0.1	0	0	1	0.1	1
Abdominal injury	255	16.5	42	30.7	213	15.1	<0.001

## The impact of major operative fractures in blunt abdominal injury

J Trauma Acute Care Surg  
2013;74:1307-1314

Nickolas J. Nahm, MD, John J. Como, MD, MPH, and Heather A. Vallier, MD, Cleveland, Ohio

- All patients with abdominal injury from 2000 to 2006 (n = 1,834) – included ISS  $\geq$ 18 pts, AIS abdomen  $\geq$ 3 pts.
- Two groups: *fracture group* (operative fractures of pelvis, acetabulum, thoracolumbar spine, femur; n=106) – *control group* (n=91)
- **Complications 34% vs 18%**, including **ARDS** (8% vs 1%) and **sepsis** (11% vs 3%)

TABLE 2. Abdominal Interventions Associated With Fractures

	Pelvis (n = 61)**	Femur* (n = 47)**	Acetabulum* (n = 22)**	Thoracolumbar Spine (n = 61)**	Patients (n = 186)
Initial abdominal intervention, n (%)					
Angiographic embolization of spleen§	3 (5)	5 (11)	1 (5)	0	8 (8)
Angiographic embolization of liver	0	2 (4)	0	0	2 (2)
Definitive exploratory laparotomy¶	10 (16)	8 (18)	3 (14)	1 (17)	15 (14)
Damage-control laparotomy	10 (16)	5 (11)	3 (14)	0	16 (15)
Primary repair of bladder††	11 (18)	1 (2)	2 (9)	1 (17)	12 (11)
Urethra realignment‡‡	2 (3)	1 (2)	1 (5)	0	2 (2)
Laparoscopic interventions§§	1 (2)	1 (2)	1 (5)	0	2 (2)
					49 (46)

## Severe Symphysis Rupture → Rectoscopy and Retrograde Cystography !



06.08.2013 06:51

### Tödlicher Ballon-Unfall im Kanton Freiburg

Beim Absturz eines Heissluftballons im Bezirk Grejenz, kam ein Mann ums Leben. Der Ballon war in Château d'Oex gestartet und touchierte offenbar beim Landeanflug eine Hochspannungsleitung. An Bord waren der Pilot und eine 4-köpfige Familie. Der Familien-Vater verstarb noch am Unfallort, die restlichen Passagiere schweben in Lebensgefahr.

### Case 2

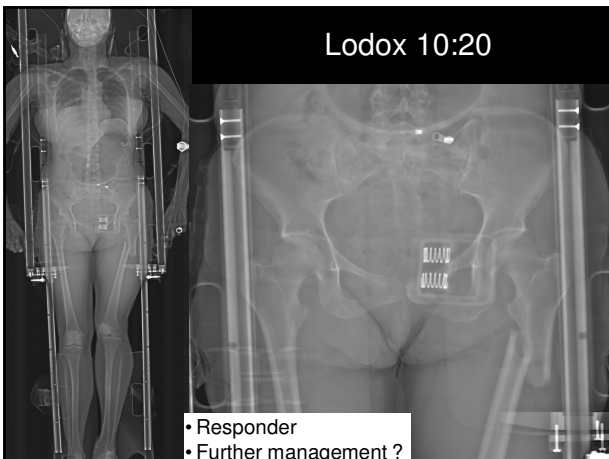


10:17

- Female, 55y. Hot-air balloon crash (50 m) – GCS 5 before intubation
- Primary Survey at admission:
  - A: intubated
  - B: ventilated, SPO2 99%, stable thorax
  - C: **Abdomen tendred**, pelvic binder, **RR 72/45 mmHg, HR 120/min. Hb 73.** FAST negative.
  - D: GCS 3
  - E: ok

