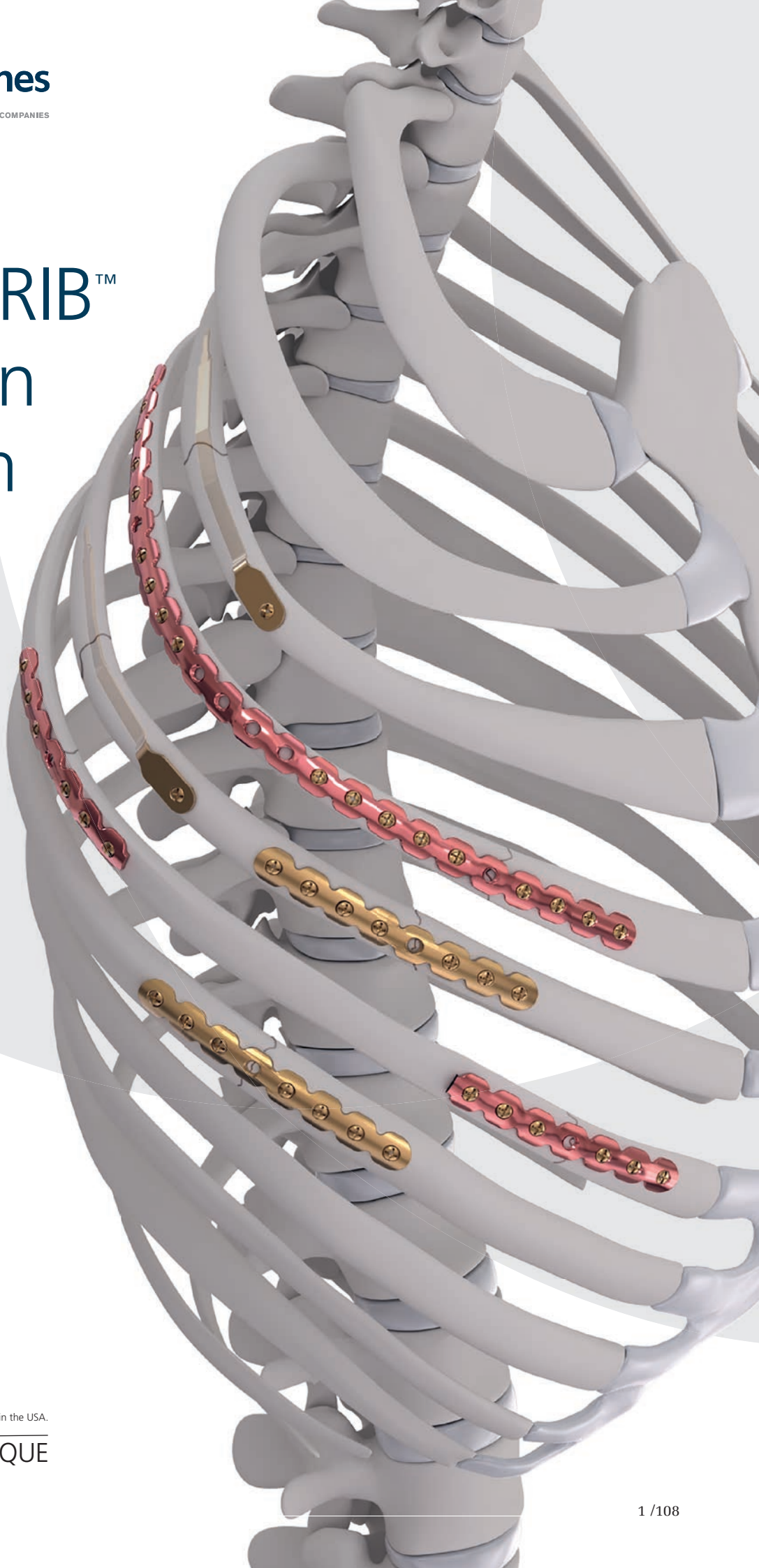
DePuy Synthes

PART OF THE Johnson & Johnson FAMILY OF COMPANIES

MatrixRIB™ Fixation System



This publication is not intended for distribution in the USA.

SURGICAL TECHNIQUE

This description alone does not provide sufficient background for direct use of DePuy Synthes products. Instruction by a surgeon experienced in handling these products is highly recommended.

Processing, Reprocessing, Care and Maintenance
For general guidelines, function control and dismantling of multi-part instruments, as well as processing guidelines for implants, please contact your local sales representative or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance
For general information about reprocessing, care and maintenance of Synthes reusable devices, instrument trays and cases, as well as processing of Synthes non-sterile implants, please consult the Important Information leaflet (SE_023827) or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance

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Introduction

Background

Rib fractures

Rib fractures are common in blunt chest wall trauma. Although fractured ribs usually heal on their own without specific treatment, a subset of patients have fractures that produce overlaying bone fragments that may produce severe pain, respiratory compromise, and chest wall deformity.

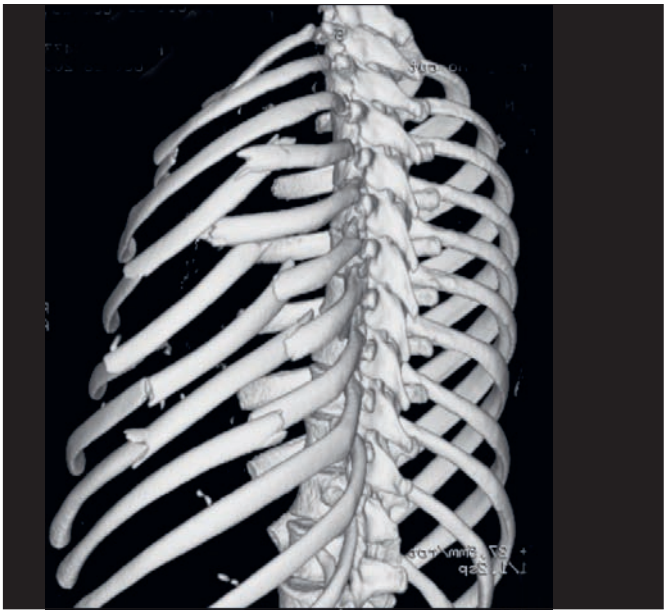
Most of the fractured ribs are treated with conservative nonoperative care. These include aggressive pain management (epidural analgesia, rib oral analgesics and/or bracing techniques), and ventilation and tracheotomy[1] until fibrous stabilization is achieved. These treatment methods have been shown to have good results in respect to restoration of the damaged chest wall, but have higher chest infection and mortality rates compared to surgical treatment.[2,3]

More severe chest wall trauma is a major cause of morbidity and mortality, especially in the presence of a flail chest where paradoxical inward movement of the flail segment in inspiration is found. Patients with flail chest often require aggressive pain control, ventilation, and prolonged ICU stay.[1]

About 10% of chest wall trauma cases result in a flail chest.[4] Flail chest injuries, defined as fracture of at least three consecutive ribs in at least two locations each, are associated with a mortality rate of up to 36%.[4,5] Flail chest injuries develop paradoxical inward movement of the flail segment which prevents effective inspiration and requires prolonged mechanical ventilation which can lead to pneumonia and sepsis.[4]

