Rib Fracture Case Study: A Rib Pain Issue

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Disclosure

- None

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Rib Fracture Case Study

- Goals:
  - Identify and assess non-flail rib fracture patients
  - Identify potential surgical candidates
  - Get familiar with the reported outcome benefits of surgical stabilization of rib fractures and cryotherapy of intercostal nerves

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Rib Fracture Case Study

- Description of the case
  - 50 year-old male s/p fall from 10 feet, landing on right side of chest, no loss of consciousness
  - Severe left clavicle and right chest wall pain without shortness of breath
  - Primary survey: negative for life threatening injuries
  - BP 105/55 HR 74 RR 20 Sat 97 GCS 15
  - Secondary survey: left clavicle and right chest tenderness, abrasions to left ear lobe
    - Severe right chest wall tenderness
    - No paradoxical movements of the chest
    - No open wounds
  - PMH: unremarkable
  - Review of systems : no additional symptoms

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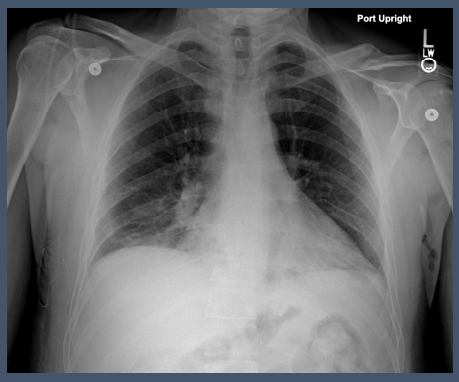
Rib Fracture Case Study



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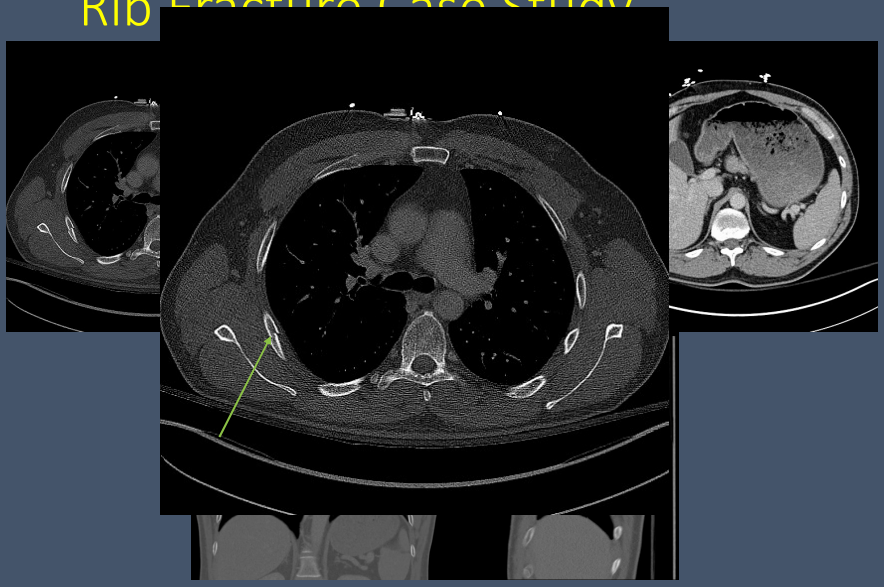
Rib Fracture Case Study



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Rib Fracture Case Study

- Severity of pain: initial visual analog scale 10/10
- Rib fracture severity score: low
- Priority level for early fixation < 72h: low
- Plan for initial non operative management

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Initial Hospital Management

- Admitted to the hospital
- Multimodal analgesia including erector spinae block
- Patient had persistent severe rib pain despite therapy specially when getting out of bed at 48 hrs
- Decreased incentive spirometry < 1 L
- Surgical option requested by the patient

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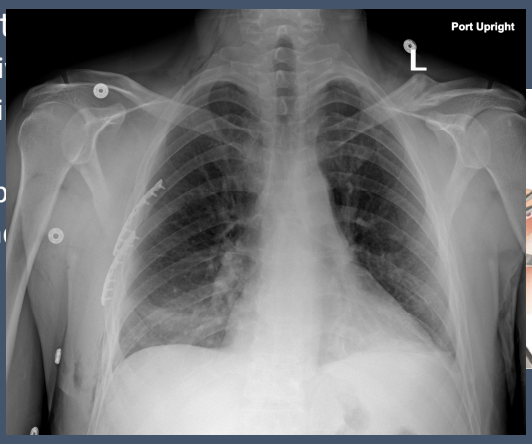
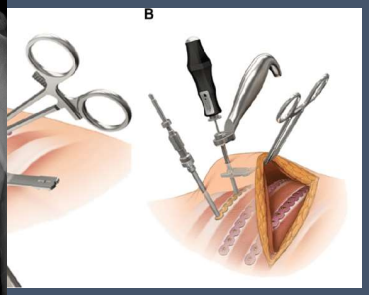
Surgical Stabilization of Rib Fractures (SSRF)

