

Rib Fracture Fixation

Say What!?! I Am Not A Lunatic

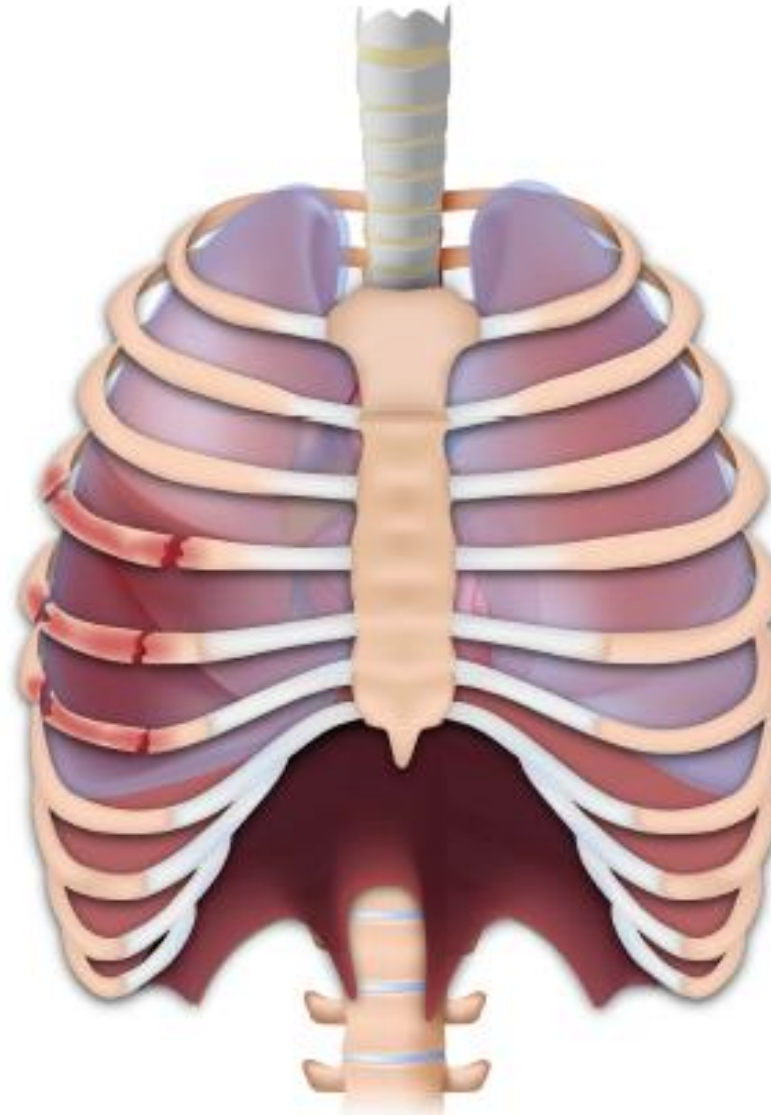


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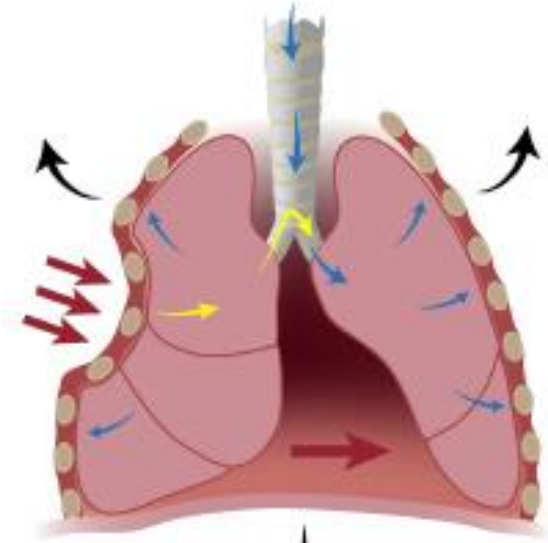
Issues with flail chest:

- Chest wall instability
- Thoracic deformity
- Pain

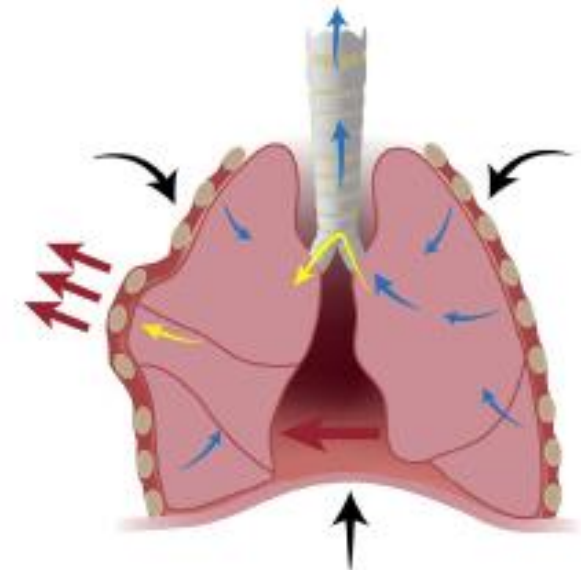
Flail Chest



Inspiration

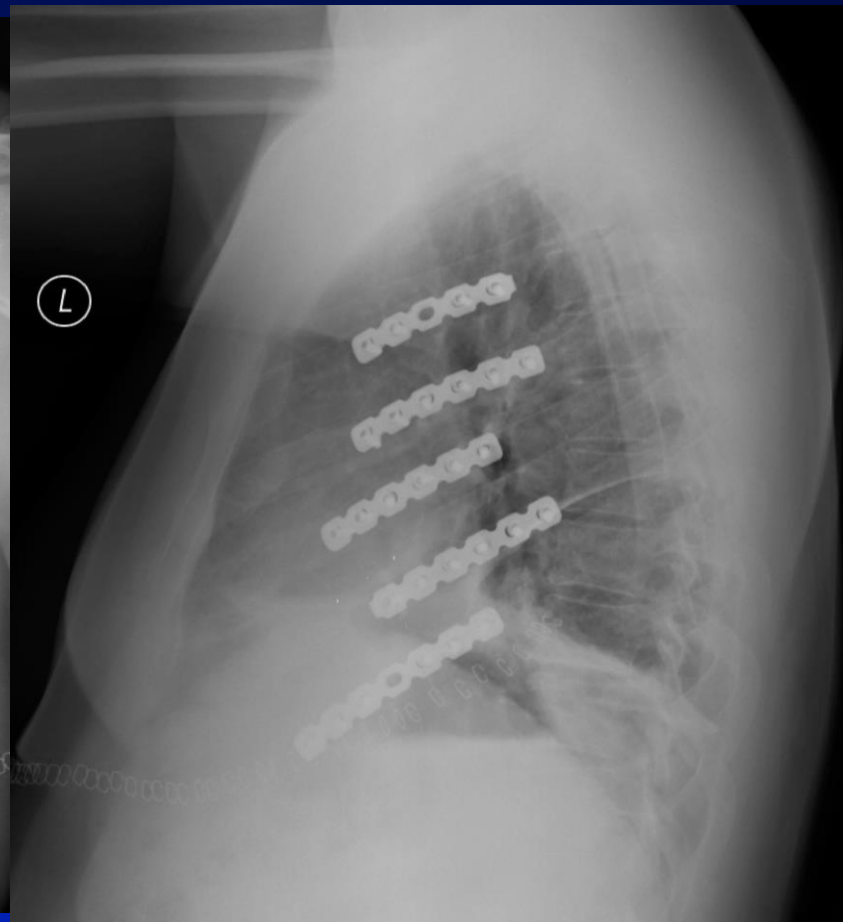
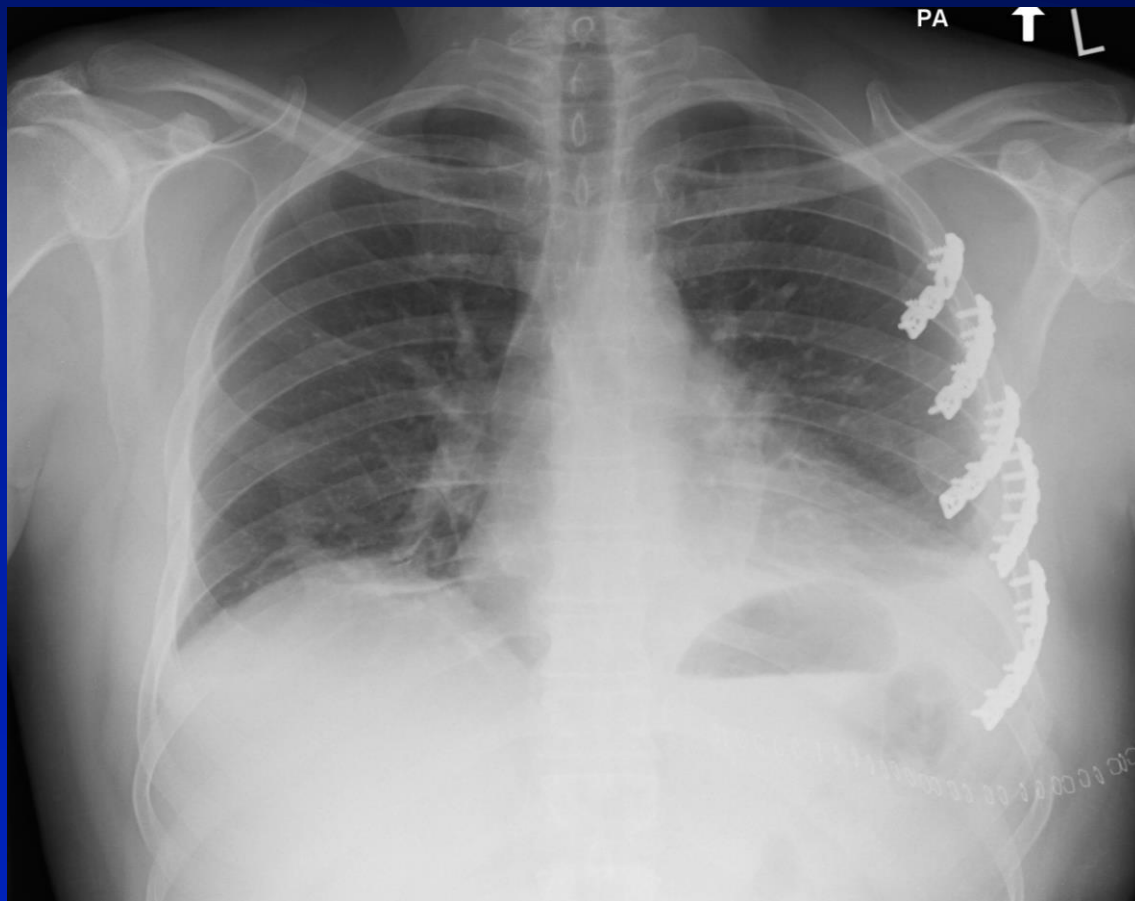