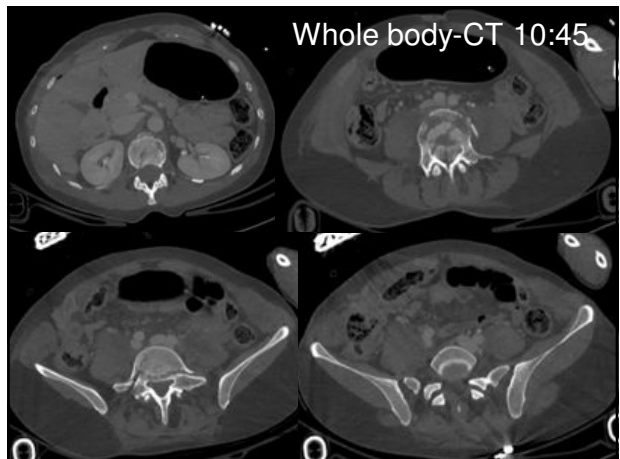
**Further management ?**

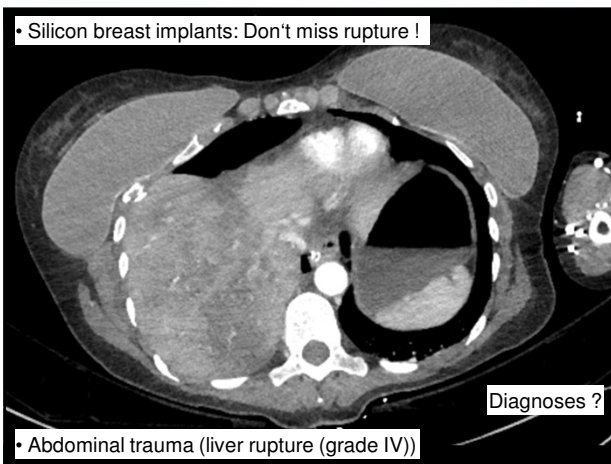
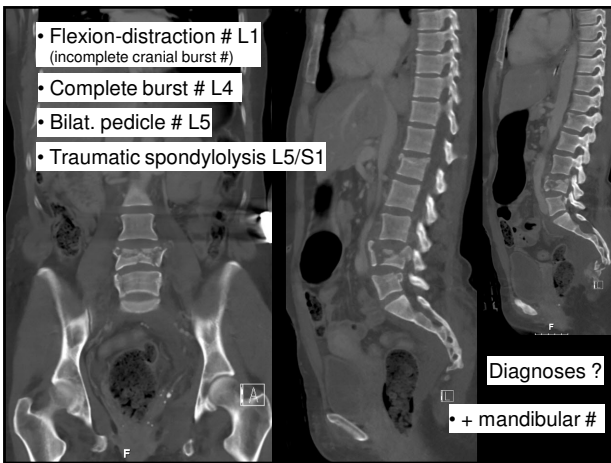
Lodox 10:20



- Responder
- Further management ?

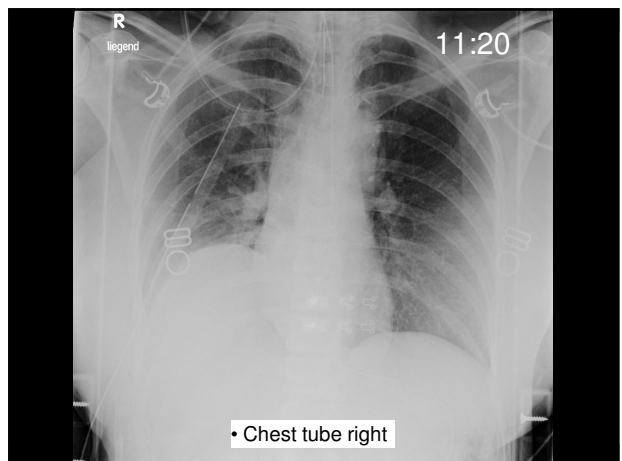
Whole body-CT 10:45





### Operative Management - Priorities ?

- Mandibula
- Thorax
- Abdomen
- Spine
- Pelvis
- Femur



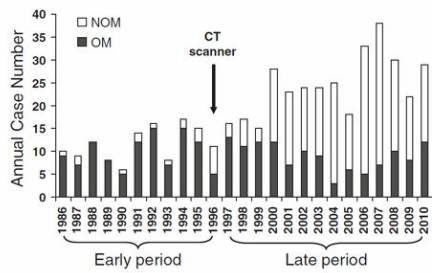


## Management of combined abdominal and spinal trauma ?

### A Quarter Century Experience in Liver Trauma: A Plea for Early Computed Tomography and Conservative Management for all Hemodynamically Stable Patients