The need to improve rib fracture treatment has been recognized for many years and some surgeons have been using operative approaches including plates, intramedullary devices, vertical bridging, wire, sutures, and struts to repair the chest wall.[2-10]

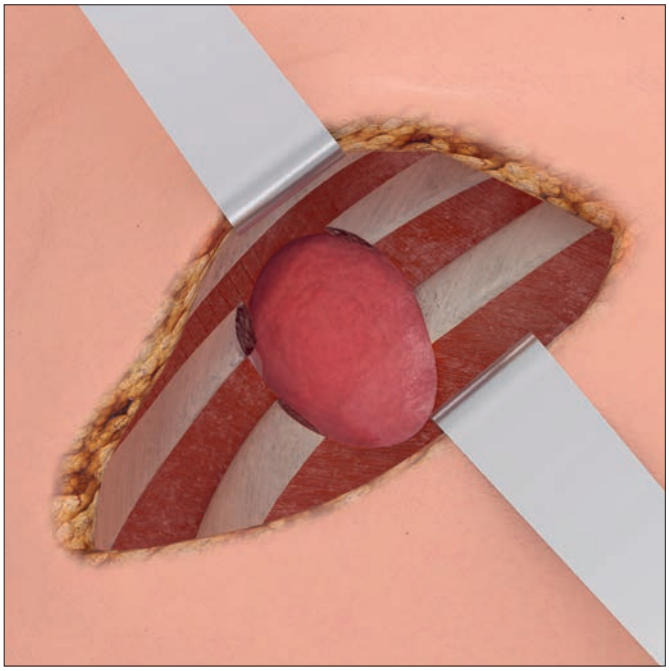
These attempts indicate a trend in better rib fracture treatment to improve pain control, reduce duration of mechanical ventilation, reduce ICU stays, reduce the risk for chest wall deformities, and ultimately improve patient care.



CT image of flail chest. Image courtesy of Mario G. Gasparri, MD, Medical College of Wisconsin.

Chest Wall Resection

Large resections of the chest wall, including the ribs, sternum, and/or surrounding soft tissue, are performed for the curative and palliative treatment of malignant and benign tumors, radiation necrosis, and deep sternal wound infections. Resections of defects greater than 5 cm in diameter require skeletal reconstruction to maintain physiologic respiratory function and protect vital intrathoracic organs.[12] Flail chest and paradoxical respiration may occur without proper stabilization causing pain, respiratory distress, and often necessitating long-term mechanical ventilation. The main goals of reconstruction are: prevention of flail chest, maintenance of physiologic respiration, protection of thoracic organs, and an acceptable cosmetic result.[12]



Example of chest wall resection

MRI Information

Torque, Displacement and Image Artifacts according to ASTM F 2213-06, ASTM F 2052-15 and ASTM F2119-07

Non-clinical testing of worst case scenario in a 3 T MRI system did not reveal any relevant torque or displacement of the construct for an experimentally measured local spatial gradient of the magnetic field of 3.65 T/m. The largest image artifact extended approximately 35 mm from the construct when scanned using the Gradient Echo (GE). Testing was conducted on a single Siemens Prisma 3 T MRI system.

Radio-Frequency-(RF-)induced heating according to ASTM F2182-11a

Non-clinical electromagnetic and thermal simulations of worst case scenario lead to temperature rises of 21.7 °C (1.5 T) and 12.4 °C (3 T) under MRI conditions using RF Coils (whole body averaged specific absorption rate (SAR) of 2 W/kg for 15 minutes).

Precautions: The above mentioned test relies on non-clinical testing. The actual temperature rise in the patient will depend on a variety of factors beyond the SAR and time of RF application. Thus, it is recommended to pay particular attention to the following points:

- **It is recommended to thoroughly monitor patients undergoing MRI scanning for perceived temperature and/or pain sensations.**
- **Patients with impaired thermo regulation or temperature sensation should be excluded from MRI scanning procedures.**
- **Generally it is recommended to use an MRI system with low field strength in the presence of conductive implants. The employed specific absorption rate (SAR) should be reduced as far as possible.**
- **Using the ventilation system may further contribute to reduce temperature increase in the body.**

Intended Use, Indications, Contraindications and Warnings

Intended Use
The Synthes MatrixRIB Fixation System is intended for the fixation and stabilization of rib and sternum fractures, fusions, and osteotomies of normal and osteoporotic bone and reconstructions of the chest wall.
Pre-contoured Synthes MatrixRIB plates (04.501.001-04.501.008) are intended for:
- Rib fracture fixations, osteotomies and reconstruction
- Rib-to-sternum fixation

Synthes MatrixRIB straight plates (04.501.096, 04.501.097) are intended for:
- Rib fracture fixations, osteotomies and reconstruction
- Rib-to-sternum fixation
- Transverse sternum reconstruction
- Transverse plating across the sternum (rib-to-rib) fixation

The Synthes MatrixRIB pre-contoured and straight plates are intended for temporary reconstruction, if they are used as implant spanning gaps after resection of ribs and/or sternum.

Synthes MatrixRIB sternal plates (04.501.068, 04.501.069, 04.501.093, 04.501.094, 04.501.095, 04.501.103, 04.501.104) are intended for:
- Sternum fracture fixations and osteotomies

The Synthes MatrixRIB intramedullary splints (04.501.010, 04.501.011, 04.501.012) and the universal plate (04.501.009) are intended for rib fracture fixations and osteotomies.

Indications
The Synthes MatrixRIB Fixation System is indicated for use in skeletally mature patients with normal or osteoporotic bone.
Pre-contoured Synthes MatrixRIB plates (04.501.001 – 04.501.008) are indicated for the fixation, stabilization and reconstruction of:
- Rib fractures, fusions, osteotomies, and/or resections, including spanning gaps and/or defects
- Pectus Excavatum, Pectus Carinatum, and other chest wall deformities

Synthes MatrixRIB straight plates (04.501.096 and 04.501.097) are indicated for the fixation, stabilization and reconstruction of:
- Rib and sternum fractures, fusions, osteotomies, and/or resections, including spanning gaps and/or defects
- Pectus Excavatum, Pectus Carinatum, and other chest wall deformities

Synthes MatrixRIB sternal plates, 2.8 mm thickness, (04.501.068, 04.501.069, 04.501.093, 04.501.094, 04.501.095, 04.501.103, 04.501.104) are indicated for the fixation, stabilization and reconstruction of:
- Sternum fractures, fusions, and/or osteotomies
- Pectus Excavatum, Pectus Carinatum, and other chest wall deformities

The Synthes MatrixRIB intramedullary splints (04.501.010, 04.501.011, 04.501.012) and the universal plate (04.501.009) are indicated for the fixation and stabilization of ribs.
Important: The Synthes MatrixRIB pre-contoured and straight plates are not intended for use as permanent implants for bridging gaps after chest wall resections.

Contraindications
The MatrixRIB Fixation System is contraindicated for:
- The fixation of the sternum in acute cardiac patients, due to the potential delay if emergent re-entry is required
- Screw attachment or fixation to the clavicle or spine
- Use in patients with latent or active infection, with sepsis, or who are unwilling or incapable of following postoperative care instructions.

