



**2022 CWISummit
Scientific Session - Friday**

Moderator: Scott C. Gardner, MMSc, PA-C
Recorder: Nir Hus, MD, PhD, FACS

Title:

Educational assessment on rib plating: Learning curves of intrathoracic and extrathoracic SSRF for trainees

Presenting author:

Madelyn Frank, BA
University of California Irvine, Medical Student
Name one item still on your bucket list. Grand Canyon

Discussant:

Cecilia Benz, MD
University of Texas Medical Branch
Name one item still on your bucket list. Taking a cooking class in Italy

Authors:

- Erika Tay-Lasso, MD
- Colin Kincaid, BS
- Brynn Sargent, BS
- Gabrielle Hovis, BS
- Leonardo Alaniz, BA
- William Grant III, BS
- Sebastian D. Schubl, MD, FACS

Background: Surgical stabilization of rib fractures (SSRF) is a procedure adopted by many institutions based on evidence of pain reduction, lower mortality, and faster recovery. Intrathoracic SSRF is a new and promising minimally invasive approach compared to the traditional extrathoracic plating method. Educational assessment can be done through descriptive analysis of learning curves with operation time used as a proxy measurement for learning. The objective of this study is to assess the learning curve of introducing intrathoracic method of plating at a large academic medical institution.

Methods: Intrathoracic surgical stabilization of rib fractures was introduced at University of California, Irvine in March of 2019. All patients that received SSRF after 2017 were gathered from the rib fracture database. Data was collected from EPIC charts. Operation time was determined from time of incision to time of close. Time per fracture and time per plate were calculated using total operation time. Patients with AIS score of the head, abdomen, extremity, or face greater than three were excluded from this analysis. Charts were made using Excel software to determine the presence of learning curves.

Results: After exclusions, there were 63 patients with extrathoracic SSRF between Nov. 2017- Sept. 2021 and 38 patients with intrathoracic plating between March 2019- Sept. 2021. There were 5 fellows and 6 residents that performed more than three extrathoracic SSRF procedures. Four fellows and 2 residents performed more than three intrathoracic SSRF procedures. Graphs of time per fracture and time per plate chronologically did not produce learning curves for extrathoracic or



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Title:

Evolution of pulmonary contusions in patients with severe rib fractures: cause for concern?

Presenting author:

Suzanne F.M. van Wijck, MD

Erasmus MC

What is a current trend that you just don't understand? Viral videos on tiktok from those guys with face tattoos

Discussant:

Jonathan Nguyen, MD

Authors:

- Suzanne F.M. Van Wijck, MD
- Elizabeth F. Smith, MSPH
- Nicole L. Werner, MD, MS, FACS
- Kelley Madden, MBA
- Ernest E. Moore, MD, FACS
- K. Barry Platnick, MD, FACS
- Mathieu M.E. Wijffels, MD, PhD
- Fredric M. Pieracci, MD, MPH, FACS

Background: Pulmonary contusions are reported in 10-20% of major thoracic trauma patients, often concurrently with rib fractures. Pulmonary contusions are generally measured only at admission. The evolution of a pulmonary contusion is unknown; therefore, the purpose of this study was to measure the radiographical change in pulmonary contusions over time. We hypothesized that pulmonary contusions frequently worsen radiographically within the first week after injury.

Methods: This retrospective cohort study included adults admitted with ≥ 3 displaced acute rib fractures or flail segment on chest CT between 2010 and 2021 at a single institution. Patients were included for analyses when they had an additional chest CT scan during the first month after injury. Presence and severity of pulmonary contusions were assessed on chest CTs using the Blunt Pulmonary Contusion Score (BPC18). Clinical data were retrieved from patient's medical records. Nonparametric statistics were used for non-normally distributed data. Paired analyses were conducted with Friedman and Wilcoxon Signed Rank tests.