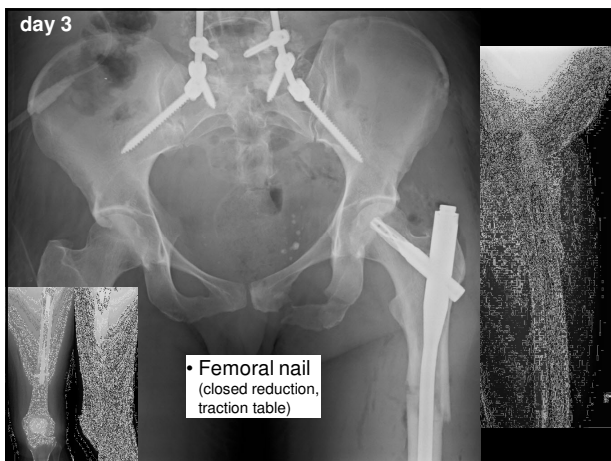
Henrik Petrowsky · Susanne Raeder ·  
Lucia Zuercher · Andreas Platz · Hans Peter Simmen ·  
Milo A. Puhani · Marius J. Keel · Pierre-Alain Clavien

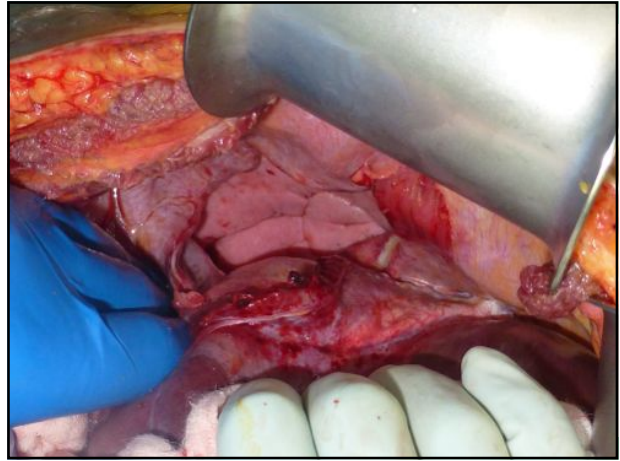
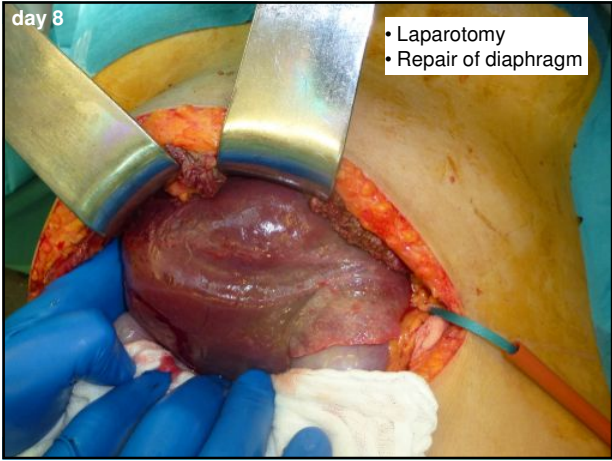
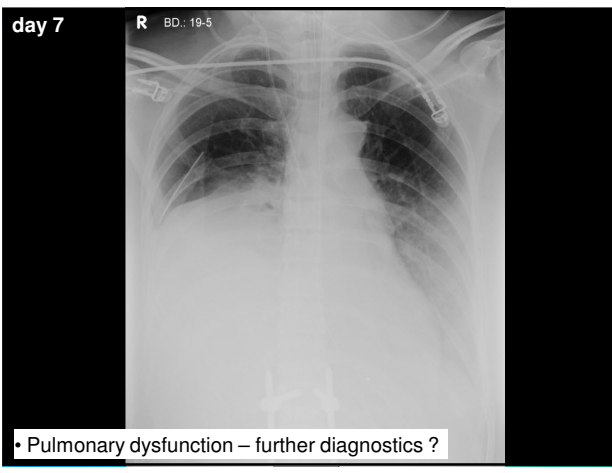
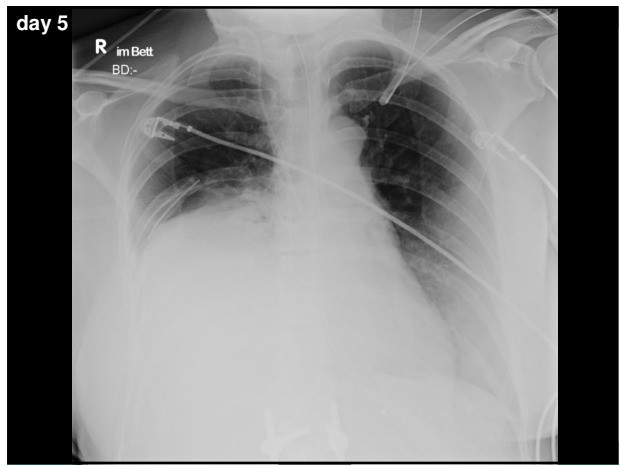
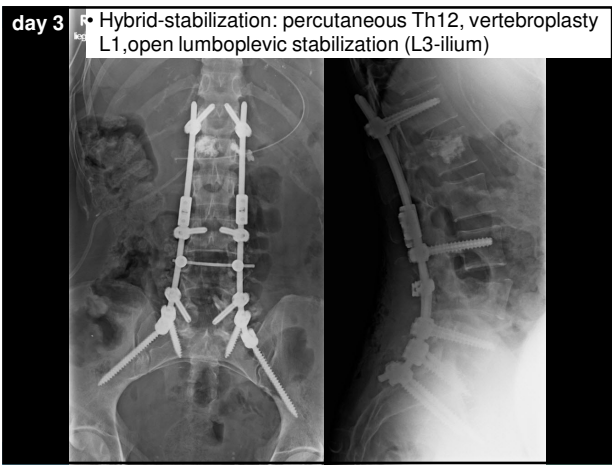
- 1986-2010 – University Hospital Zurich
- N=468; 395 patients (84%) blunt trauma - 73 (16%) penetrating trauma
- 233 patients OM (50%) - 235 with NOM (50%)
- Significant shift to **NOM** in later period (early 15%, late 63%) with a **low conversion rate to OM of 4.2%**
- Age, degree of hepatic and head injury, injury severity, intubation at admission, and early period were independent predictors of mortality in multivariate analysis