Warnings
- Metallic internal fixation devices cannot withstand activity levels and/or loads equal to those placed on normal healthy bone as these devices are not designed to withstand the unsupported stress of full weightbearing, load-bearing, or gap spanning which may result in fatigue failure of the device.
- Additionally, using the device for spanning gaps in patients that put extreme strain on the implant (e.g. ove weight or non-compliant) may further contribute to premature device failure.
- These devices can break intraoperatively when subjected to excessive forces or outside the recommended surgical technique. While the surgeon must make the final decision on removal of the broken part based on associated risk in doing so, we recommend that whenever possible and practical for the individual patient, the broken part should be removed.
- Medical devices containing stainless steel may elicit an allergic reaction in patients with hypersensitivity to nickel.
- The MatrixRIB Fixation System is not intended for use as a permanent implant for bridging gaps after chest wall resections.

Potential Adverse Events, Undesirable Side Effects and Residual Risks
- Adverse Tissue Reaction, Allergy/Hypersensitivity Reaction
- Infection
- Damage to Vital Organs or Surrounding Structures
- Neurovascular Damage
- Spinal Cord Compression and/or Contusion
- Peripheral Nerve Compression and/or Contusion
- Bone Damage including Intra-and Post-Operative Bone Fracture, Osteolysis, or Bone Necrosis.
- Soft Tissue Damage
- Soft Tissue Irritation
- Malunion / Non-union
- Pain or Discomfort
- Injury to User
- Symptoms resulting from Implant Migration, Loosening or Breakage

Suggested* Clinical Applications for the MatrixRIB Fixation System

Application	Pre-Contoured Plates (1.5 mm)	Universal Plate (1.5 mm)	Straight Plates (1.5 mm)	Sternal Plates (2.8 mm)	Intramedullary Splints (1.0 mm)
					
Trauma					
Rib Fracture	✓	✓	✓		✓
Sternal Fracture			✓	✓	
Thoracotomy					
Rib Osteotomy/ Iatrogenic Fracture	✓	✓	✓		✓
Transverse Sternotomy				✓	
Chest Wall Reconstruction					
Rib Reconstruction/ Resections	✓		✓		
Sternal Reconstruction/ Resections/			✓		
Chest Wall Deformity Repair					
Transverse Sternotomy				✓	
Rib Osteotomy	✓	✓	✓		✓

*Selection of plates should be based on individual patient anatomy, severity of injury/deformity, and surgeon preference.

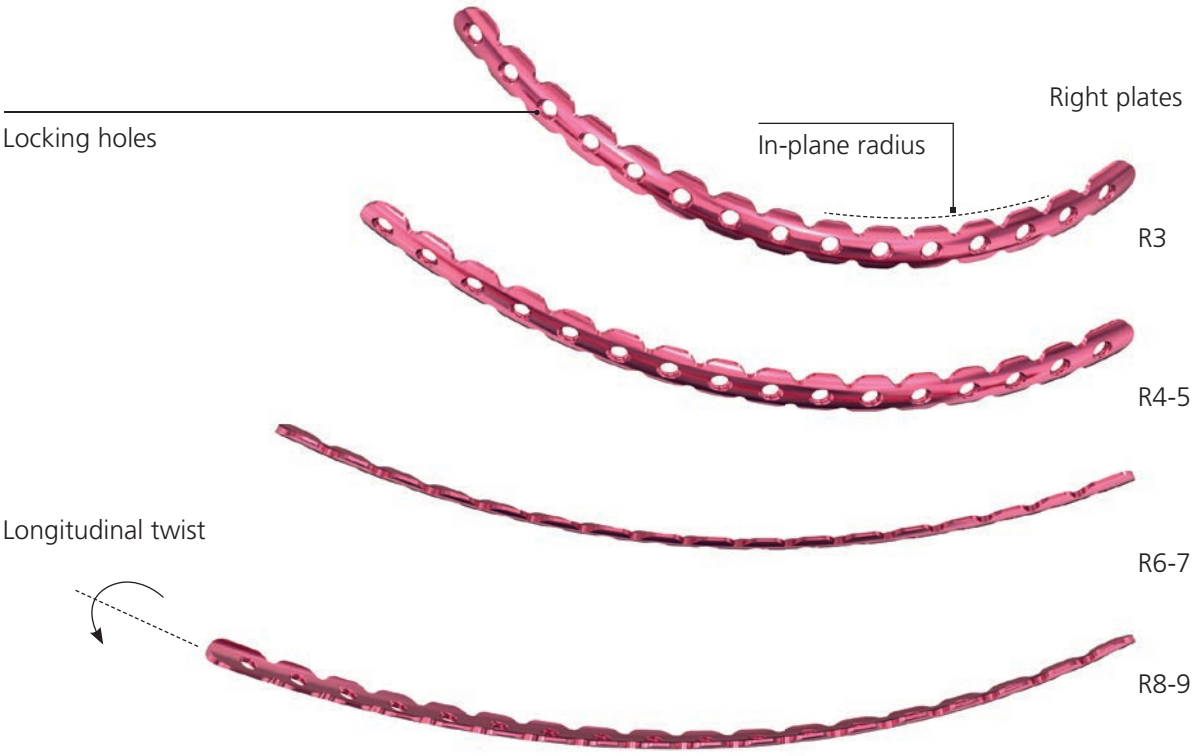
Features And Benefits

The DePuy Synthes CMF MatrixRIB™ Fixation System consists of precontoured, shaped, and straight locking plates, locking screws, and intramedullary splints for the fixation and stabilization of the chest wall.

- Used without removing periosteum to limit disruption of the blood supply to the bone[13]
- Drill bit with stop to prevent over-drilling
- Self-retaining screwdriver blades

Precontoured Plates

- Plates are precontoured to fit an average rib shape, which minimizes intraoperative bending[17,18,19,20]
- Low profile, 1.5 mm thick plates
- Plates are color coded to distinguish left and right designs
- Plates are etched on medial end to indicate the corresponding rib curvature

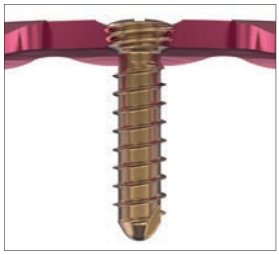


Intramedullary Splints

- Intramedullary splints allow less invasive procedures[20,22]
- Three widths available (3 mm, 4 mm, 5 mm)
- One screw needed to secure splint

Locking Screws

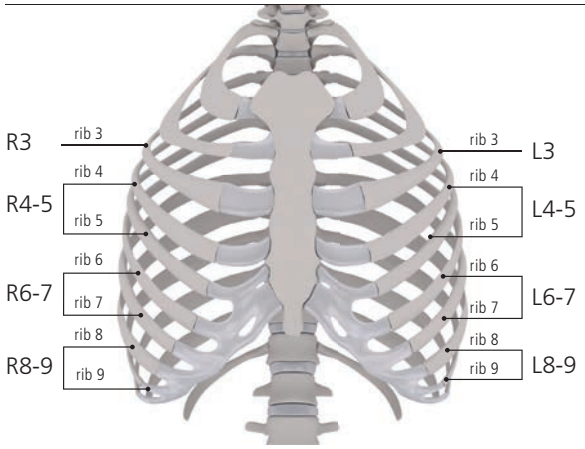
- Locking design allows for stable fixation compared to non locking screws[15,16]
- Screws work with self-retaining screwdriver blades



Self-tapping Locking Screw.
Requires pre-drilling.
Does not require tapping.

