

RibLoc® U+
Chest Wall Plating System
Muscle-Sparing and Subscapular Rib Fracture Repair

Surgical Technique



Muscle-Sparing and Subscapular Rib Fracture Repair

Planning, Positioning, and Surgical Approach

Timothy Pohlman, MD
IU Health Methodist Hospital, IN

R. Lawrence Reed, MD
IU Health Methodist Hospital, IN

John Seccombe, MD
St. Vincent Hospital, WI

John C. Mayberry, MD
St. Alphonsus Health Systems, ID

Bruce Ham, MD
Oregon Health & Science University

Operative repair of rib fractures is beneficial and cost effective, reducing pain and disability and restoring pulmonary function.^{1,2,3} Muscle-sparing exposure is advocated in any rib fracture repair. Addressing subscapular fractures may not be necessary in all cases,⁴ but when deemed beneficial, it can be technically challenging and requires a planned approach.

Keys for Success

Preoperative Planning

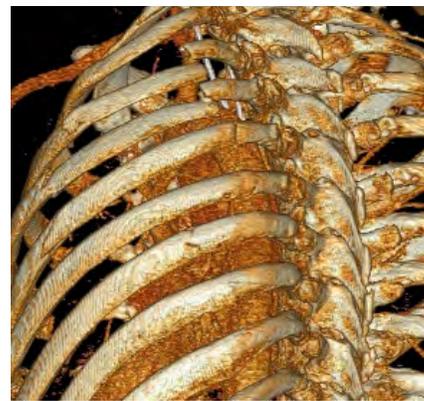
- ▶ 3D CT imaging to identify fracture locations and to plan approach
- ▶ Patient-specific risk-benefit analysis to determine if fractures should be addressed and which to target
- ▶ Optimal patient positioning to access fractures: lateral or prone
- ▶ Arm prepped into sterile field to aid in scapula manipulation
- ▶ Table-mounted retraction system (worth the set-up time)

Surgical Exposure

- ▶ Muscle-sparing primary incision to address majority of displaced fractures
- ▶ Identification of muscles to preserve, divide, and split
- ▶ Preservation of scapula muscles for shoulder function
- ▶ Anterolateral counterincision at scapular border for plate tunneling
- ▶ Use of palpation to ensure proper plate contour and fracture reduction
- ▶ Protection of long thoracic nerve if creating counterincision

Closure and Postoperative Care

- ▶ Meticulous repair of any partial division of the rhomboid, if made
- ▶ Standard post-thoracotomy care at the discretion of surgeon
- ▶ Physical therapy of the shoulder may be important to maximize return to function for some patients.