- Surgical intervent
  - Minimally invasi
  - Cryotherapy of i
  - No chest tube
  - No bronchoscop
  - Single lumen en





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Rib Fracture Case Study

- Postoperative care:
  - Floor
  - Significantly decreased opioid analgesia
  - Erector spinae block discontinued 24 hours later
  - Tolerated early mobilization
- Home discharge on postoperative day 2 with minimal pain
- Total length of stay : 4 days
- Follow up clinic : off pain medication and no evidence of complications at 2nd week

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How Did We Assess This Patient?

- Assessment:
  - Severity of pain
  - Severity of rib fracture patterns
  - Pain response to multimodal therapy at 72 hours
  - Degree of pulmonary dysfunction
  - Priority level for early surgical intervention if needed at 72 hours based on scoring system and in the absence of contraindications

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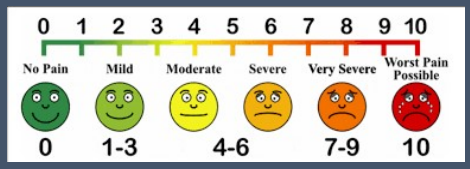
Defining Severity of Rib Pain

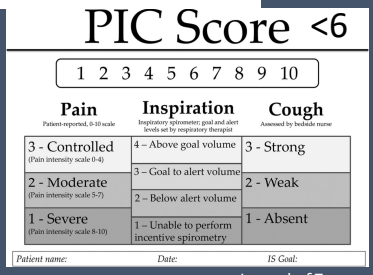
SCARF Score >3

Parameter	Points
Numeric pain score ≥ 5	1
Incentive spirometry < 50% predicted	1
Respiratory rate ≥ 20	1
Poor cough	1

VAS >6



PIC Score <6



Journal of Trauma and Acute Care Surgery: December 2019 Volume 87 Issue 6 p 1260-1268

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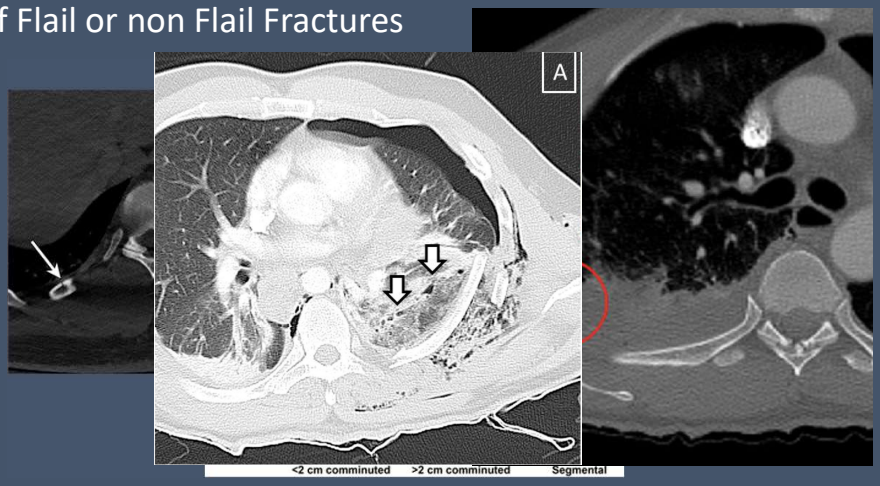
Defining Severity of Rib Fracture: Patterns

- If Flail or non Flail Fractures



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Severity of Rib Fracture: Scoring Systems

RibScore > 3

Parameter	Points
≥ 6 fractures	1
Flail chest	1
Bilateral fractures	1
≥ 3 severely displaced fractures	1
≥ 1 anterior, lateral, and posterior fracture	1
First rib fracture	1
Total	6

J Trauma Acute Care Surgery 2016 Jan;80(1):95-101

Chest trauma score >6

Age score	Score	Rib score	Score
<45 y	1	<3 RIBFX	1
45-65 y	2	3-5 RIBFX	2
>65 y	3	>5 RIBFX	3
Pulmonary contusion score		**Bilateral RIBFX**	
None	0	No	0
Unilateral minor	1	Yes	2
Bilateral minor	2		
Unilateral major	3		
Bilateral major	4		

(Final score 2-12, Patients grouped as <5 and ≥5). RIBFX – Rib fractures

Am J Surg. 2012;204(6):910–3

Rib fracture score >8

Rib Fracture Score = (Breaks × Sides) + Age Factor

Breaks	Number of fractures
Sides	Unilateral = 1, bilateral = 2
Age Factor	
0	If <50 years old
1	If 51–60 years old
2	If 61–70 years old
3	If 71–80 years old
4	If >80 years old

Surgery. 2014;156(4):988–93

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Defining Priority: SSRF Optimal Timing

- High priority If severe level on scoring system: early SSRF < 72 hours
- Low priority if non severe level on scoring system but persistent pain or pulmonary complications < or > 72 hours
- Contraindicated if severe TBI, hemodynamic instability, unstable spine or pelvis

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What Outcomes Should Get Better with SSRF?