Self-drilling Locking Screw.
Does not require pre-drilling or tapping.

*Mechanical test results may not be indicative of clinical performance. DePuy Synthes, Data on File. Rib Plate Evaluation under Exaggerated Loading Conditions.

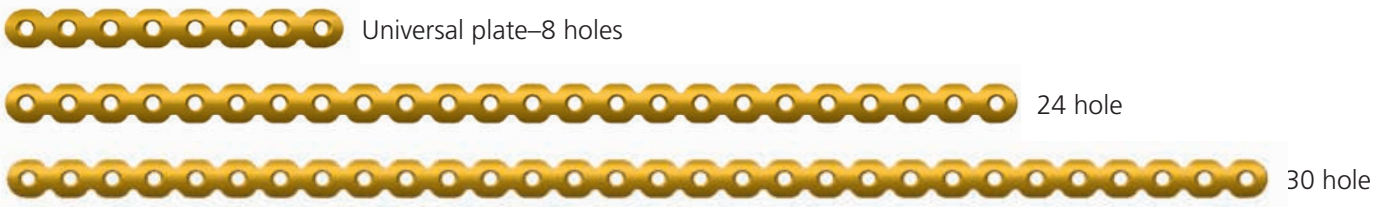


Sternal Body Plates

- Plates are shaped for sternal osteotomies and fractures[15,16]
- 2.8 mm thickness for higher loads on sternal body[15,16]

Universal/Straight Plates

- A universal plate with 8 holes is available for smaller fracture areas and osteotomies
- Straight plates with 24 or 30 holes are available for complex or custom bends

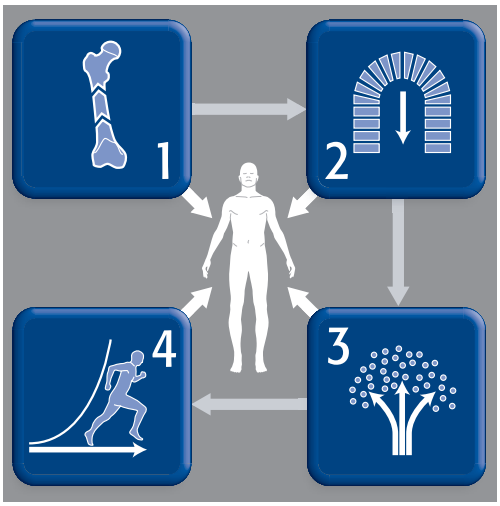


AO Principles

In 1958, the AO formulated four basic principles, which have become the guidelines for internal fixation.[13,14]

Anatomic reduction
Fracture reduction and fixation to restore anatomical relationships.

Early, active mobilization
Early and safe mobilization and rehabilitation of the injured part and the patient as a whole.



Stable fixation
Fracture fixation providing absolute or relative stability, as required by the patient, the injury, and the personality of the fracture.

Preservation of blood supply
Preservation of the blood supply to soft tissues and bone by gentle reduction techniques and careful handling.

Rib Plating Technique

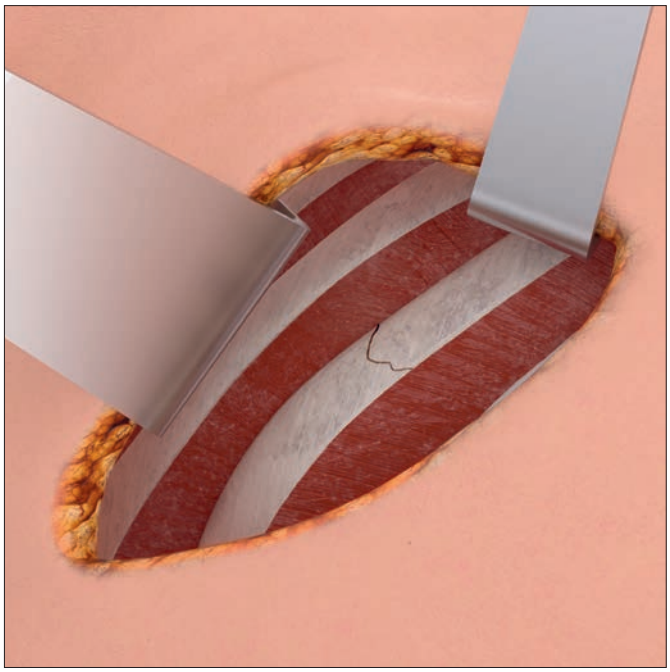
1
Expose rib

Expose the rib to allow a minimum of three screws on each side of the fracture.

Remove any nonviable bone.

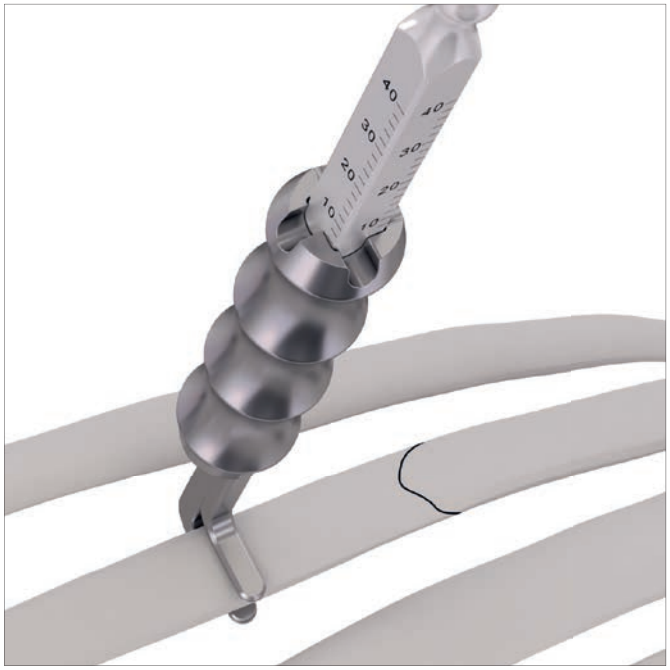
Precaution: **Avoid significant muscle division to preserve as much respiratory function as possible.**

Note: **Removal of the periosteum is not required.**



2
Measure rib thickness

Instrument	
03.501.074	Universal Caliper
Optional instrument	
03.501.065	Caliper



Make a small incision in the intercostal space at the superior border of the rib to allow insertion of the caliper tip. Insert the caliper tip through the incision and measure the rib thickness.

Note: **If an existing access into the intercostal space is available for measuring the rib thickness, it is recommended to insert the caliper tip using the existing access.**

To select the appropriate drill bit with stop and the appropriate screw length, add 2 mm to the measurement to allow for the plate thickness.