PRE-OP: 3D CT reconstruction showing displaced subscapular fractures

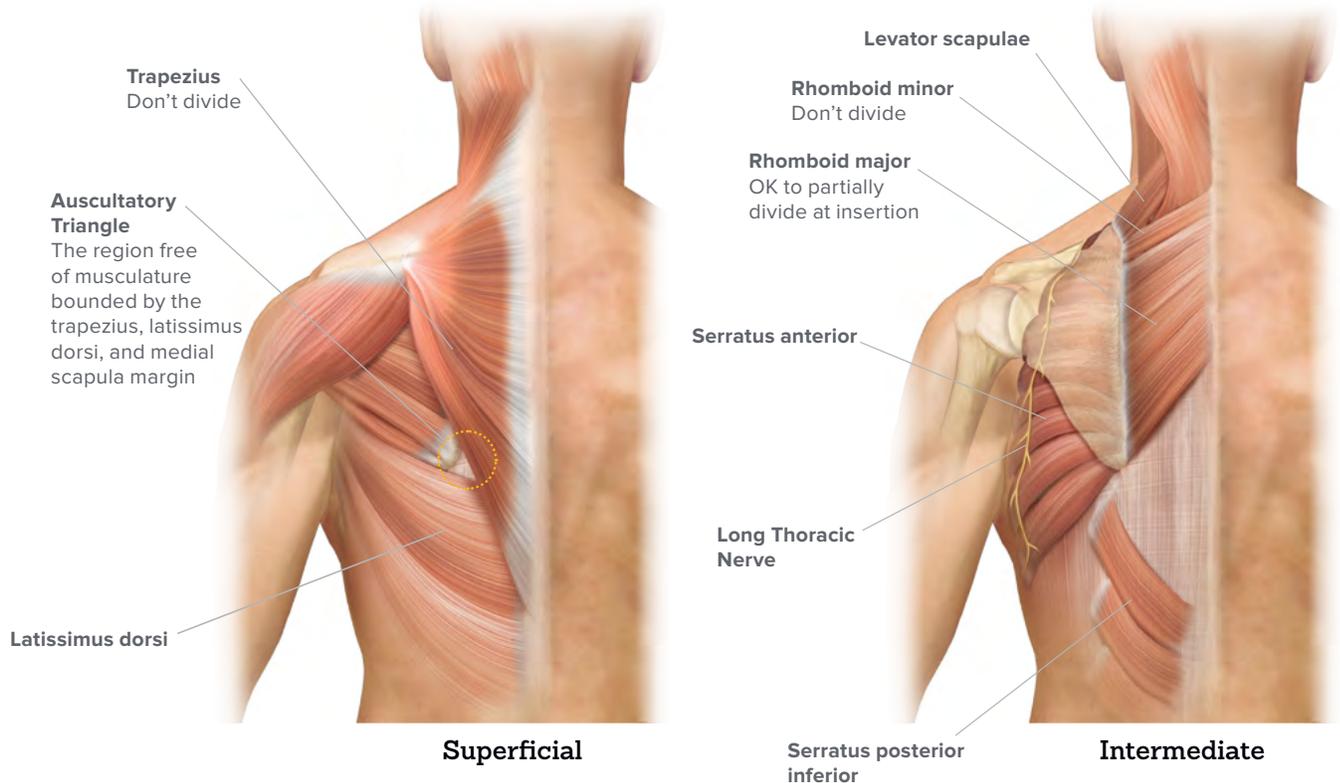


POST-OP: Repaired subscapular fractures

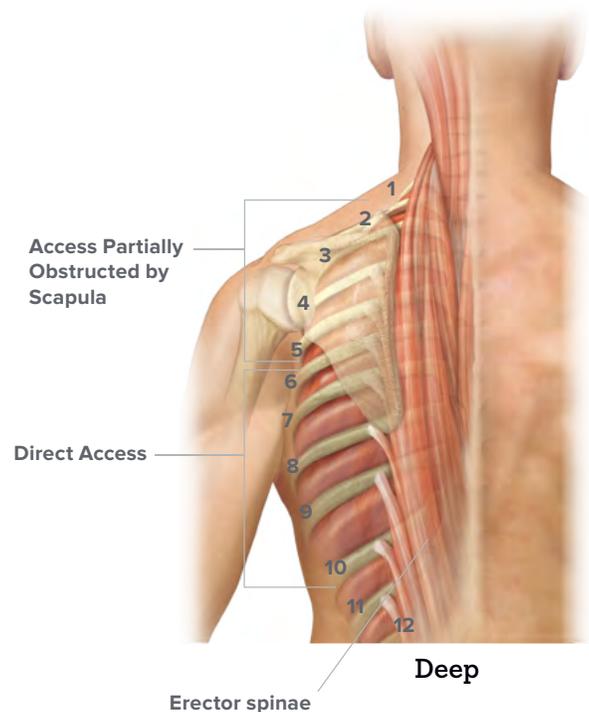
This monograph describes a surgical technique developed in collaboration with the identified surgeons for the operative repair of subscapular rib fractures using the RibLoc U Plus System. It is intended for support and educational purposes and is not to be used in any other capacity. All questions regarding surgical implantation of the product should be directed to a licensed medical professional familiar with Acute Innovations products. Please consult the product Instructions for Use for more detailed information.