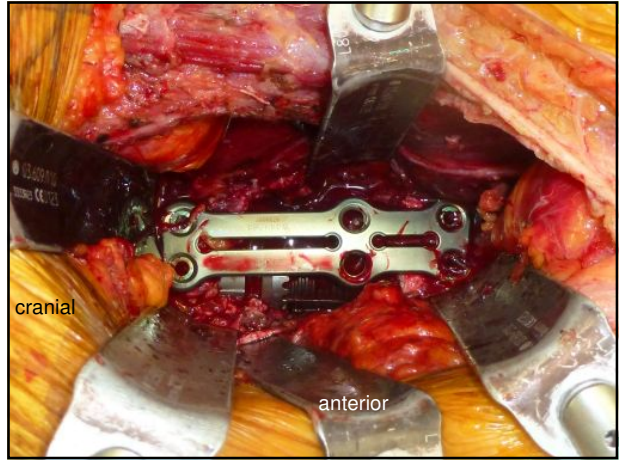
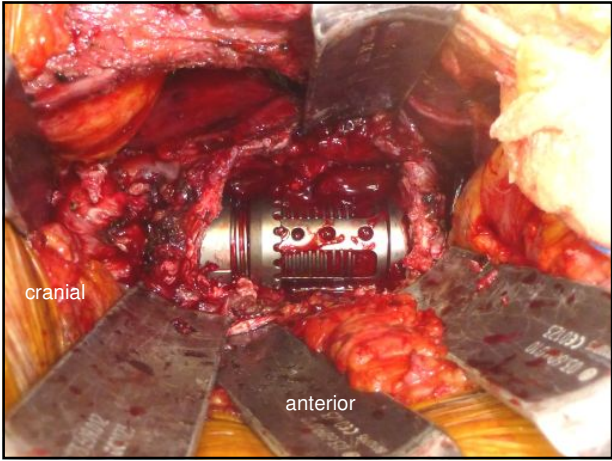
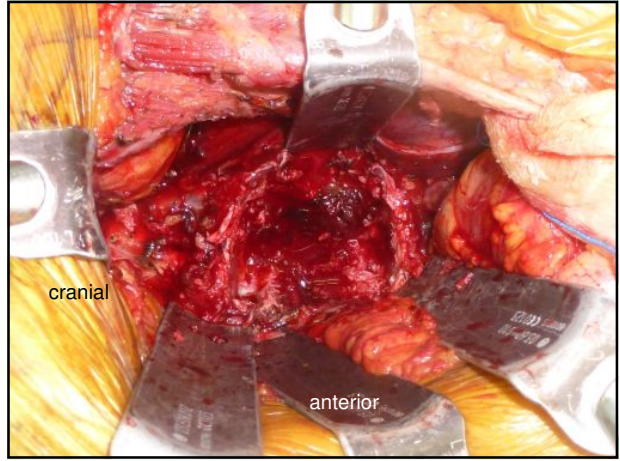
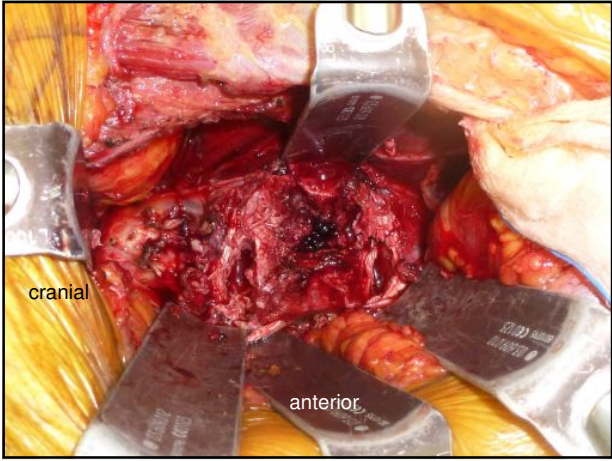
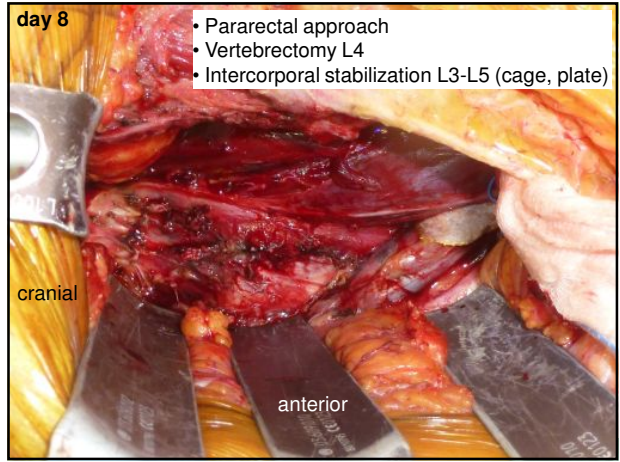
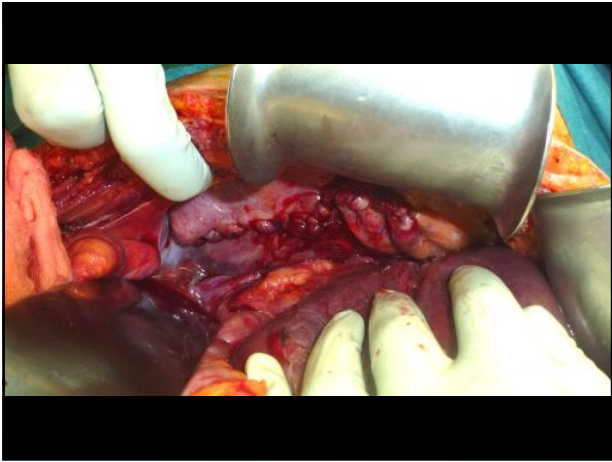