Results: In total 231 patients were identified of whom 88 (38%) had a repeat CT scan at a median 124 hours from the initial CT (P25-P75 69-237). Of these, 87 (99%) had some degree of pulmonary contusion on the first CT scan with a median BPC18 of 5 (P25-P75 3-7). The mean age was 53 (SD 16.7) years and 70% were male. The median number of rib fractures per patient was 14 (P25-P75 9-18), and 62 patients (71%) had a flail segment, which was higher than in patients without repeat CT (median 11 rib fractures, $p < 0.001$ and 51% flail chest, $p = 0.004$). Repeat CT scans demonstrated worsening BPC18 score in 24 (27%) patients with a median 1.5 points increase, stable contusion in 8 (9.1%) patients, and improved contusion in 56 (64%) patients with median 2.0 points BPC18 decrease. Shorter time between injury and the repeat CT was the strongest predictor for increasing



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Title:

Impact of Sternal Fixation on Patient Outcomes: A Propensity Matched Review

Presenting author:

Sydney Todd, BS

University of Nebraska Medical Center, Medical Student

If you were a baseball player, what would be your walk-up introduction song? Thunderstruck by AC/DC

Discussant:

Graciela Bauza, MD, FACS

Assistant Professor of Surgery, UPMC

Name one item still on your bucket list. Live on the beach

Authors:

- Zachary M. Bauman, DO, MHA, FACOS, FACS
- Sydney Todd, BS
- Ashley Raposo-Hadley, MS
- Jana Binkley, MD
- Tylor King, BS
- Kevin Cahoy, BS
- Andrew Kamien, MD
- Samuel Cemaj, MD, FACS
- Bennett Berning, MD
- Charity H. Evans, MD, FACS
- Emily Cantrell, MD, FACS

Background: Sternal fractures are debilitating injuries often resulting in severe pain, respiratory compromise and need for opioid pain medications. Surgical fixation of sternal fractures has been gaining popularity as a treatment modality for sternal fractures. Unfortunately, a paucity of literature exists on this topic. The objective of this study was to further examine the benefits of sternal fixation, hypothesizing sternal fixation results in improved pain, improved respiratory function, and decreased opioid use.

Methods: This was an Institutional Review Board approved retrospective comparison of patients with sternal fractures who underwent non-operative management (NOM) versus operative sternal fixation (SF). Propensity score matching was used to construct an artificial control group matched on age and Injury Severity Score (ISS) using a 1:1 ratio of treatment to control. Only patients \geq 18 years of age were included in the study. Given the outcomes of interest, ventilator dependent patients or those suffering inpatient mortality were excluded prior to the matching process. Outcomes of interest included mean pain score, total opioid requirements (in morphine milliequivalents (MME)) within 24 hours of discharge, ICU and hospital length of stay (LOS), and incentive spirometry (IS) percent predicted value at discharge. Dependent variables were analyzed utilizing t-test for dependent samples and ISS was analyzed utilizing the sign test for dependent samples. Statistical significance was set at $p < 0.05$.



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Title:

Lucky Number Thirteen: Association Between Incidence of Chest Wall Stabilization per Hospital and Patient Outcome

Presenting author:

Anastasia Tillman, BA
Alpert Medical School at Brown University, Medical Student
Imagine you can instantly learn any language. Which would you choose? Arabic

Discussant:

Jason Miner, MD, MAJ USAF
Wright State University, Assistant Professor
If you were a baseball player, what would be your walk-up introduction song? Wild Thing ala Vince Vaughn

Authors:

- Thomas J. Martin
- Tareq S. Kheirbek, MD, ScM, FACS
- Andrew H. Stephen, MD, FACS

Background: Chest wall stabilization (CWS) has been shown to improve outcome of patients with acute chest wall injury. However, the difference in outcomes due to variations in rate of CWS performed at different hospitals has yet to be examined. We hypothesized that hospitals with higher rates of CWS are associated with improved outcomes of patients undergoing CWS.