Relevant Anatomy

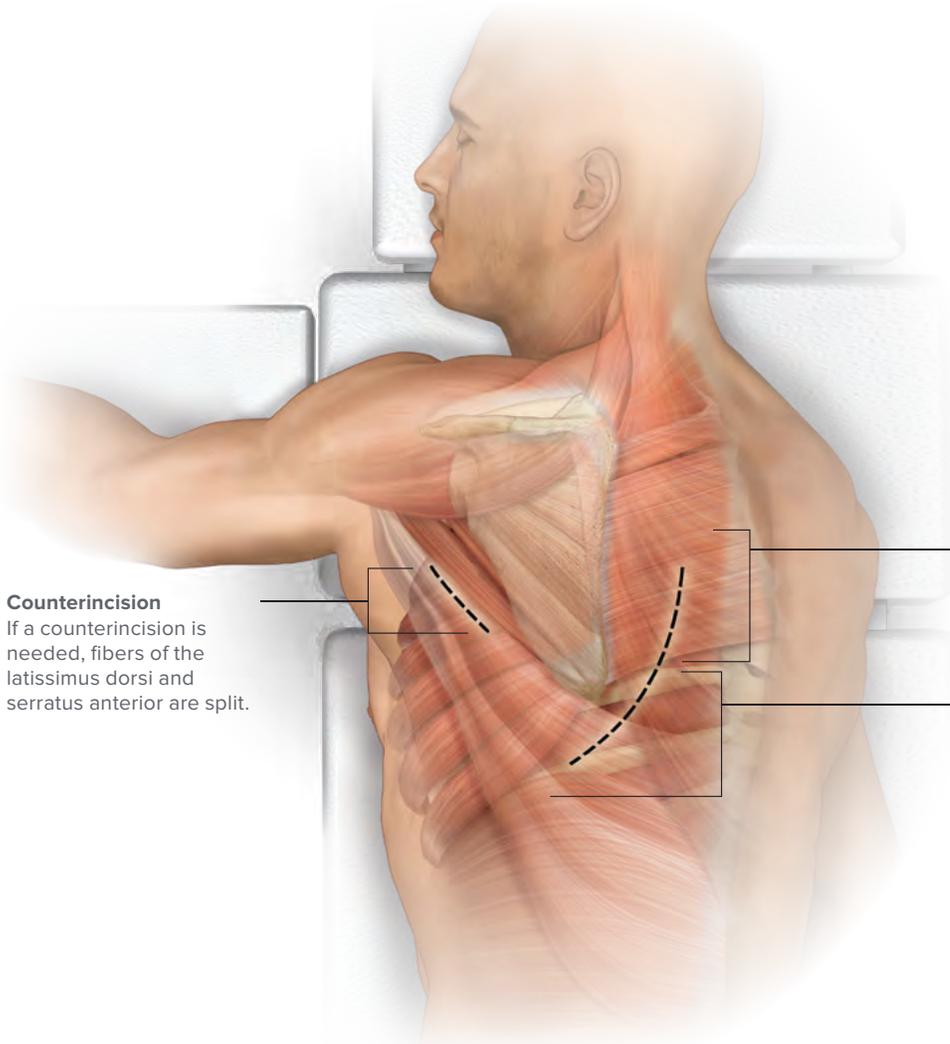
The following anatomy is relevant when addressing rib fractures, regardless of patient positioning or approach. Muscle-sparing approaches, such as muscle splitting in the direction of the fibers, should be used whenever possible. The auscultatory triangle facilitates relatively easy access to the chest wall at the level of the 7th rib.



3D CT reconstruction imaging should be used to determine fracture locations and plan the approach. The position of the arm at the time of imaging is noted to aid in fracture location relative to the scapula during surgery. Imaging taken from all three planes may be used if 3D imaging is unavailable.



Patient Positioning and Surgical Approach



Counterincision
If a counterincision is needed, fibers of the latissimus dorsi and serratus anterior are split.