Expiration



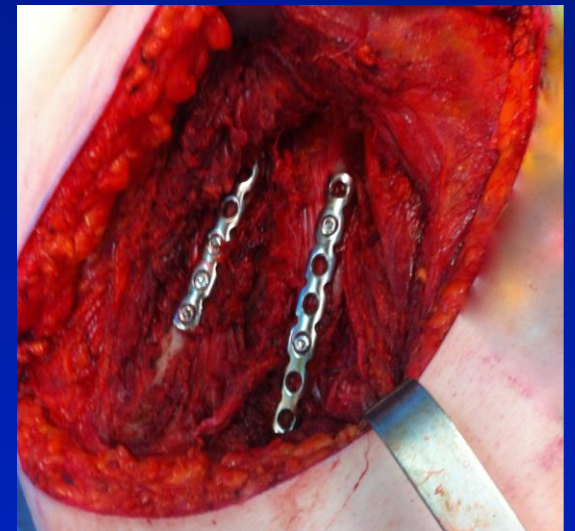
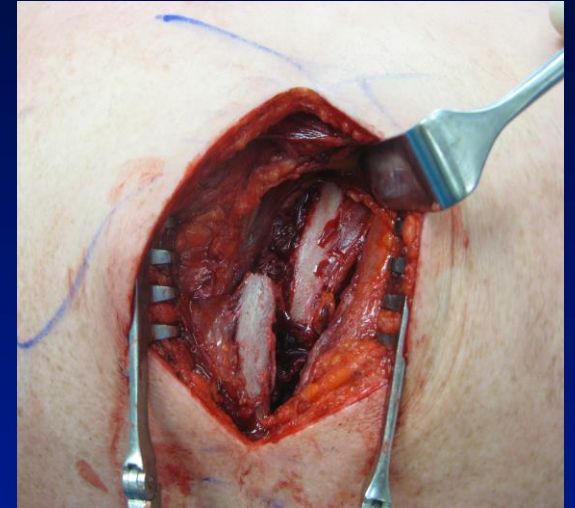
- Prolonged mechanical ventilation leads to:
 - ↑ ICU stay
 - ↑ Pneumonia, VAP
 - ↑ Tracheostomy
 - ↑ Sepsis
 - ↑ Barotrauma
 - ↑ Health care costs





