

### Flail chest – To plate or not to plate?

**Plate it! The importance of surgical restoration of chest wall integrity.**

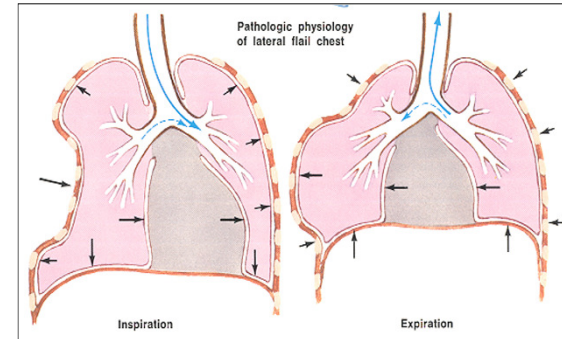
**Kuster, Sharafi, Schmid  
Klinik für Thoraxchirurgie Inselspital Bern**



3rd Swiss Trauma & Resuscitation Day

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### Pathologic Physiology



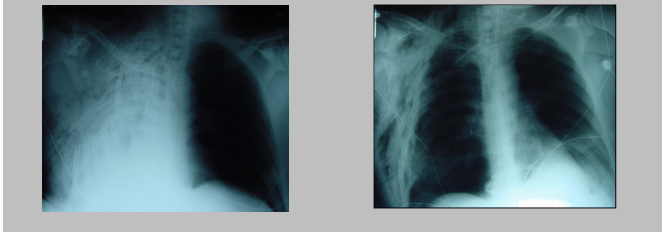
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### Surgical Stabilisation of Flail Chest

- Immediate intervention (within 1 d)
- Delayed intervention (within 7 d)
  - Secondary intervention
  - Late intervention