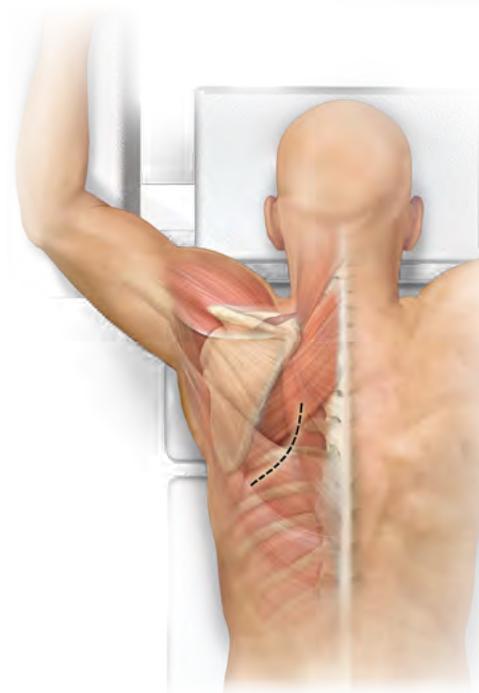
Lateral Decubitus
The lateral decubitus position is the most common for addressing rib fractures and provides excellent access to lateral, posterior, anterolateral, and subscapular fractures.

Skin incisions may be adjusted in length and location as necessary for a muscle-sparing approach.

Ribs 3-5
Access to posterior and subscapular fractures

Ribs 6-10
Access to posterior, lateral, and anterolateral fractures

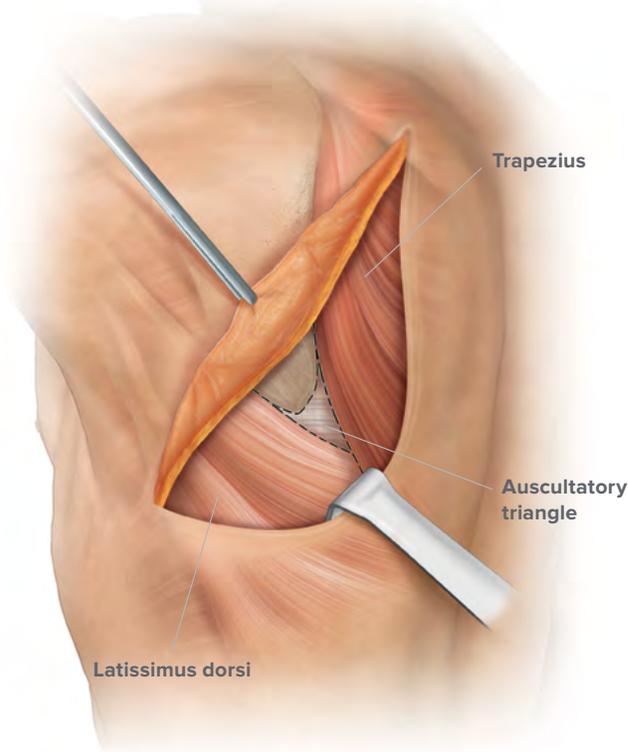
Scapula Manipulation
With any approach, the scapula can be manipulated to facilitate exposure by moving the arm and shoulder. The arm may be prepped into the sterile field or repositioned under the drape.



Posterior Approach
The prone position provides excellent direct access to posterior and posterolateral fractures of ribs 3-10.⁵
The scapula is manipulated to allow access through abduction of the shoulder or by hanging **the arm off the table.**
It should be noted that placement of the chest tube is challenging in the prone position.