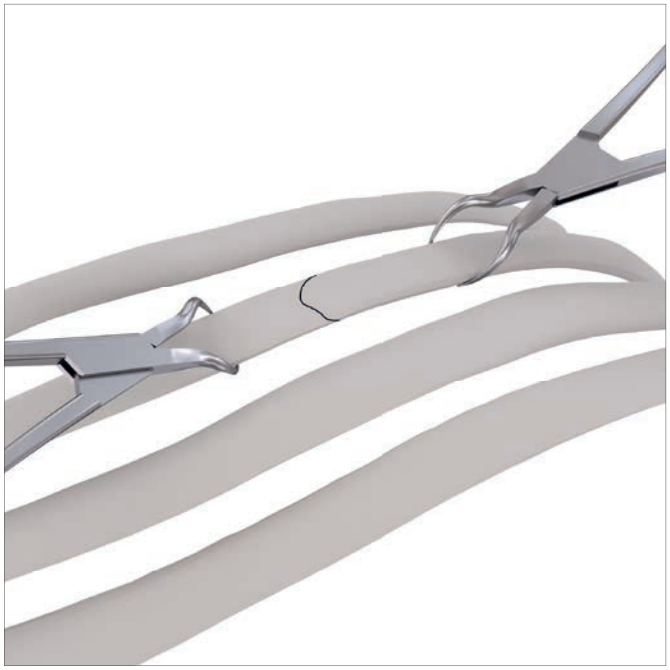
If the bone is measured with the plate in place, do not add 2 mm.

Precaution: **Take care to avoid damaging the nerve and vessel bundle at the inferior border of the rib.**

3
Approximate broken rib segments

Instrument	
398.400	Reduction Forceps with points, narrow, ratchet, 132 mm length

Use the forceps to approximate the broken rib segments.



4
Cut and contour plate template (optional)

Instrument	
03.501.090	Bending Template for MatrixRIB Locking Plates, 300 mm length

Cut the bending template to a length that allows placement of a minimum of three screws on each side of the fracture.

Contour the template to the rib.

5
Select and cut plate (optional)

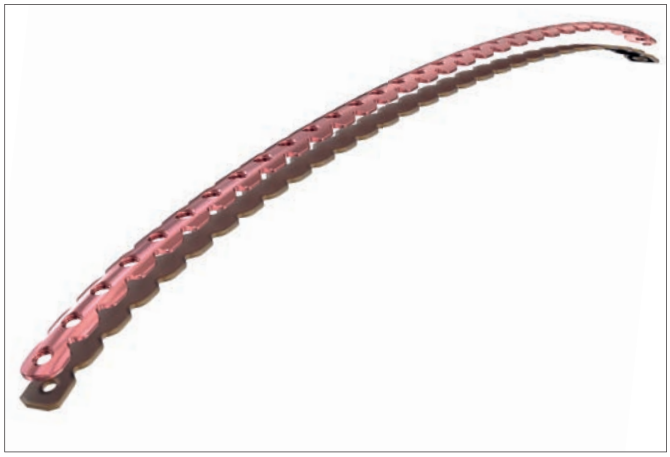
Instrument	
03.503.057	Short Cut Plate Cutter (2 required)

Use the plate template contoured in Step 4 to select the best matching plate.

Notes:
- **Position the precontoured plate with the marking toward the sternum**
- **Straight plates are available for use in place of a precontoured plate (see implants on page 76)**

If necessary, cut the plate to the desired length.

Precaution: **Use a minimum of three screws on each side of the fracture, to properly secure the plate.**



6
Contour plate (optional)

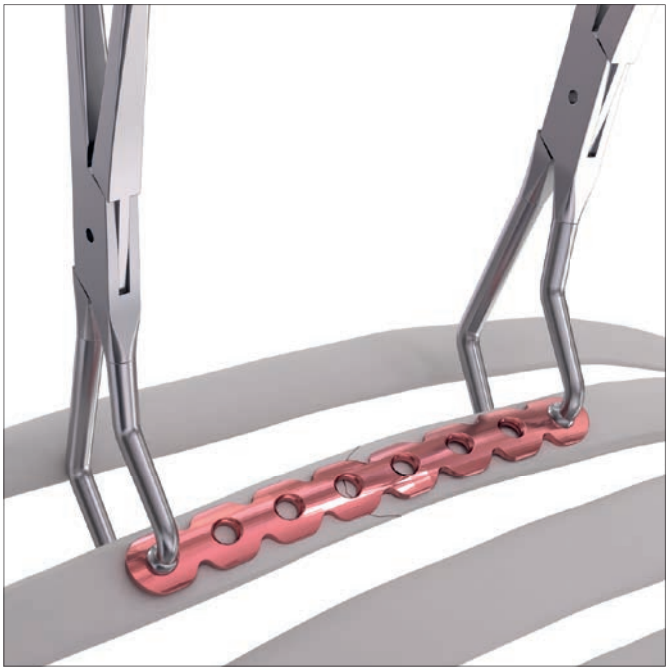
Instrument	
03.501.091	Combination Bending Pliers for MatrixRIB

Using the bending pliers, contour the plate to match the template.

Precaution: **If contouring is necessary, avoid sharp bends, reverse bends, or bending the implant at a screw hole. Avoid notching or scratching the implant. These factors may produce internal stresses which may become the focal point for eventual breakage of the implant.**

7
Position plate

Instrument	
03.501.071	MatrixRIB Plate Holding Forceps, small
Optional instruments	
03.501.030	MatrixRIB Plate Holding Forceps, small, with ball tips
03.501.031	MatrixRIB Plate Holding Forceps, large, with ball tips
03.501.704	Threaded Reduction Tool for MatrixRIB System, AO Quick Coupling (see page 54 for instructions)
03.501.708	MatrixRIB Plate Holding Forceps, upright with ball tip
03.501.709	MatrixRIB Plate Holding Forceps, large



Position the plate on the rib over the fracture, allowing a minimum of three screws on each side of the fracture.

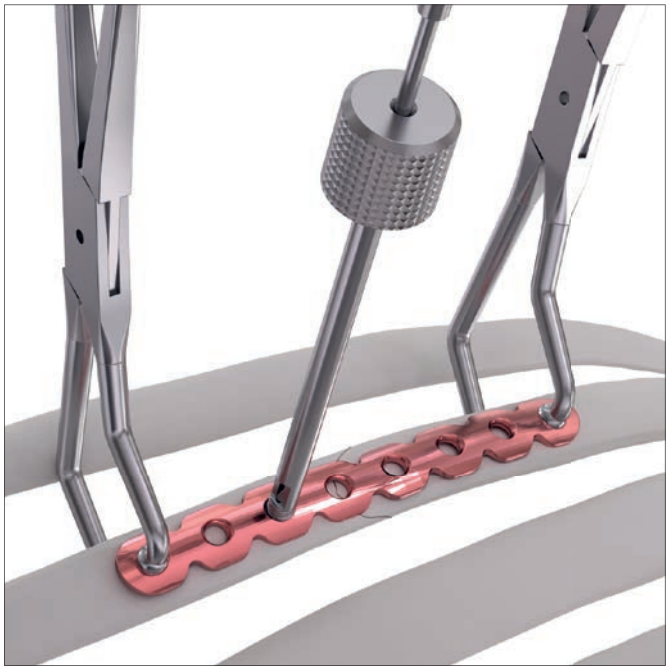
Verify that the contour of the plate matches the rib.

Using the plate holding forceps, hold the plate on the rib.