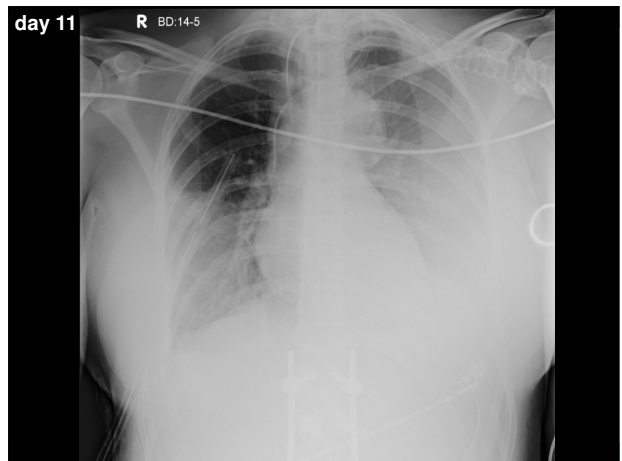
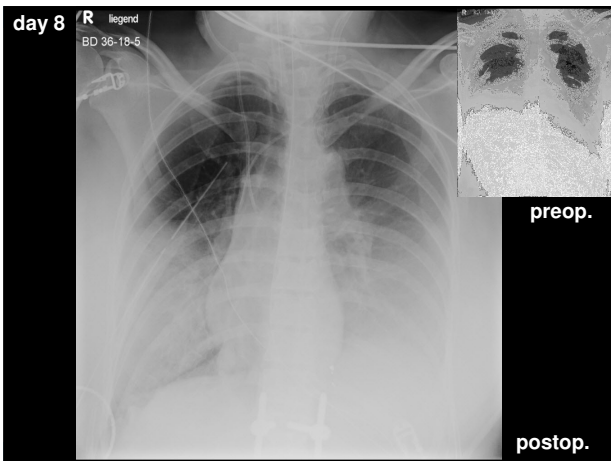
**Fig. 1** Annual number of patients treated for liver trauma for the period 1986–2010. *Solid and open bars* represent case numbers of operative (OM) and nonoperative management (NOM). Damage control surgery was introduced in our center in the early 1990s and a computed tomography (CT) scanner was installed in our trauma room in 1996