Muscle-Sparing Surgical Approach

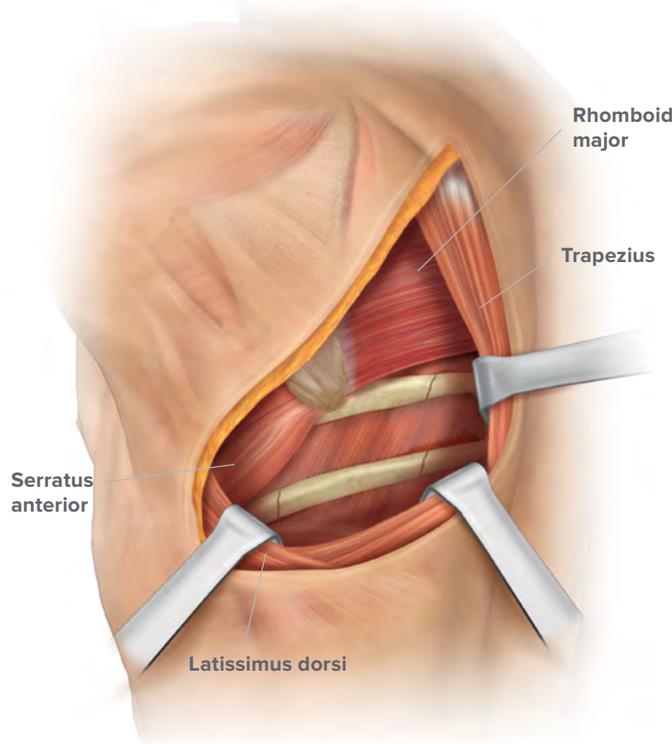


Primary Incision

With fracture locations identified and the patient in the lateral decubitus position, a muscle-sparing modified thoracotomy incision is made over the auscultatory triangle.

Subcutaneous flaps are developed and the outline of the auscultatory triangle is visualized.

Note: Incision shown allows access to subscapular and inferior rib fractures. Size and location can be adjusted based on fracture location.



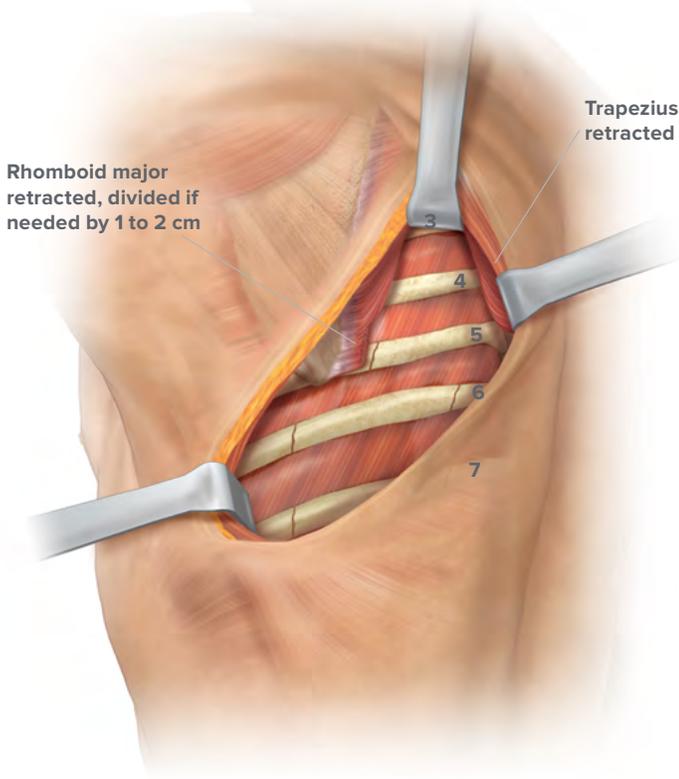
Access to Inferior Ribs

The triangle of fascia between the trapezius and latissimus is raised, exposing the serratus and the rhomboid muscles deeply. The latissimus is freed from the underlying serratus. Similarly, the trapezius is freed from the underlying rhomboids. Much of this dissection can be performed bluntly.

Care is taken not to damage the neurovascular supply to the serratus, which lies on the superficial surface of the muscle.

Access to the ribs can now be obtained by widening the opening provided by the auscultatory triangle. Ribs that are inferolateral to the incision can be exposed if necessary by muscle splitting through the latissimus and the serratus. Superiorly, the scapula and the serratus anterior muscle can be elevated off the rib cage to expose the ribs and to enable palpation of the subscapular fractures.

