CASE REPORT

# Posterior chest wall reconstruction: A novel approach

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## ABSTRACT

Traditional access for open reduction internal fixation (ORIF) of posterior rib fractures occurs through either a posterior lateral thoracotomy or posterior paramedian approach. We report the case of severe blunt chest wall injury reconstruction using the novel implementation of an Opening Wedge Thoracostomy (OWT) approach. This approach is conventionally indicated for expansion thoracostomy in the surgical management of scoliosis. The OWT approach facilitates chest wall reconstruction vis-a-vis reflection of the trapezius and latissimus dorsi muscles providing excellent exposure of the posterior thoracic cage facilitating surgical reduction and fixation. Satisfactory stability of the posterior chest is not achievable using previously described approaches. OWT approach exposure for posterior thoracic reconstruction absents the surveyed literature.

**Key Words:** Chest wall reconstruction, Trauma, Rib fixation, Flail chest, Posterior approach

## 1. INTRODUCTION

Rib Fractures occur in at least 10% of all patients presenting to trauma centers with blunt trauma, with the trauma occurring most often secondary to motor vehicle accidents (MVA).[1,2] Morbidity and mortality correlate with the number of ribs fractured and the most drastic increase in morbidity and mortality occurs when 6 ribs or more ribs have been fractured.[1] Mortality has been specifically shown to increase by 19% for each additional rib fracture and the risk of pneumonia has been shown to increase by 27.6% for each additional rib fracture.[2] Operative fixation of rib fractures has developed from a desire to offset the associated morbidity and mortality. Posterior thoracic musculature has complicated posterior rib surgical fixation. Conventional approaches to posterior rib fractures consist of an intramedullary splinting technique that avoids the posterior thoracic musculature.[3] We describe a novel approach in which reflection of the trapezius and latissimus dorsi muscles permit exposure of the posterior thoracic cage facilitating operative reduction and fixation with surgical plating.

## 2. CASE REPORT

A 56-year-old male presented to the emergency department of our American College of Surgeons Verified Level II Trauma Center following a motor vehicle collision (MVC) as an ejected unrestrained driver. Vital signs on arrival demonstrated tachycardia (121 bpm), hypotension (90/51 mmHg), and tachypnea (26 breaths per minute). The patient responded to fluid resuscitation with normalization and stabilization of vital signs. He was alert and oriented to person, place, and time and complaining of chest and back pain exacerbated with movement and palpation. Paradoxical breathing was appreciated bilaterally. Subcutaneous emphysema grossly involved the neck with multiple abrasions involving

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the forehead and lower extremities. Computed tomography (CT) imaging revealed subarachnoid hemorrhage, intracranial contusion, left pneumothorax, bilateral flail chest, and closed fractures of the cervical spine, scapula. Flail segments involved 8 ribs on the right and 5 ribs on the left. Left chest tube thoracostomy was performed in standard fashion and the patient was placed on mechanical ventilation and admitted to the intensive care unit (ICU).

Three days following admission, the patient was taken to the Operating Room (OR) for bilateral anterior chest wall reconstruction with open reduction internal fixation (ORIF) of ribs using Zimmer Biomet RibFixBluTM(Warsaw, Indiana) thoracic fixation system. Exposure was afforded using vertical incisions bilaterally. Blunt dissection and Bovie electrosurgery were used to dissect through the subcutaneous tissues exposing the bony thoracic cage. Fractured and fractured dislocated ribs were identified, reduced and surgically stabilized. Calipers were used to measure screw size and plates were fashioned to the contour of the individual ribs. Flail segments required the use of more than one plate per rib. Several involved ribs of the left hemithorax were operatively discovered to have severely displaced fractures of a magnitude not clearly revealed with preoperative three-dimensional CT imaging. The operative return for posterior ORIF was decided.

The patient was placed prone on an open frame Jackson table for posterior chest wall reconstruction. The patient's left upper extremity was draped free to allow manipulation of the scapula during the approach. Paraspinous skin incision ideally exposed the involved rib fractures and facilitated spinous processes exposure. Surgical dissection laterally reflected the paraspinous, parascapular, trapezius and latissimus dorsi musculature off the spine in a similar manner to a routine posterior approach to the thoracic spine. Operative tissue reflection preserved the innervation of both the trapezius and latissimus dorsi muscles, as well as the parascapular musculature. The paraspinous musculature may be left intact if fracture fixation does not require exposure to the very most medial aspects of the ribs. The case reported herein required operative reflection of paraspinous muscles. At this point, dissection was taken deep into the scapula. Meticulous attention was afforded as dissection progressed anteriorly and proximally to avoid injuring the thoracodorsal nerve and structures of the axilla. Once exposure of the fractures was achieved, the fractures were debrided, reduced, and stabilized with RibFixBluTM plates. Right–angle drills and screwdrivers were required for screw placement deep to the scapula and for the extremes of both the anterior and lateral limits of the exposure. Following satisfactory rib fixation, attention was directed to the dorsal fascia investing the rhomboids, latissimus dorsi, and trapezius muscles. The dorsal fascia was sutured to the supraspinatus ligament and contralateral fascia using interrupted heavy, braided, non-absorbable #2 ETHIBOND EXCEL® (Ethicon, Inc., Cincinnati, OH) sutures. The dorsal fascia closure was also reinforced with a running 0 Vicryl (Ethicon, Inc., Cincinnati, OH) suture. Post-Operative X-rays are displayed in Figure 1.