Methods: We analyzed Trauma Quality Improvement Program 2019 dataset to identify patients with acute chest wall injury who underwent CWS, excluding those who died within 24 hours from presentation and patients with each body region AIS of 6. Hospitals were divided per number of CWS procedures into quartiles. We compared patient's demographics, comorbidities, and hospital complications among the groups. Our primary outcome was a composite of mortality, ventilator associated pneumonia (VAP), respiratory failure, sepsis, unplanned intubation, and unplanned return to the ICU. Logistic regression optimal-cut point was used to determine number of chest wall stabilizations needed to develop a negative outcome. We then compared centers that performed above the cut-point (HIGH) versus those that performed below the cut-point (LOW). Significance was set at $\alpha=0.05$.

Results: We identified 3,207 patients who underwent chest wall stabilization at 430 hospitals. Number of procedures performed per hospital ranged from 1 to 66 a year. There were no differences between the groups in age, gender, injury severity (ISS). Patients in the fourth quartile (Q4) had significantly lower rate of the composite outcome compared to the other groups (14% in Q4, 18.4% in Q3, 17.4% in Q2, and 22.1% in Q1 – $p=0.001$). They also had shorter hospital ($p<0.001$) and ICU ($p<0.001$) lengths of stay. Adjusted for ISS, age, gender, flail chest, chest AIS, and pre-injury dependent status, patients in Q4 had lower odds of the composite outcome compared to Q1 (OR:



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Title:

Redefining the Costal Margin

Presenting author:

Mujahed Laswi, MD

MUSC, Surgical Critical Care Fellow

What is a current trend that you just don't understand? Tik Tok

Discussant:

Michel Wagner, MD, FACS

What is a current trend that you just don't understand? I plead the 5th

Authors:

- Richard N. Lesperance, MD, FACS
- Adam J. Kaye, MD, MHA, FACS
- Zachary M. Bauman, DO, MHA, FACOS, FACS
- Adam Hansen, MD
- Steven Kubalak, PhD
- Evert A. Eriksson, MD, FCCM, FCCP

Background: Classical teaching of rib anatomy contends that the 7,8,9, and 10th ribs join the rib above and form the costal margin of the chest. Slipped rib syndrome has been identified as a symptomatic impingement of the lower rib subluxation into the thorax and rubbing on the intercostal nerve of the rib above. We sought to determine the incidence of this finding and characterize the costal margin.

Methods: Cadavers were evaluated, and the mobility and attachments of the 9th and 10th ribs were assessed. Experienced anatomists and chest wall surgeons from 5 trauma centers developed and conducted a standardized dissection and assessed rib tip mobility using predefined criteria. Videos of dissections were submitted to a single investigator who reviewed the findings to remove inter-observer variability. Data was collected in Excel and statistics determined with SPSS.

Results: 40 cadavers (45% male) were evaluated bilaterally. The average age, height, and weight was 83+/-11 years, 66+/-4 inches, and 150+/-50 pounds. The 9th rib was found to be attached to the 8th rib 100% of the time usually by a costochondral cartilaginous attachment along the body of the 8th and 9th ribs. Subluxation into the chest was noted in 19%(15/80) and the tip of the rib was mobile in 79%(63/80) evaluations. The 10th rib was attached to the 9th rib in 18%(14/80). A "floating" 10th rib was noted in 59%(47/80) of specimens. Subluxation was noted in 33% (26/60). Half of the ribs that had subluxation noted moved medially (13/26) to the 9th rib and half went external (13/26). An upwardly pointed "hook" tip was noted in 10%(8/80). Ribs with a "hook" tip had subluxation present in 63% (5/8) of the time and all of these the ribs (5/5) moved to the interior of the chest (p=0.020). There was not a significant difference in specimens with subluxation of the 10th rib with respect to side (right vs. left), gender, height, or weight (p>0.05)



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Title:

Surgical treatment of rib fractures - Are there any changes in the last 15 years?

Presenting author:

Stefan Schulz-Drost, MD, PhD, FEBS

Helios Hospital Schwerin, Head of Department

If you were a baseball player, what would be your walk-up introduction song? Thunderstruck by AC/DC

Discussant:

Greg Semon, DO, FACS, FACOS

Wright State University, Assistant Professor

Name one item still on your bucket list. I completed my bucket list goal of visiting every Disney Park around the world in 2019. My next goal is to visit every continent!