Muscle-Sparing Surgical Approach [continued]

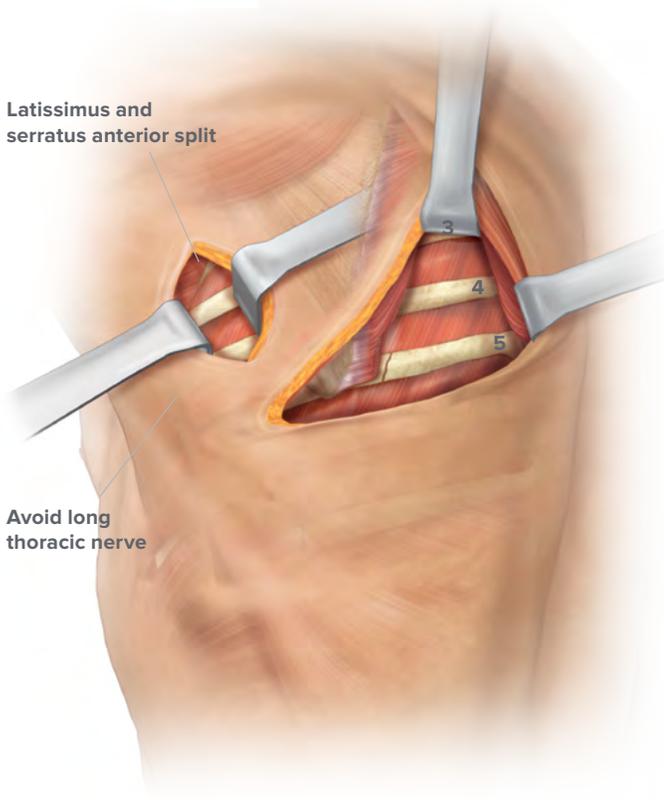


Access to Superior Ribs

To gain access to higher rib levels (3–5), the trapezius is elevated. The underlying rhomboid major is then retracted. Identifying the muscle plane between the trapezius and rhomboid can sometimes be challenging; the rhomboid typically appears shinier and darker red than the trapezius.

By releasing of the fascia and using a retract-wait-retract method, the muscles are allowed to stretch, facilitating exposure without division. If necessary, the rhomboid major may be partially divided near its insertion at the posterior scapula border by 1 to 2 cm.

It is now possible to gain access to the posterior aspects of ribs 3–5. With patient arm manipulation and scapula retraction, direct access to posterolateral fractures is also obtained.



Counterincision

To address fractures directly deep to the scapula, an anterolateral counterincision is created. Using a muscle-sparing technique, the latissimus and underlying serratus are split directly over the location where the end of the plate will be placed.

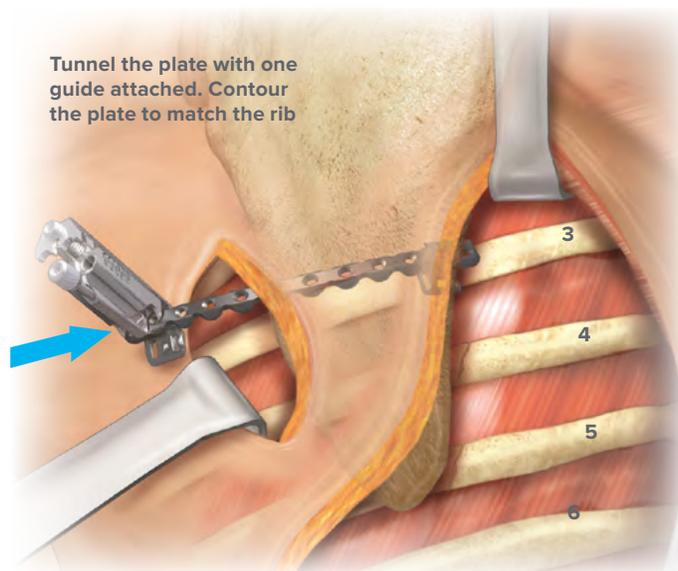
Caution should be taken to identify and avoid damage to the long thoracic nerve, which can lead to loss of shoulder function.⁶

It is now possible to tunnel from the counterincision to the primary incision, working deep to the scapula between the serratus anterior and the rib cage.

A table-mounted retraction system (e.g., Y, ring, spinal, Bookwalter, Rultract) can greatly facilitate access and is typically worth the time required to set up.