Precaution: **It is recommended to insert the forceps from the superior border of the rib to avoid damaging the nerve and vessel bundle located at the inferior border of the rib.**

8
Drill

Instruments	
03.501.033	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates
03.501.036– 03.501.050	2.2 mm Drill Bits with stop, Stryker J-Latch, 6 mm to 20 mm stop
Optional instruments	
03.501.700	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates, long



Thread the drill guide into the plate. This will help ensure safe drilling and alignment of the drill hole with the plate hole.

Select the drill bit with stop as determined in Step 2 and drill.

Drill bits with stop are available with stop lengths ranging from 6 mm to 20 mm, in 2 mm increments, matching the locking screw lengths.

Precautions:

- **Irrigate during drilling to avoid thermal damage to the bone.**
- **Do not drill any deeper than necessary, to avoid the risk of pneumothorax.**
- **Drilling speed should never exceed 1800 rpm. Higher speeds can result in thermal necrosis of the bone and increased hole diameter and may lead to unstable fixation.**

Remove the 2.2 mm drill guide after drilling.

Options:

- **The Trocar Instrumentation for MatrixRIB Fixation System may be used for drilling (see Trocar Instrument Instructions for MatrixRIB Fixation System on page 68).**
- **The 90° Screwdriver for MatrixRIB Fixation System may be used for drilling (see 90° Screwdriver instructions for MatrixRIB Fixation System on page 74).**

9
Confirm rib thickness (optional)

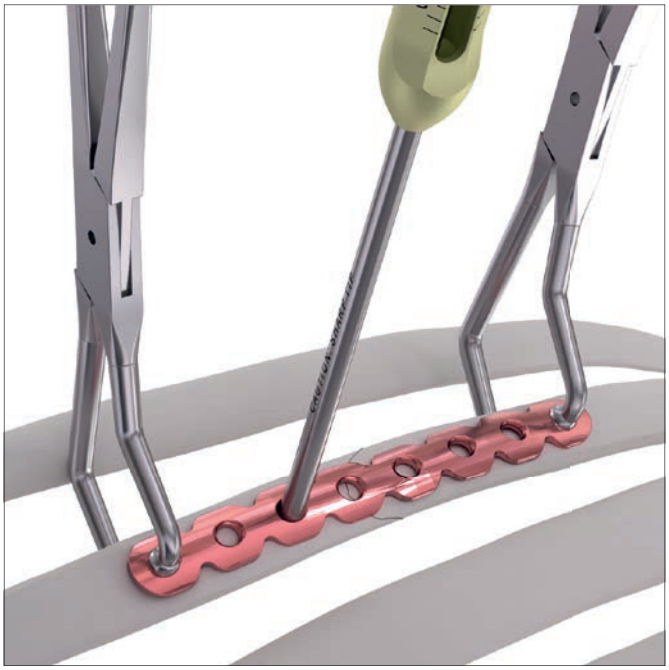
Instruments	
03.503.085	Depth Gauge for 2.0 mm to 3.0 mm screws with polymer handle

Optional instrument	
03.501.001	Depth Gauge for 2.7 mm and larger screws with zero offset

Use the depth gauge through the plate to confirm the appropriate screw length determined in Step 2.

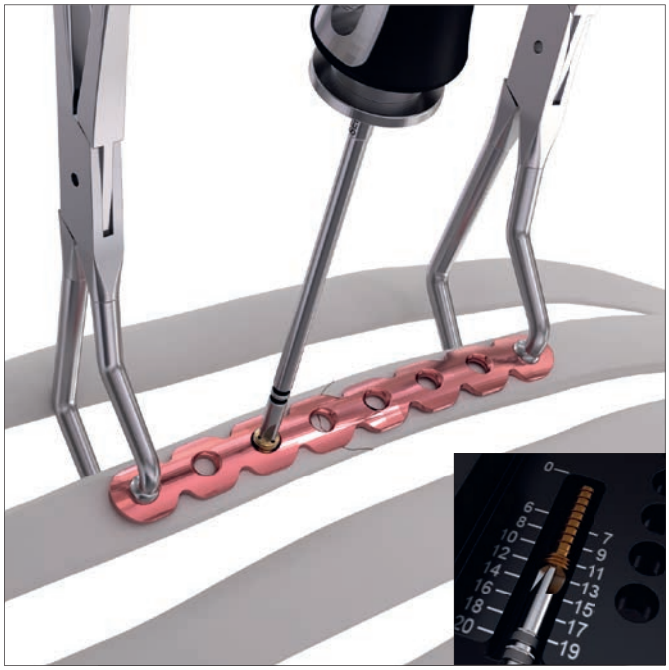
Precaution: **Do not extend the tip of the depth gauge too far beyond the posterior cortex of the rib.**

Note: **When using the cannula, the 03.503.085 depth gauge must be used.**



10
Select and insert screw

Instruments	
03.503.071	MatrixMANDIBLE / THORAX Self-Retaining Screwdriver Blade, medium
311.023	Ratcheting Screwdriver Handle
Optional instrument	
03.503.072	MatrixMANDIBLE / THORAX Self-Retaining Screwdriver Blade, long



Select and insert the locking screw (with proper length determined in Step 2) through the plate and tighten until secure.

Screws can be measured using the screw length indicator on the module

Precautions:

- **The screw should be placed bicortically. The tip of the screw should not extend too far beyond the posterior cortex to avoid deeper injury.**
- **In order to determine the appropriate amount of fixation for stability, the surgeon should consider the size and shape of the fracture or osteotomy. DePuy Synthes recommends at least three screws per plate per fracture side when repairing osteotomies and fractures with this system. Additional fixation is recommended to ensure stability of large fractures and osteotomies.**
- **The non-locking screws are for temporary fixation and will need to be replaced with locking screws before closure.**

Options:

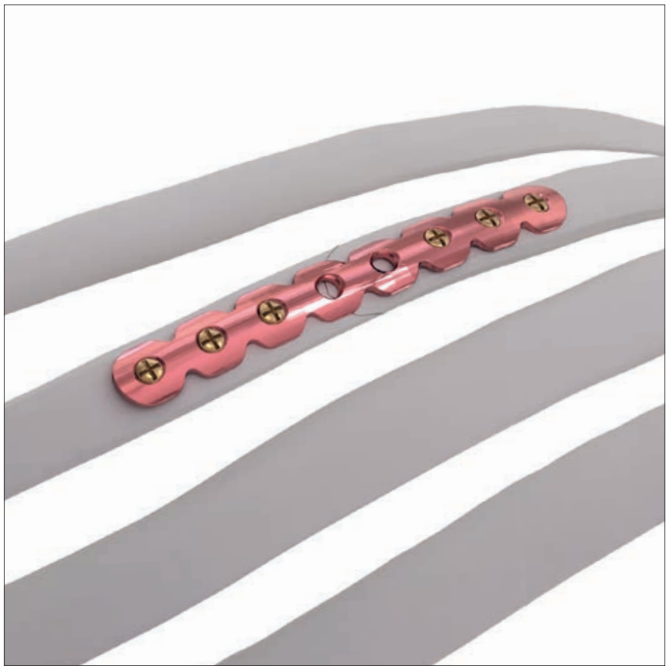
- **The Trocar Instrumentation for MatrixRIB Fixation System may be used for screw insertion (see Trocar Instrument Instructions for MatrixRIB Fixation System on page 68).**
- **The 90° Screwdriver for MatrixRIB Fixation System may be used for screw insertion (see 90° Screwdriver instructions for MatrixRIB Fixation System on page 74).**
- **10 and 12 mm non-locking screws are available to ensure the plate sits flush with the bone.**
- **Self-drilling screws may be used as an alternative to self-tapping screws. (See self-drilling screw selection and insertion instructions on page 55)**

11

Drill and place remaining screws

Verify proper reduction of the fracture.