Outcome	Rounded Mean Score	Importance
Mortality	9	Critical
Ventilator LOS	7	Critical
ICU LOS	7	Critical
Hospital LOS	7	Critical
Pneumonia	7	Critical
Tracheostomy requirement	7	Critical
Pain control	7	Critical
Lung volumes on spirometry	5	Important
Quality of life	6	Important
Exercise tolerance	4	Important
Chronic disability	6	Important
Time away from work	5	Important

Journal of Trauma and Acute Care Surgery82(3):618-626, March 2017

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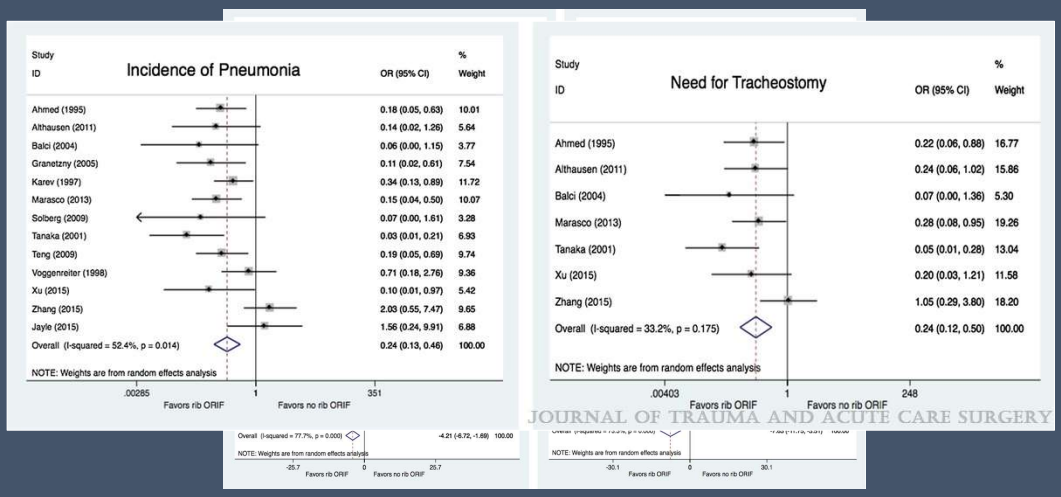
SSRF Clinical Outcomes: Flail Chest



Journal of Trauma and Acute Care Surgery82(3):618-626, March 2017

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SSRF Clinical Outcomes: Non Flail Chest

- Lower pain score (2.9 vs 4.5, p<0.01)
- Lower disability score (21 vs 25, p<0.03)
- Lower narcotic use (0.5 vs 1.2, p=0.05)
- Lower pleural complications(0% vs 10.2%, p=0.02)

CWIS 2019 SUMMIT ARTICLE

A multicenter, prospective, controlled clinical trial of surgical stabilization of rib fractures in patients with severe, nonflail fracture patterns (Chest Wall Injury Society NONFLAIL)

Pieracci, Fredric M. MD, MPH; Leasia, Kiara MD; Bauman, Zach DO; Eriksson, Evert A. MD; Lottenberg, Lawrence MD; Majercik, Sarah MD; Powell, Ledford MD; Sarani, Babak MD; Semon, Gregory DO; Thomas, Bradley MD; Zhao, Frank MD; Dyke, Cornelius MD; Doben, Andrew R. MD

Author Information

Journal of Trauma and Acute Care Surgery: February 2020 - Volume 88 - Issue 2 - p 249-257

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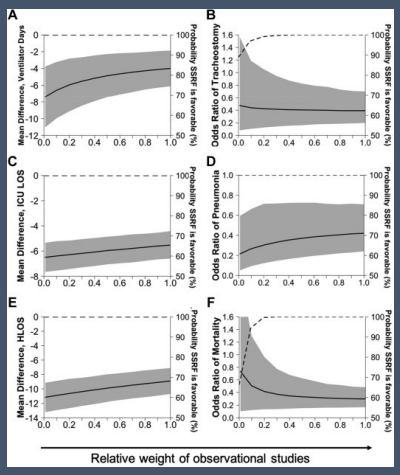
SSRF Clinical Outcomes: Flail and Non Flail Chest