Stabilizing Subscapular Rib Fractures



Tunnel the plate with one guide attached. Contour the plate to match the rib

Note: Please reference the RibLoc U Plus installation technique for complete instructions on all installation steps including attaching the Primary Guides, use of the plate benders, compression of the U-clips, and screw installation.

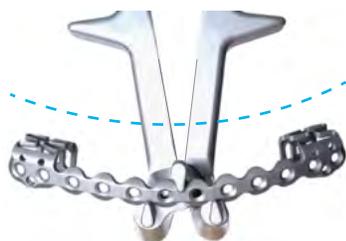
Plate Tunneling

A plate long enough to span beneath the scapula is selected; 115 mm is typically appropriate.

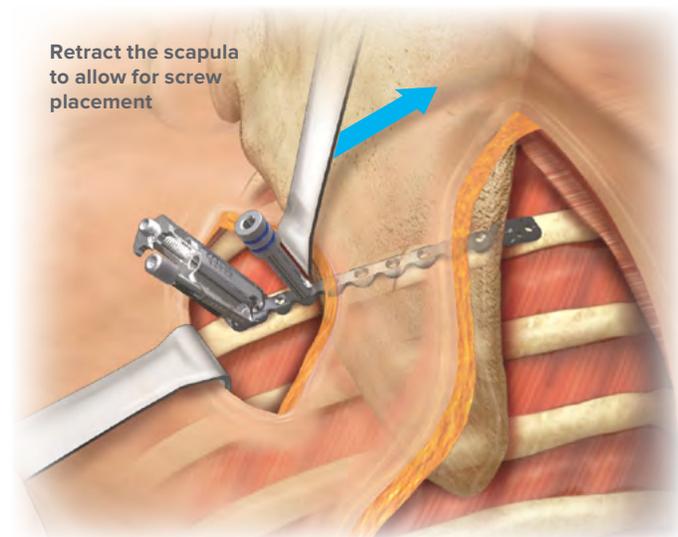
While elevating the scapula to create working space, the plate, with one Primary Guide attached, is tunneled through the counterincision towards the primary incision. A chest tube passer can be introduced through the primary incision to help pull the plate into place. Care should be taken to protect the U-clip from deformation.

The plate is fit over the fractured rib, dividing the intercostal muscles only at the location of the U-clips and leaving the periosteum intact.

Using visualization and palpation, the contour and tracking of the plate is assessed. It is removed and reinstalled as necessary to adjust the contour using the custom bending tools. A bending template can be helpful, and, in some cases, the contour may be adjusted in situ. Achieving proper contour and placement will be the most challenging and time-consuming step, but also one of the most important for an accurate installation.



Tip: To match the in-plane contour of the third rib, a 115 mm plate requires about two bends of "smile" using the Hand Bender as shown.



Retract the scapula to allow for screw placement

Securing the First U-clip (Counterincision)

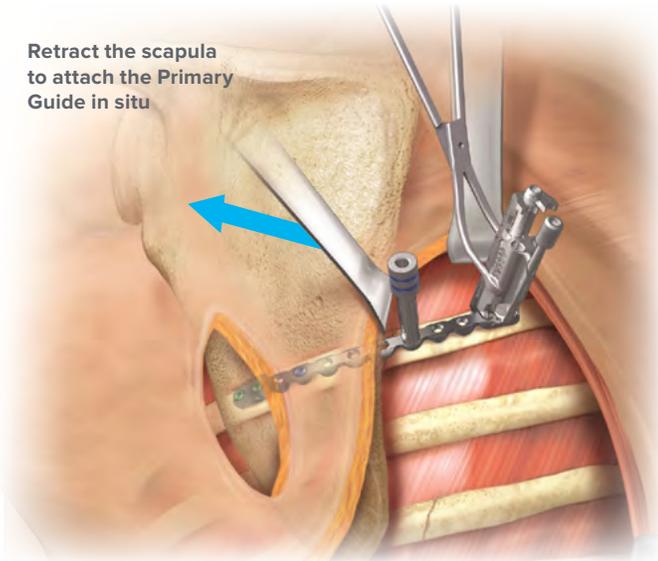
The scapula is retracted posteriorly, allowing access through the counterincision. Manipulation of the arm will also aid in scapula movement.