Insert a second screw on the opposite side of the fracture following Steps 8 and 10. Insert remaining screws in the same manner.



Precautions:

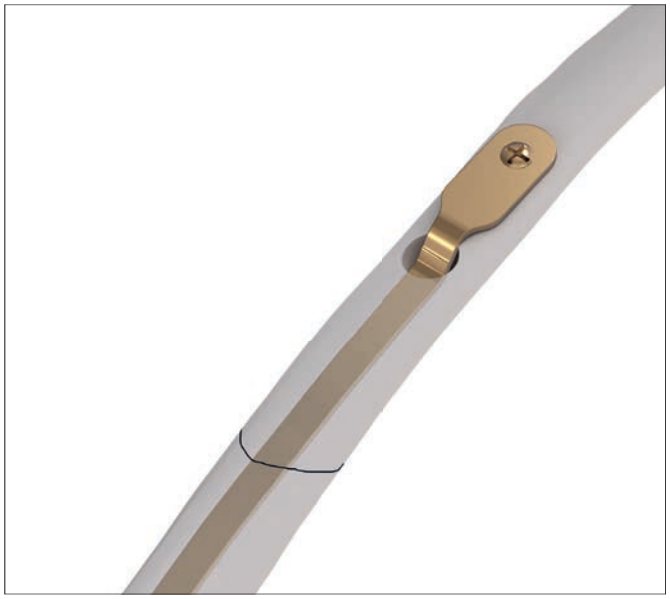
- **If non-locking screws are not replaced with locking screws, the likelihood of implant loosening/migration may be increased.**
- **Use a minimum of three screws on each side of the fracture, to properly secure the plate.**
- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**

Splint Insertion Technique

Splint Insertion

Intramedullary splints allow for a less invasive procedure for the fixation of the posterior rib fracture.[20,21,22]
The intramedullary splints have a rectangular profile for rotational stability within the canal, and a locking feature to limit migration and rotation of the implant.[22]

Intramedullary splints
- Intramedullary splints allow minimally invasive procedures [20,22]
- Three widths available (3 mm, 4 mm, 5 mm)
- One screw needed to secure splint



1
Expose rib

Expose the rib to allow splint head placement. A minimum of 50 mm on the medial side of the fracture is recommended.

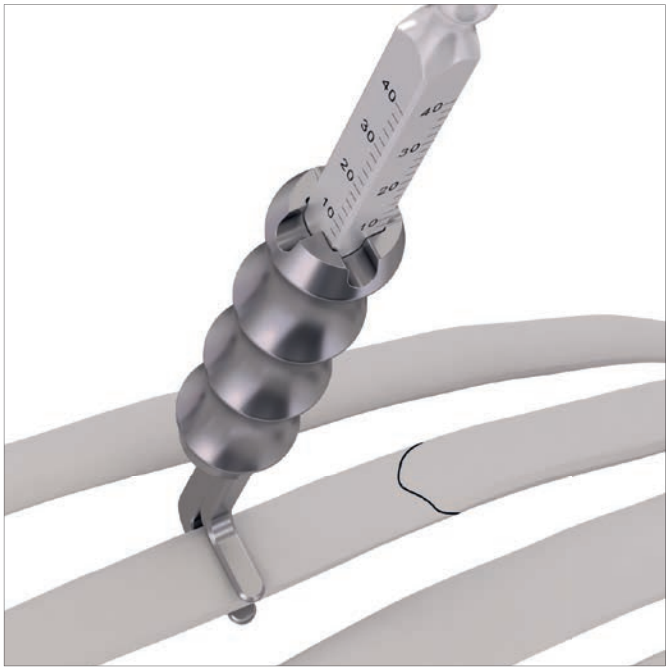
Remove any nonviable bone.

Precautions:
- **It is recommended to minimize the dissection of the soft tissue on the lateral side of the fracture**
- **Avoid significant muscle division to preserve as much respiratory function as possible.**

Note: **Removal of the periosteum is not required.**

2
Measure rib thickness

Instrument	
03.501.074	Universal Caliper
Optional instrument	
03.501.065	Caliper



Make a small incision in the intercostal space at the superior border of the rib to allow insertion of the caliper tip.

Insert the caliper tip through the incision and measure the rib thickness.

Note: **If an existing access into the intercostal space is available for measuring the rib thickness, it is recommended to insert the caliper tip using the existing access.**

To select the appropriate drill bit with stop and the appropriate screw, add 1 mm to the measurement to allow for the splint thickness.

Precaution: **Take care to avoid damaging the nerve and vessel bundle at the inferior border of the rib.**

3
Prepare splint insertion hole

Instruments	
03.501.055	5.5 mm Drill Guide for MatrixRIB Intramedullary Splints
03.501.070	5.5 mm Drill Bit with stop, Stryker J-Latch
03.501.071	MatrixRIB Plate Holding Forceps, small
Optional instruments	
03.501.032	MatrixRIB Intramedullary Splint Driver
03.501.075	5.5 mm Drill Guide for MatrixRIB Intramedullary Splints, without handle

Insert the hook end of the drill guide into the intramedullary canal of the medial segment until it is seated fully on the rib.

Notes:
- **It is recommended to insert the hook near the superior edge of the rib, and to drill an entry hole in the upper ⅔ of the rib**
- **The small plate holding forceps can be used to hold the drill guide against the rib during drilling**

Precautions:
- **If the drill guide without handle is used, ensure the tapered end, labeled "Fracture," is aligned with the fracture to ensure the hole is approximately 30 mm from the fracture line.**
- **Ensure the lateral fracture segment is at least 5 cm long to accommodate the insertion length of the splint before drilling.**

Note: The splint driver may be threaded into the drill guide to act as a handle, as needed.

Ensure the medial end of the drill guide contacts the bone.

Using the 5.5 mm drill bit with stop, drill monocortically.