Potential benefits of surgical fixation

- Mechanical ventilation(3.7 vs 15 days)
- ICU stay.....(6.8 vs 21 days)
- Pneumonia.....(7.6% vs 50%)
- Pain.....(5.5% vs 49%)
- Chest wall deformity.....(5% vs 45%)
- Time off work.....(95% vs 43%)
- Long term respiratory dysfunction



Operative vs Nonoperative Treatment of Acute Unstable Chest Wall Injuries





A Randomized Clinical Trial

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IMPORTANCE Unstable chest wall injuries have high rates of mortality and morbidity. In the last decade, multiple studies have reported improved outcomes with operative compared with nonoperative treatment. However, to date, an adequately powered, randomized clinical trial to support operative treatment has been lacking.

OBJECTIVE To compare outcomes of surgical treatment of acute unstable chest wall injuries with nonsurgical management.

DESIGN, SETTING, AND PARTICIPANTS This was a multicenter, prospective, randomized clinical trial conducted from October 10, 2011, to October 2, 2019, across 15 sites in Canada and the US. Inclusion criteria were patients between the ages of 16 to 85 years with displaced rib fractures with a flail chest or non-flail chest injuries with severe chest wall deformity.

-  [Visual Abstract](#)
-  [Invited Commentary](#)
-  [Multimedia](#)
-  [Supplemental content](#)

Methods

- Multi Center Randomized Controlled Trial
- 15 sites across Canada and USA
- Recruitment: July 2011 – Dec 2018

1) Non-operative group:

- Mechanical ventilation as needed
- Pain management, pulmonary toilet, chest physio therapy

2) Surgical group:

- All non-operative treatments as above
- Surgical fixation within 4 days

Inclusion criteria:

- Age 16-85 years of age
- Flail chest or Severe deformity of the chest wall

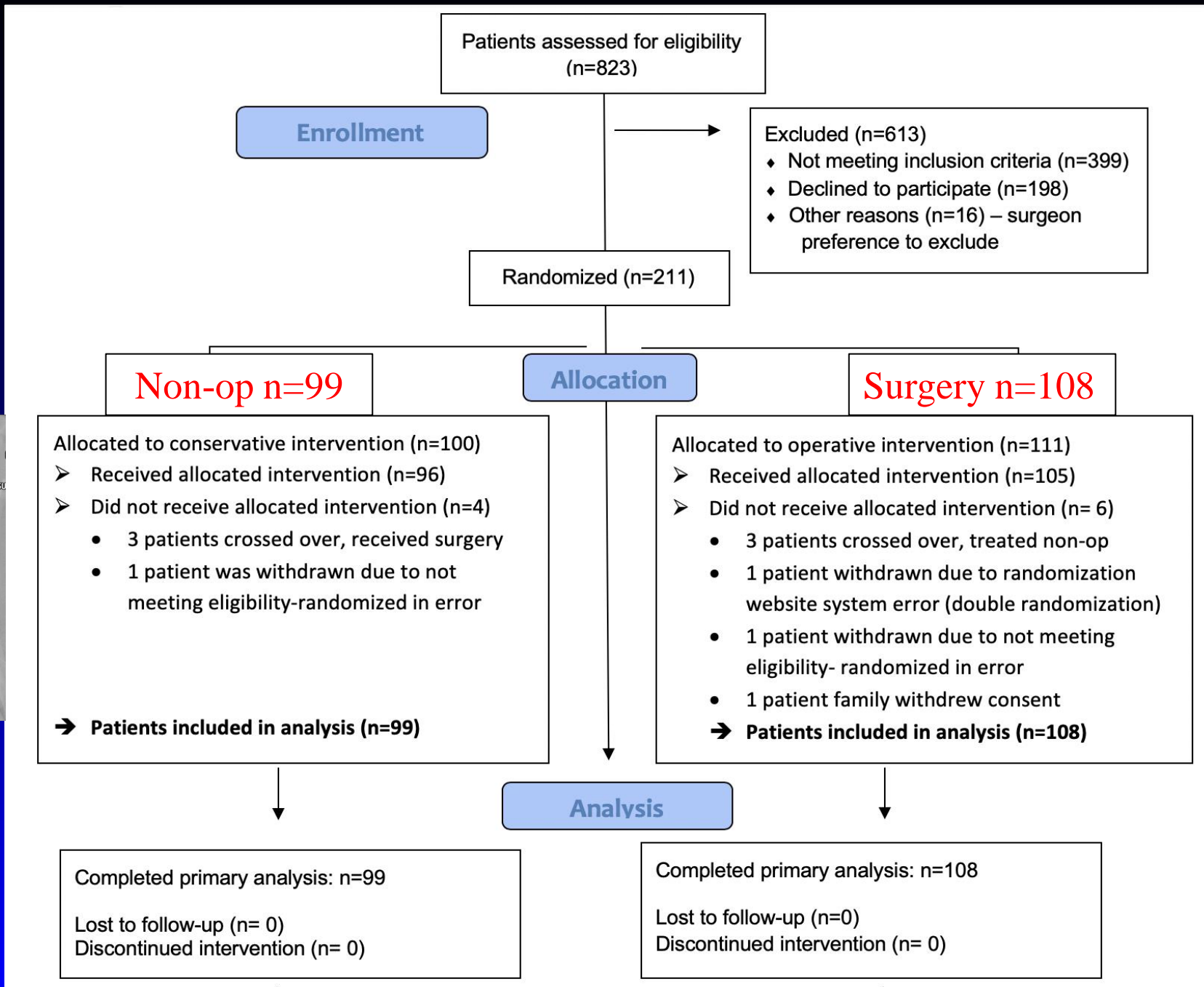
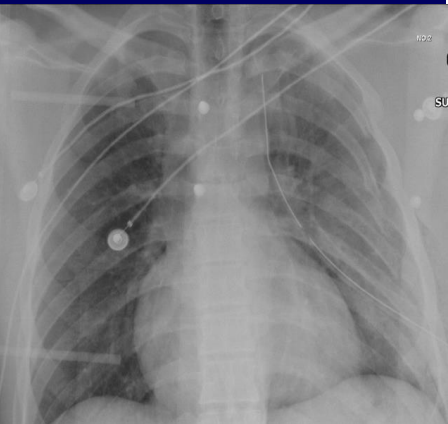
Exclusion criteria:

- Anatomic location not amenable to surgical fixation
- Other significant injuries that may require long-term intubation:
 - Severe pulmonary contusion
 - Severe head injury/Traumatic brain injury
- Randomization > 72 hours from injury
- Surgical fixation > 96 hours from injury



Outcomes

- Primary outcome:
 - Number of ventilator-free days (VFDs) in the first 28 days
- Secondary outcomes :
 - Days on mechanical ventilation, days in ICU, days in hospital
 - Incidence of acute pneumonia, ventilator associated pneumonia (VAP), sepsis, tracheostomy, death
 - Surgical complications

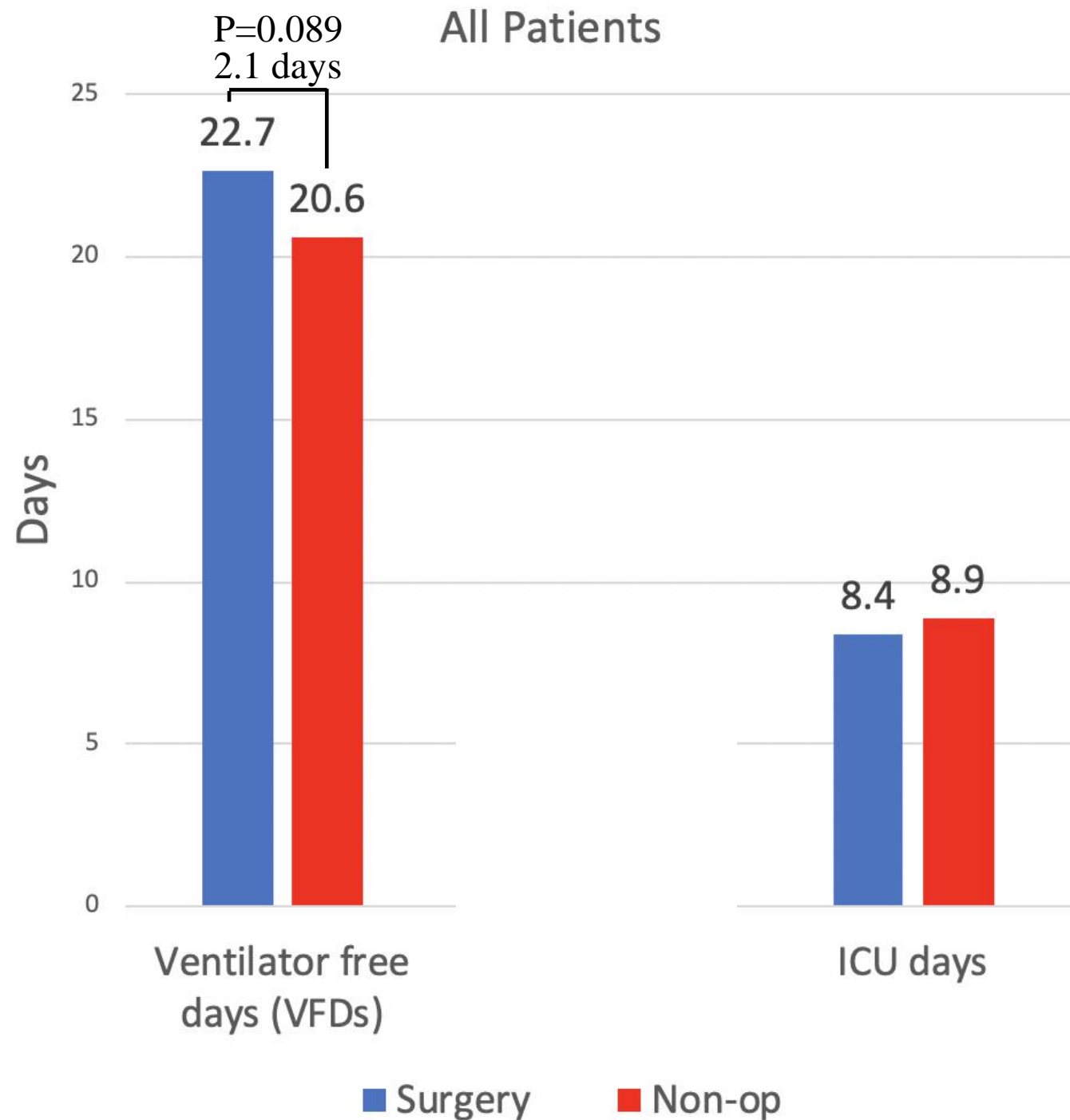


Results

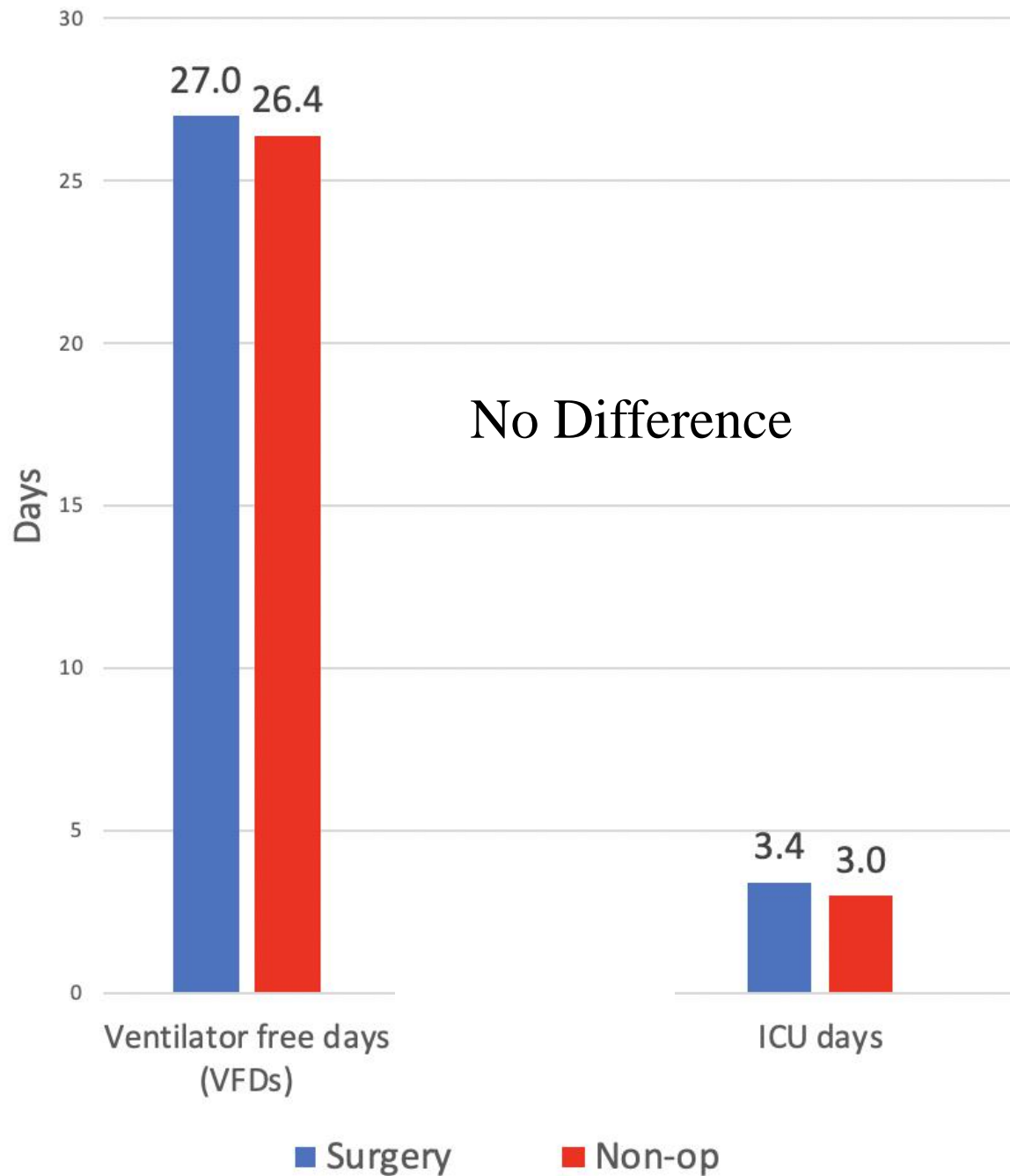
- Mean age 53
- Mean 10.3 rib fractures
- Mean ISS 25.6
- 43% intubated at randomization
- 22% required ventilation after randomization
- 78% admitted to the ICU

Patient characteristics	Surgery n=108		Non-op n=99	
	Mean	sd	Mean	sd
Age	52.9	13.5	53.2	14.3
	n	%	n	%
Sex				
Male	81	75%	75	76%
Female	27	25%	24	24%
Current Smoker	37	35%	32	33%
Diabetic	19	18%	9	9%
Prior chest injury	18	17%	17	17%
Prior lung disease	No Difference			
Mechanism of injury				
Motor vehicle collision	40	37%	30	30%
Fall	18	17%	26	26%
Motorcycle	14	13%	15	15%
Pedestrian struck	12	11%	10	10%
Crush injury	8	7%	4	4%
Cycling	6	6%	2	2%
Other recreational activities	0	0%	0	0%
Assult	0	0%	2	2%
Pneumothorax	93	87%	91	92%
Hemothorax	84	79%	73	74%
Pulmonary contusion	57	53%	54	55%
Head injury	7	7%	12	12%
Chest tube	105	97%	82	83%
	Mean	sd	Mean	sd
Number of rib fractures	10.1	3.8	10.5	4.3
Injury Severity Score (ISS)	25.3	10.7	26.0	10.9
Glasgow Coma Scale	12.5	3.9	12.3	4.5