Following typical installation, the U-clip is compressed to fit the rib and screws are installed. Intermediate screws can now be placed as well, typically within 2 cm of the fracture.

A nasal speculum can be helpful for tissue retraction when working through a counterincision.



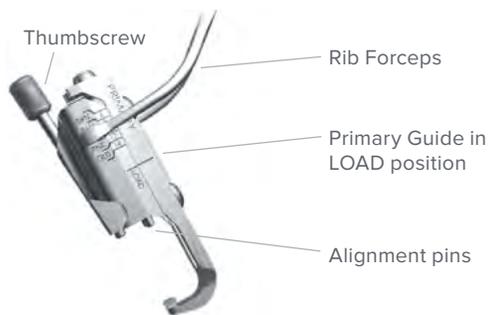
Stabilizing Subscapular Rib Fractures [continued]



Securing the Second U-clip (Primary Incision)

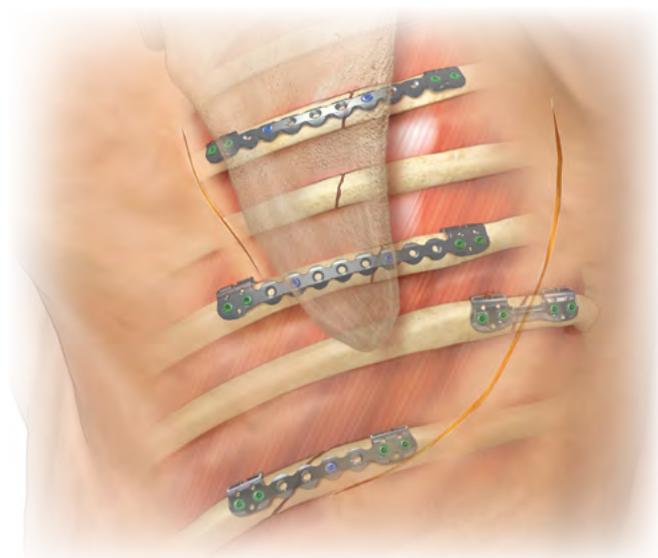
By dropping the arm and using retraction to full advantage, the scapula is shifted laterally. The Primary Guide is attached to the U-clip in situ through the primary incision.

With one U-clip secured, the free end of the plate is used to provide traction and aid in fracture reduction. Approximation of the fracture is ensured by palpation before securing the second U-clip. Again, intermediate screws may typically be placed within 2 cm of the fracture.



Attaching the Primary Guide In Situ

1. Ensure the Primary Guide is in the LOAD position.
2. Use the Rib Forceps to grasp and introduce the guide.
3. Feel for the engagement of the alignment pins into the holes on the front of the U-clip.
4. Tighten the thumbscrew fully.
5. Compress the guide to the 14 mm marking.



Stabilizing Additional Fractures

Additional subscapular fractures may be plated by shifting the counterincision and following the same procedure. It may be unnecessary to plate all fractures, but enough stability is needed to support and restore the thoracic contour.⁴ Plating all fractures to maximize pain control and thoracic volume is also advocated.⁷

Closure

Meticulous repair of any partial division of the rhomboid, if made, is done with suture. The fascia of the auscultatory triangle is sutured to the latissimus and trapezius to maintain their anatomical positions. A chest tube is installed away from the plates.

Postoperative Care

Physical Therapy

Shoulder strengthening and range of motion exercises following rib fracture repair can be initiated at the discretion of the surgeon and may be an important element of a rapid return to function. Physical therapy may not be necessary in all cases. However, it is often overlooked, even for patients who might benefit the most.

References

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Acumed Headquarters
5885 NE Cornelius Pass Road
Hillsboro, OR 97124
Office: +1.888.627.9957
Office: +1.503.627.9957
Fax: +1.503.520.9618
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