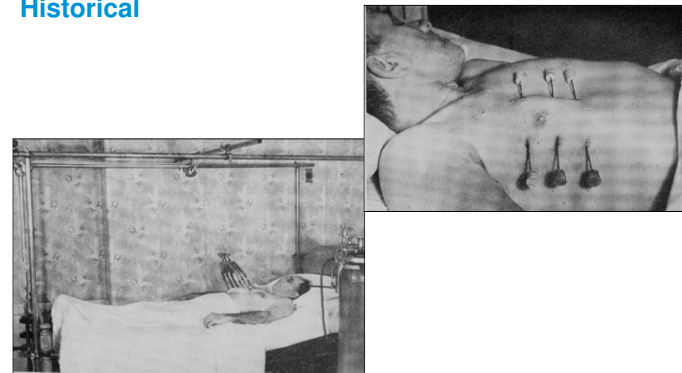


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### Historical

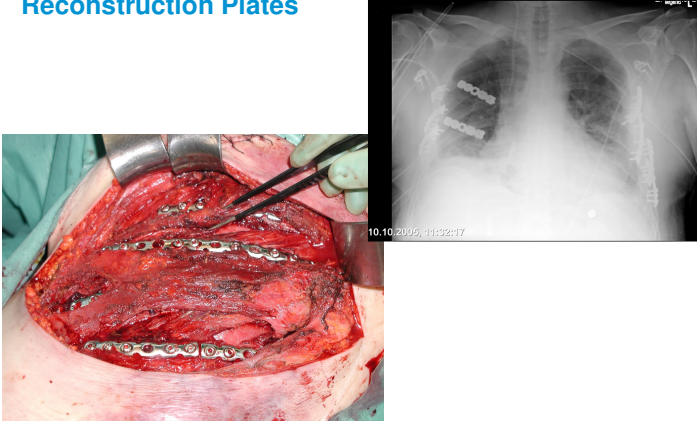


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### Reconstruction Plates

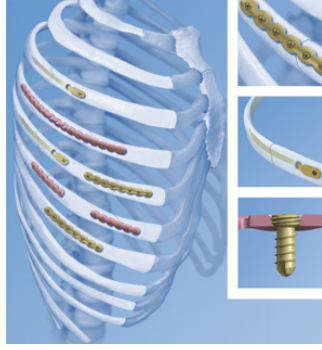


10.10.2005, 11:32:17

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### Matrix Rib System



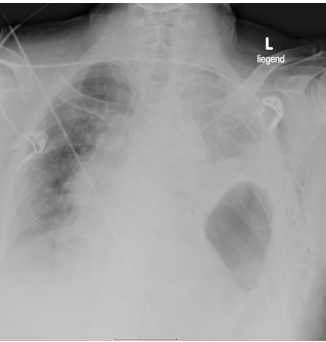
- Internal Fixation
- Bended Titan Plates
- Periosteum and Blood Supply not damaged
- Plates: 11 mm x 75 mm

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### Case report 1: Immediate Intervention

- M. M-T. 1927
- High velocity car accident (80-100 km/h)
- Bilateral series of rib fractures
- Left diaphragmatic rupture
- Spleen rupture

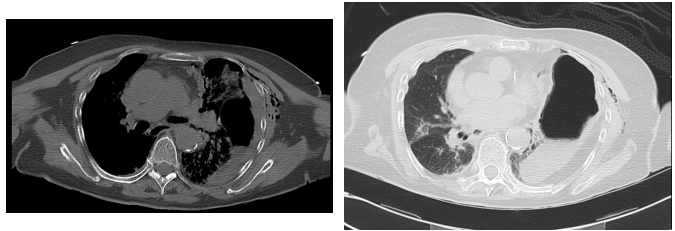


L  
Legend

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### Case report 1: Immediate Intervention



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### Case report 1: Immediate Intervention



0:49

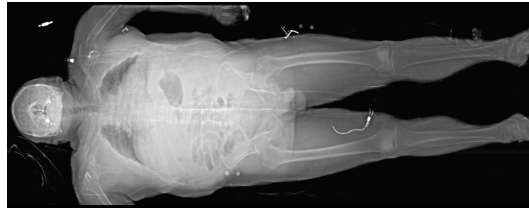
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Detailed description: A frontal chest X-ray showing multiple bilateral rib fractures. A central venous catheter is visible on the left side. The lung fields appear clear, and the heart size is within normal limits. The image is labeled with 'R' and 'BD' in the top left corner and a timestamp '0:49' in the bottom left corner.

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### Case report 2: Delayed Intervention

- F.P. 1930
- Blunt trauma, farmer
- Series of rib fractures dorsal right side
- Lateral fractures ribs 3-6 left side
- Oblique fracture of sternum
- No weaning possible



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Detailed description: A whole-body X-ray (AP view) showing multiple rib fractures on both sides. The fractures are most prominent on the right side. The rest of the skeleton appears normal. The image is labeled with 'R' and 'BD' in the top left corner and a timestamp '0:49' in the bottom left corner.

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### Case report 2: Delayed Intervention



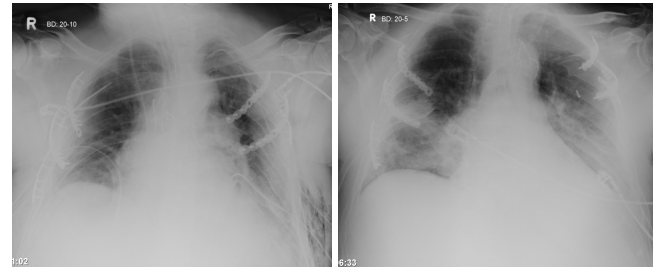
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Detailed description: An axial CT scan of the chest at the level of the main bronchi. It clearly shows multiple bilateral rib fractures. The lung parenchyma and mediastinal structures are also visible. The image is labeled with 'R' and 'BD' in the top left corner and a timestamp '0:49' in the bottom left corner.