Collective review

Surgical Stabilization of Rib Fracture to Mitigate Pulmonary Complication and Mortality: A Systematic Review and Bayesian Meta-Analysis



Journal of the American College of Surgeons, volume 232, issue 2, 2020,pgs 211-219.e2

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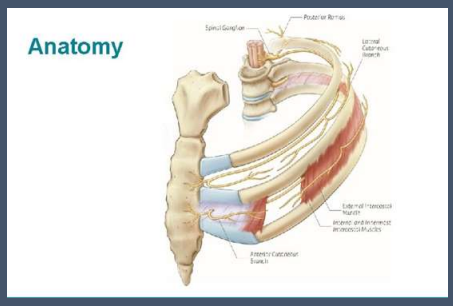
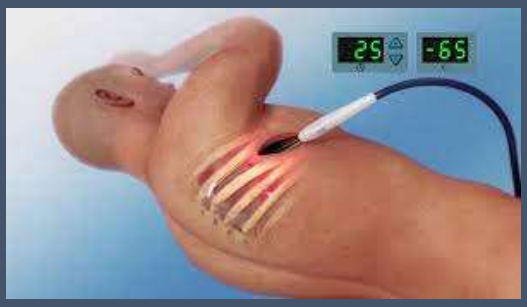
Cryotherapy of Intercostal Nerves

- The use of compressed nitrous oxide to freeze the intercostal nerves at a controlled low temperature to cause a temporary nerve block for 2 months
- Rib fracture healing time : 2 months





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SSRF-Cryotherapy: Emergent Evidence

Surgical stabilization of rib fractures combined with intercostal nerve cryoablation proves to be more cost effective by reducing hospital length of stay and narcotics

Variable	SSRF Only(n = 92)	SSRF plus INCA(n = 44)	Mann-Whitney U	P
Total HLOS (days) median, (IQR)	10(8 – 13)	9(7 – 11)	1517.5	0.018
Postoperative HLOS (days) median, (IQR)	6(4 – 8)	4(2 – 5.75)	1217.5	<0.001
HC Day of SSRF ($), median, (IQR)	71,143(52,401 – 86,611)	93,932(79,384 – 114,292)	1106	<0.001
Total HC ($), median, (IQR)	143,196(109,183 – 212,318)	153,908 (118,820 – 213,823)	1951	0.734
Postoperative HC ($), median, (IQR)	20,269(10,445 – 43,430)	10,556(4,481 – 23,026)	1327	0.001
Narcotic Requirements (MME), median, (IQR)	113.65(67.5 – 254.6)	88.55(33.5 – 125.49)	1544.5	0.026

HLOS = Hospital length of stay; IQR = Interquartile range; HC = Hospital charges; MME = Morphine milliequivalents. Note: any p-value bolded is statistically significant.

Injury Volume 52,Issue 5, May 2021, Pages 1128-1132

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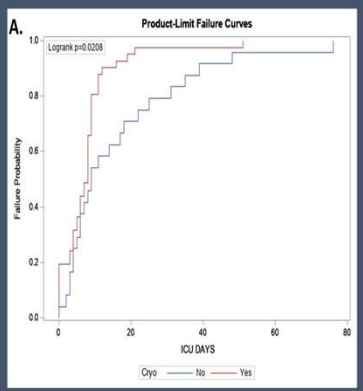
SSRF-Cryotherapy: Emergent Evidence



	No Cryotherapy (n = 24)	Cryotherapy (n = 44)	NNT	p
Intubation At Any Time				
No	9 (37.50%)	34 (77.27%)	3	0.0012
Yes	15 (62.50%)	10 (22.73%)		
Vent Days	10 [2-18]	8 [3-13]	-	0.6967
ISS				
≤14	4 (26.67%)	2 (20.00%)	-	-
15-24	6 (40.00%)	5 (50.00%)	-	-
≥25	5 (33.33%)	3 (30.00%)	-	-
Trach	6 (25.00%)	2 (4.55%)	5	0.0194
PNEUMONIA	8 (33.33%)	7 (15.91%)	6	0.0977
Pain Score Avg	2.96 (±2.17)	3.36 (±1.86)	-	0.4247
MME average day	113.74 (±238.29)	57.37 (±73.42)	-	0.0128
Disposition-Home	13 (54.17%)	36 (81.82%)	4	0.0152

Intercostal cryotherapy for the management of rib fractures. Unpublished data

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Take Home Messages: SSRF Non Flail Chest

- SSRF should be done for non flail chest patients with severely displaced fractures
- SSRF should be offered as valid option for patients with non severely displaced rib fractures if persistent pain or pulmonary dyfunction
- Cryotherapy of intercostal nerves is an important adjunct for the management of rib fracture pain

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