Authors:

- Taha Mouhriz, MD
- Sinan Bakir, MD
- Stefan Schulz-Drost, MD, PhD, FEBS

Background: Rib fractures are among the most common fractures in humans. In addition to high-speed accidents with multiple trauma, more and more low-energy accidents such as falls on the ground are gaining importance as a cause of accidents. The focus is on the aging population and the geriatric patient collective. In the meantime, more than half of all rib fractures are observed in people over the age of 70, while less than 10% of all fractures are observed under the age of 45. Most fractures are treated conservatively. In the past few years, however, the focus has once again been on surgical care, with some clear advantages in terms of patient outcome. This has been well proven in scientific studies, especially for the unstable thorax. Nevertheless, osteosynthesis is still not the standard therapy in Germany, mainly for historical reasons with numerous experiences of material failure. Many surgeons are very reluctant to do this. However, a large number of new implants meanwhile enable a safe surgical procedure, and structured treatment algorithms are being developed by medical societies.

Has there been a change in the reality of care in recent years? How often is an osteosynthesis performed and which patient groups does it mostly affect?

Methods: In a comprehensive analysis of German routine data from 2005-2018, all inpatient cases with rib fractures are examined for patient age, possible secondary diagnoses and procedures. Particular attention is paid to the surgical stabilization of the rib fractures. By means of descriptive statistics, frequencies and trends of the year numbers are evaluated and displayed graphically.

Results: Of 765,228 cases in the included period, only 3195 (0.41%) were treated surgically, in the years 2005-2010 only 30 to 90 patients were treated surgically annually (<0.1% of cases). From 2011



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Title:

Three-Dimensional Mapping of Sternum Fractures from High-Energy Trauma

Presenting author:

Michael LaRoque, BSME

Regions Hospital, St. Paul, MN, Research Fellow

Name one item still on your bucket list. Attend a Stanley Cup Final Game (ideally in Minnesota)

Discussant:

Brian D. Kim, MD, FACS

Mayo Clinic, Trauma Medical Director

Imagine you can instantly learn any language. Which would you choose? Teenage slang

Authors:

- Peter A. Cole, MD, FAOA

Background: Sternum fractures are relatively uncommon injuries which generally occur as a result of a high energy mechanism to the chest wall, and are often associated with significant concomitant injuries. These injuries may result in decreased quality of life if not properly addressed, and yet are rarely operated on, stressing the importance of understanding sternum injury patterns. Fracture mapping analyses have previously been shown to have important clinical implications in various articular and long bone fractures. The purpose of this project is to evaluate high energy sternum fracture patterns using a previously published three-dimensional (3D) computed tomography (CT) reconstruction process to produce fracture frequency maps.

Methods: All patients aged 18-65 presenting to a level 1 trauma center with sternum fractures due to high-energy trauma between 2013 and 2021 were identified by ICD code. Patients were excluded from the study based on age, a history of sternum trauma, pathologic fracture, low energy mechanism, fragility fracture, or an absence of quality CT imaging. Electronic medical records were retrospectively reviewed for demographics, mechanism of injury, and associated injuries. Each patient's injury was assigned an AO/OTA classification using plain radiograph and chest CT scans. A 3D reconstruction and reduction was performed for each sternum using medical image processing software (Materialise NV, Leuven, Belgium). The reconstructions were subsequently overlaid onto a template sternum and normalized using bony landmarks. Fracture lines for each injured sternum were transferred onto the template, creating 3D frequency maps.

Results: A total of 50 patients met inclusion criteria. The study population had a mean age of 48.3 years and was 48.0% female. Among all patients, the most common mechanisms of injury were motor vehicle collision (62.0%), motorcycle collision (12.0%), pedestrian versus automobile (8.0%), and fall from height > 10 feet (8.0%). The breakdown of sternum fractures in the study population were isolated sternal body fractures (48.0%), isolated manubrium fractures (42.0%), and combined