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### Case report 2: Delayed Intervention

#### Bilateral Rib Stabilisation



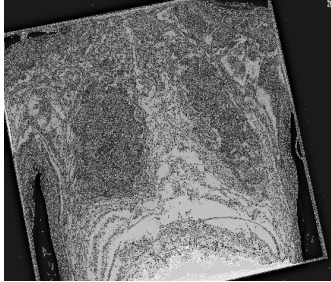
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Detailed description: Two frontal chest X-rays side-by-side. The left image shows the initial rib fractures. The right image shows the same patient after bilateral rib stabilization with external fixators. The image is labeled with 'R' and 'BD' in the top left corner and a timestamp '0:49' in the bottom left corner.

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### Case report 3: Secondary Intervention


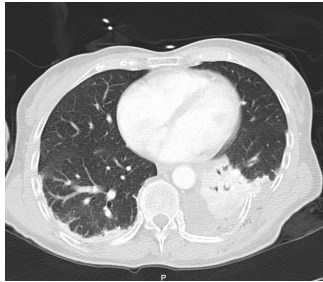
- Ski accident , rib fractures left side
- Initial conservative therapy
- No further problems, good analgesia
- Secondary dislocation of rib fragments dorsal with lung laceration and pneumothorax



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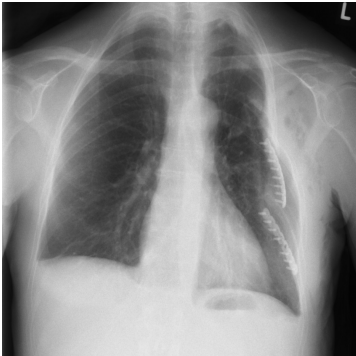
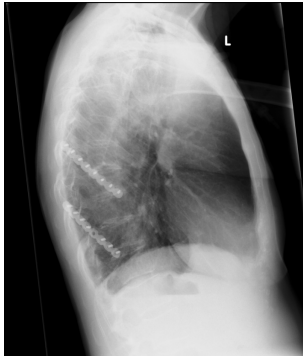
### Case report 3: Secondary Intervention

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### Case report 3: Secondary Intervention

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### Decision making in the ICU +/- Rib Stabilisation


<p><b>+ Factors</b></p> <ul style="list-style-type: none"> <li>• Weaning from ventilation impossible</li> <li>• Chest instability</li> <li>• Prophylaxis against secondary complications (pneumonia, pleural empyema etc.)</li> </ul>	<p><b>- Factors</b></p> <ul style="list-style-type: none"> <li>• Severe brain injury</li> <li>• absence of respiratory compliance</li> <li>• Multiple traumatic injuries with multiple operative procedures over a long time</li> <li>• Multiple comorbidities, elderly patients</li> <li>• Severe lung contusion</li> <li>• Dorsal located rib fractures</li> </ul>
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### Case report 4: Late Intervention

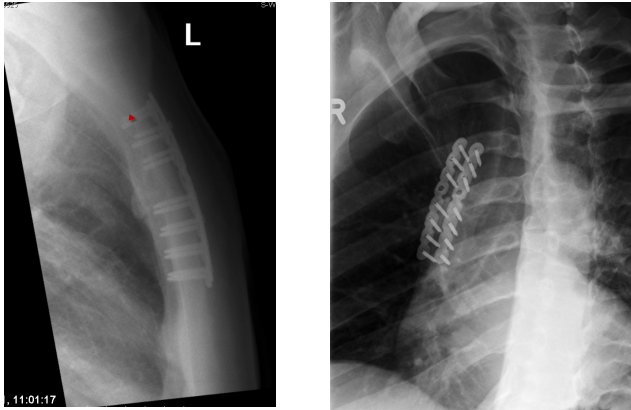
- usually rib pseudarthrosis
- car accident August 2010
- oblique sternum fracture, BWK-fractures 4-7, bilateral lung contusions
- conservative therapy
- persistent pain, inability to work as a farmer



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### Case report 4: Late Intervention