## Management of orthopedic trauma (femur – spine) ?









**Outcome ?** Mi 12.02.2014 06:51

Dear Professor Keel,  
 Good to hear from you. Thank you so much for all the great work you and your team did on us. We are doing very well under the circumstances. How are you doing? I hope this email finds you well.  
 ...  
 My mom is transitioning from using 1 crutch to using a cane. She walks pretty well with the cane. She can also walk unaided, but very slowly and has to concentrate a lot.  
 ...  
 My mom plans to return to work (she is a law professor) in August.  
 ...



**Hits in Pubmed ?**

- "Traumatic diaphragm rupture": n=654
- "Right traumatic diaphragm rupture": n=180
- "Missed traumatic diaphragm rupture": n=52
- "Missed right traumatic diaphragm rupture": n=25
- "Traumatic diaphragm rupture and liver injury": n=105

## Diagnosis of Diaphragm Rupture

- **Multidetector CT (MDCT)** is the modality of choice for the detection of diaphragmatic injury
- Initially **missed** diagnoses on **CT: 12-63%**
- CT to have a variable sensitivity of 61–87% and specificity of 72-100%
- **Sensitivity** for detecting **left**-sided ruptures (**78%**) is higher than for **right**-sided ruptures (**50%**)
- Missed diagnosis can later present as intrathoracic **visceral herniation** and **strangulation** with a **mortality** rate of **30–60%**
- **Cave:** increasing nonoperative management for most cases of blunt abdominal trauma

**Table 1.** CT signs of diaphragmatic injury\*

Direct signs
1. Direct discontinuity of the diaphragm
2. Dangling diaphragm sign
Indirect signs
1. Collar sign
2. Intrathoracic herniation of viscera
3. Dependent viscera sign
4. Contiguous injury on either side of the diaphragm
5. Sinus cut-off sign
Signs of uncertain origin
1. Thickening of the diaphragm
2. Hypoattenuated diaphragm
3. Fractured rib
4. Diaphragmatic/peridiaphragmatic contrast extravasation

\*Modified from Bodanapally et al. (7) and Desir and Ghaye (8).

## Traumatic diaphragmatic injury: a review of CT signs and the difference between blunt and penetrating injury

Ananya Panda, Atin Kumar, Shivanand Gamanagatti, Aruna Patil, Subodh Kumar, Amit Gupta

- CT scans of 23 patients with surgically proven diaphragmatic tears (both blunt and penetrating)
- **Discontinuous diaphragm** sign: **96%**
- **Diaphragmatic thickening:** **70%**
- **Dependent viscera** sign and **collar** sign exclusively in blunt-trauma patients
- **Organ herniation** and **dangling diaphragm** signs significantly more often in blunt trauma
- **Contiguous injury** on either side of the diaphragm more often in penetrating trauma (83%) than in blunt trauma (18%).