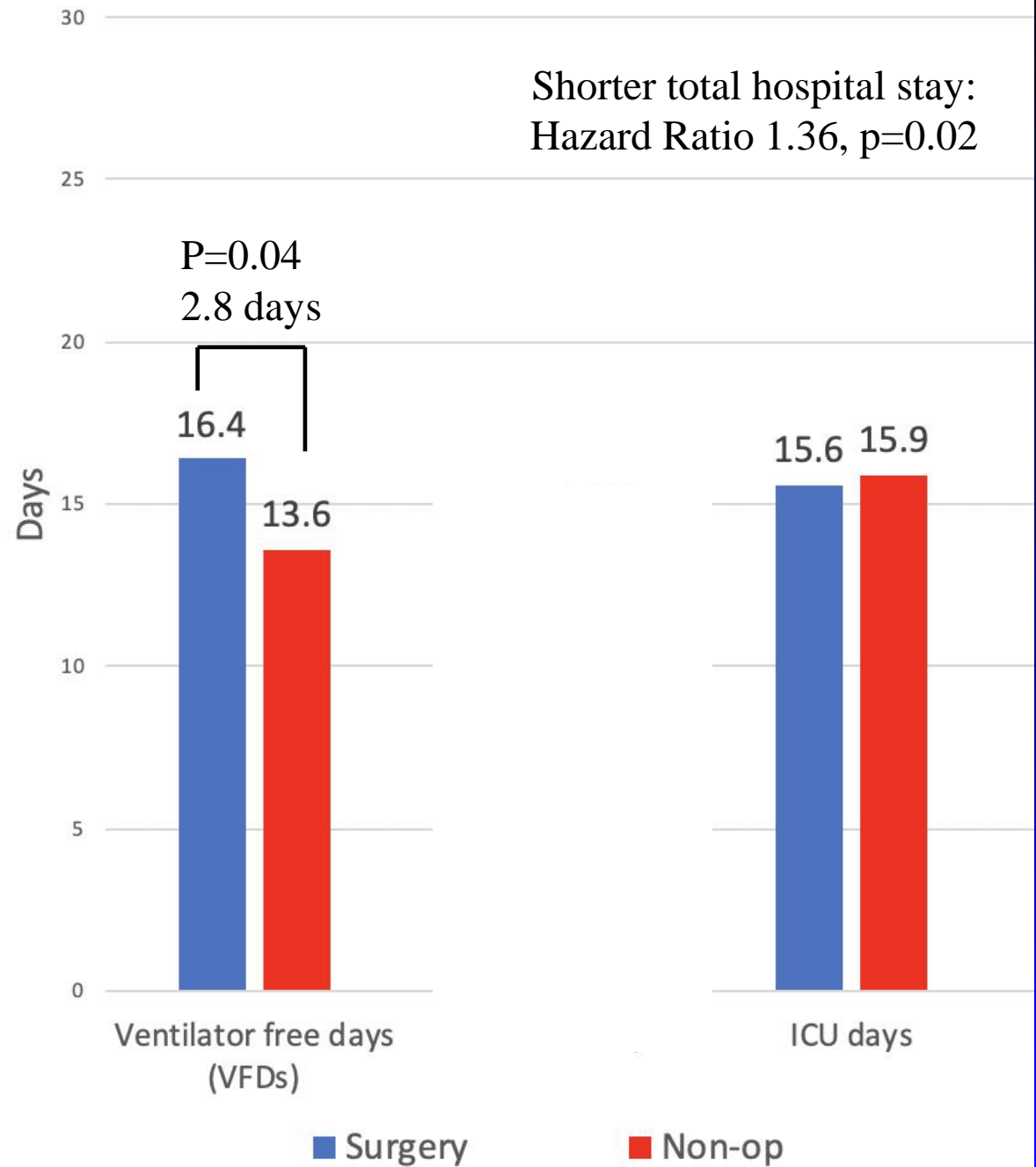
- Trend towards improved ventilator free days with surgery vs. non-op
- No difference in ICU days



Patients Not Intubated at Randomization



Patients Intubated at Randomization



Complications

Complications	Non-operative n=99		Surgical n=108		p
	n	%	n	%	
Pneumonia	3	3%	7	6%	0.34
VAP	20	20%	23	21%	0.98
Sepsis	12	12%	12	11%	0.99
Tracheostomy	16	16%	9	8%	0.13
Empyema	3	3%	2	2%	0.67
Death	6	6%	0	0%	0.011

Subgroup Analysis

- Patients who were mechanically ventilated at the time of randomization vs. not ventilated:
 - Higher VFDs (2.8 days) in favour of surgery ($p=0.04$)
 - Shorter total hospital stay (Hazard Ratio 1.36, $p=0.02$) with surgery
 - No difference in ICU length of stay
 - No different in complications
 - No difference in SF-36 scores

- **Ventilated patients at randomization:**
 - 2.8 day improvement in VFDs with surgery
 - shorter total hospital stay (Hazard Ratio 1.36, $p=0.02$)
- **Non-ventilated patients at randomization**
 - No differences in any outcome

Conclusion

- This is the largest prospective randomized study of surgical vs non-operative treatment for unstable chest wall injuries
- Surgical fixation is associated with lower mortality, and appears to have some improved outcomes in ventilated patients (improved ventilator free days, hospital days)
- Minimal benefits for non-intubated patients

Thank you!

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