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### Studies to this topic 1

Tanaka et al., Journal of Trauma 2002  
Randomized prospective study

Group S with rib stabilisation (18 cases), Group I conservative therapy (19 cases)

Results:

	Group S (d)	Group I (d)	p
Ventilation period	10,8 d	18,3 d	< 0,05
Stay in the ICU	16,5 d	26,8 d	< 0,05
pneumonias	24 %	77 %	< 0,05

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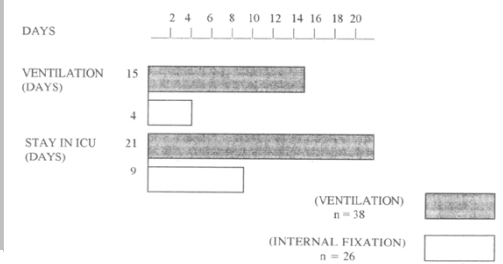
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### Studies to this topic 2

Ahmed et al., J Thorac Cardiovasc Surg 1995

Retrospective study

Conservative therapy n = 38  
Internal fixation n = 26



Parameter	Conservative therapy (n = 38)	Internal fixation (n = 26)
Ventilation (Days)	15	4
Stay in ICU (Days)	21	9

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### Own Results I, N = 42 2010 – 2013 (Sharafi)

1. Age: **mean 66 y**, minimum 41 y, maximum 85 y
2. **Flail Chest: 82,4 %**, no Flail Chest: 17,6 %
3. Degree of **lung contusion**:  
unilateral 29,4 % - **bilateral 70,5 %**  
mild 64,7 % - moderate 17,6 % - **severe 11,6 %**
4. **Surgical indication**: cardiopulmonary instability 29,4 %, rib dislocation 11,7 %, hemothorax 17,6 %, lack of compliance 5,8 %, impossible weaning 5,8 %, thoracic instability 29,4 %

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### Own Results II, N = 42 2010 – 2013 (Sharafi)

5. **Length of surgery**:  
**mean: 150 min.**, min.: 70 min, max: 280 min.
6. **Time till extubation(d)**:  
**within 24 hours: 70,5 %**, within 3 d: 23,4 % ,  
within 6 d: 5,8 %
7. **Length of Stay in the ICU**:  
**mean 5,5 d**, max: 31 d, min: 1 d

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### Own Results III, N = 42 2010 – 2013 (Sharafi)

8. Complications :  
**pneumonia 17,6 %**, **sepsis 5,8 %**, **STEMI 5,8 %**
9. **Length of hospital stay**:  
**mean: 11,9 d**, min: 8 d, max: 15 d
10. **Revision Surgery**:  
**no revisions at all**

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### Comparison Own Results - Studies

	Bern (Sharafi)	Tanaka	Ahmed
ICU-Time mean	5,5 d	16,5 d	9 d
Weaning within 24 h	> 70 %		81 %
Hospital Stay	11,9 d		
Pneumonia	17,9 %	22 %	15 %
Sepsis	5,8 %		4 %

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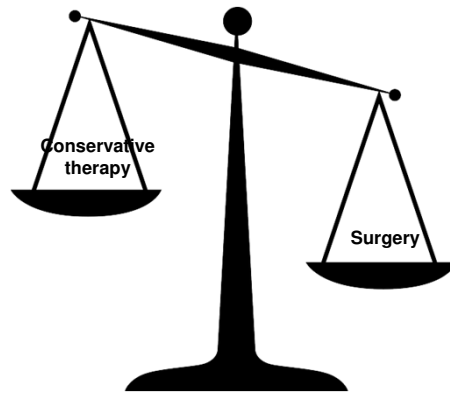
**Conclusion**

**Chest wall stabilisation ist an important part of treatment of severe chest wall injury.**

**Together with our colleagues of the ICU we discuss the indication, and we perform chest wall stabilisation without the distress of complications.**

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Conservative therapy

Surgery

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