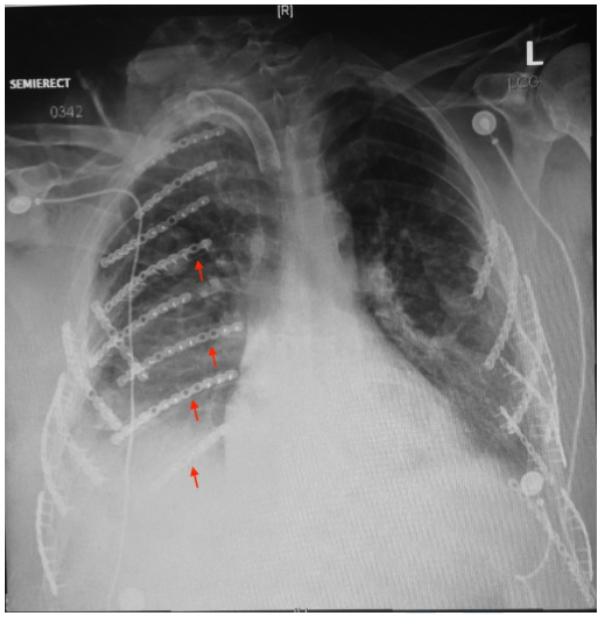


**Figure 1.** Post-operative x-rays

**Figure 2.** Operative repair


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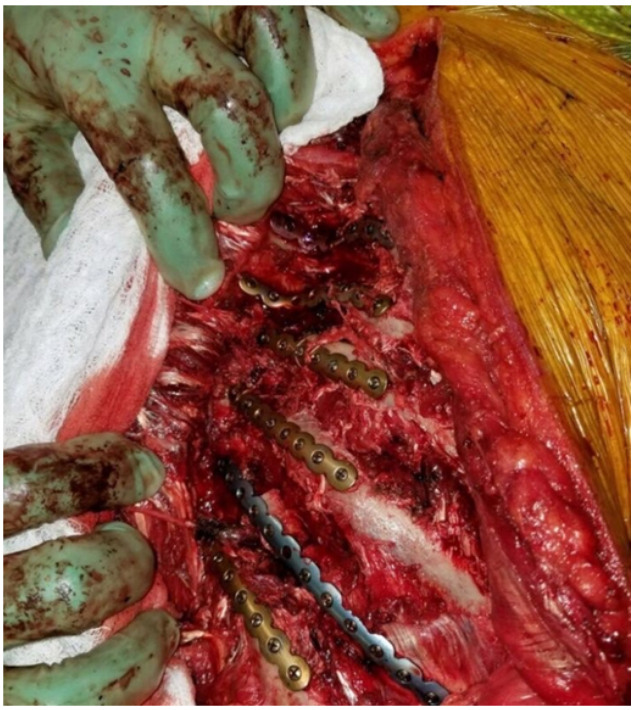

**Figure 3.** Chest wall reconstruction

The patient tolerated the procedure well and was admitted directly to the Surgical Intensive Care Unit (SICU). Recovery was complicated by the development of postoperative hospital-acquired pneumonia successfully treated with antibiotics. On postoperative day 7, the patient underwent percutaneous tracheostomy and percutaneous gastrostomy tube placement. The patient's condition improved throughout the hospital stay. He was transferred to the floor on postoperative day 29 and was liberated from mechanical ventilation on postoperative day 43. The patient was discharged to home on postoperative day 53 with close outpatient follow-up.

## 3. Discussion

The case described above is unique from two major perspectives. The first is that of morbidity and mortality. Holcomb et al. demonstrated that for age greater than 45 years with 4 or more ribs fractured leads to significantly higher morbidity measured by ventilator days, ICU days, and hospital days.[4] Flagel et al. reported that the risk of mortality associated with more than 6 rib fractures ranged from 15%-42%.[2] The patient in this case report falls into both of these high-risk categories being 56 years old and having sustained a total of 13 fractured ribs (see Figure 1). Operative repair of traumatic flail chest is not practiced widely despite evidence demonstrating reduced Ventilator Length of Stay (VLOS) and Intensive Care Unit Length Of Stay (ICU-LOS) compared to non-operative management.[5,6] Escalating bilateral flail chest analgesia for the patient in this report lead to the decision to perform operative chest wall reconstruction in the subject patient to avoid attendant analgesic iatrogenic. The patient's mentality clarity and physiologically insignificant pulmonary contusions support operative intervention. Traumatic thoracic chest wall reconstruction using an OWT approach for surgical fixation of posterior rib fractures is first described herein. While the OWT approach is generally indicated for surgical management of scoliosis with a Vertical Expandable Prosthetic Titanium Rib (VEPTR), preoperative planning lead to the conclusion that this technique afforded optimal exposure for ideal posterior thoracic reconstruction. The exposure afforded by an OWT approach afforded extracortical plating rather than intramedullary splinting of displaced posterior rib fractures. Extracortical plating provided superior fracture stabilization compared to intramedullary rib splinting as intramedullary splinting has been shown to fail in vitro and in vivo secondary to cortical bone perforation and fracture line instability.[7] Extracortical rib plating provides proximal and distal fixation not afforded by intramedullary splinting. OWT approach may serve as a viable option for external posterior rib fixation in future chest wall reconstruction. This case report highlights the OWT approach as an alternative to posterior chest wall reconstruction for severe thoracic trauma that provides improved exposure for extracortical plating with attendant greater stability over intramedullary techniques.

## Conflicts of Interest Disclosure

The authors declare they have no conflicts of interest.

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