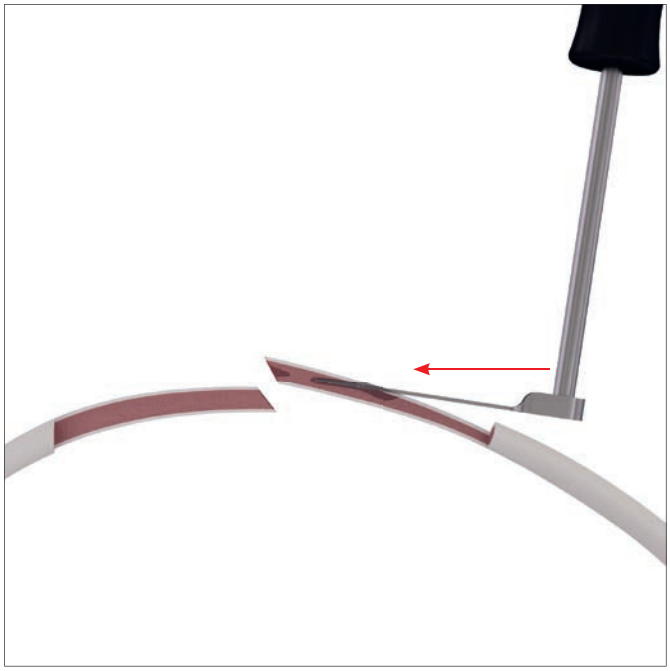
Precautions:

- **Irrigate during drilling to avoid thermal damage to the bone.**
- **Drilling speed should never exceed 1800 rpm. Higher speeds can result in thermal necrosis of the bone and increased hole diameter and may lead to unstable fixation.**

Remove the drill guide and verify the hole is approximately 30 mm from the fracture line.

4
Select splint

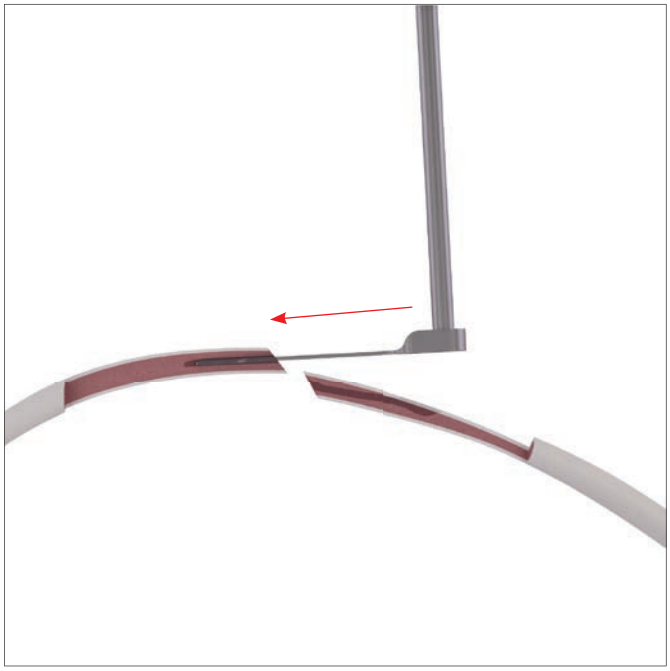
Instruments	
03.501.032	MatrixRIB Intramedullary Splint Driver
03.501.061	MatrixRIB Intramedullary Splint Template, small
03.501.062	MatrixRIB Intramedullary Splint Template, medium
03.501.066	Mallet, 200 g
398.400	Reduction Forceps with points, narrow, ratchet, 132 mm length



The splint template is used to prepare the canal and select the correct size of splint. It is recommended to start with the small template before using the medium template.

Thread the splint driver into the splint template and insert the template into the insertion hole prepared in Step 3.

Remove the splint template.



Fully insert the template into the canal of the lateral fracture segment.

Remove the splint template.

Notes:

- **If the small template fits snugly, use the 3 mm wide splint.**
- **If the medium template fits snugly, use the 4 mm wide splint.**
- **If the medium template fits loosely, use the 5 mm wide splint.**
- **Use the mallet to assist insertion of the splint template, if needed.**

Use bone reduction forceps to hold the rib segment during splint template insertion.

5
Insert splint

Instruments	
03.501.032	MatrixRIB Intramedullary Splint Driver
03.501.066	Mallet, 200 g
398.400	Reduction Forceps with points, narrow, ratchet, 132 mm length

Thread the splint driver into the splint selected in Step 4, with the splint marking facing up toward the handle.

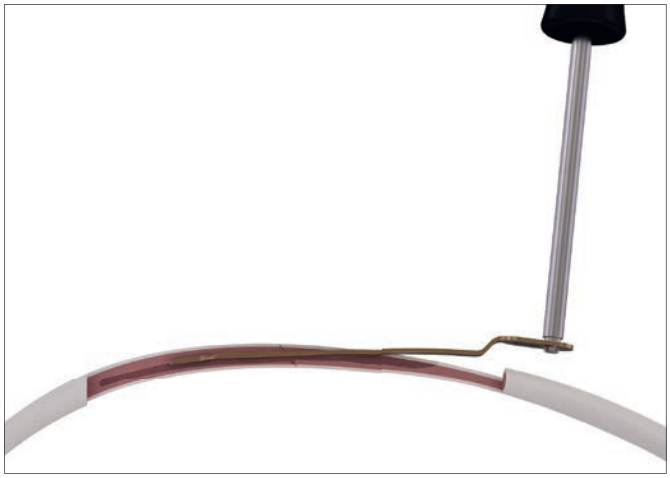
Insert the splint through the insertion hole prepared in Step 3.

Drive the splint across the fracture line and into the canal of the lateral segment. The splint is fully inserted when the head of the splint rests flush on the outside of the rib.

Remove the splint driver after the splint is fully seated.

Precautions:
To prevent additional injuries to the rib, spine, and/or underlying organs:
- **Avoid any steep angle during splint insertion to prevent damage of the posterior cortex of the rib.**
- **Do not insert the splint head further once it is seated in the insertion hole.**

Note: The mallet can be used to assist insertion of the splint, if needed.



6
Drill screw hole

Instruments	
03.501.033	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates
03.501.036– 03.501.050	2.2 mm Drill Bits with stop, Stryker J-Latch, 6 mm to 20 mm stop

Optional instrument	
03.501.700	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates, long
03.501.071	MatrixRIB Plate Holding Forceps, small

Thread the drill guide into the splint.

Note: **Plate holding forceps may be used to hold splint head flush to bone during drilling.**

Select the drill bit with stop as determined in Step 2 and drill.

Drill bits with stop are available with stop lengths ranging from 6 mm to 20 mm, in 2 mm increments, matching the locking screw lengths.

Precautions:
- **Irrigate during drilling to avoid thermal damage to the bone.**
- **Do not drill any deeper than necessary to avoid the risk of pneumothorax.**
- **Drilling speed should never exceed 1800 rpm. Higher speeds can result in thermal necrosis of the bone and increased hole diameter and may lead to unstable fixation.**

Remove the 2.2 mm drill guide after drilling.

Optional method

7
Confirm rib thickness (optional)

Instrument	
03.501.001	Depth Gauge for Sternal Cable
Optional instruments	
03.503.085	Depth Gauge for MatrixMANDIBLE, measuring range up to 40 mm

Use the depth gauge through the splint to confirm the screw length determined in Step 2.

Precaution: **Do not extend the tip of the depth gauge too far beyond the posterior cortex of the rib.**

8
Select and insert screw

Instruments	
03.503.071	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, medium
311.023	Ratcheting Screwdriver Handle
Optional instrument	
03.503.072	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, long

Select and insert the locking screw (with proper length determined in Step 2) through the splint and tighten until secure.

Screws can be measured using the screw length indicator on the module.

Precautions:

- **The screw should be placed bicortically. The tip of the screw should not extend too far beyond the posterior cortex to avoid deeper injury.**
- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**

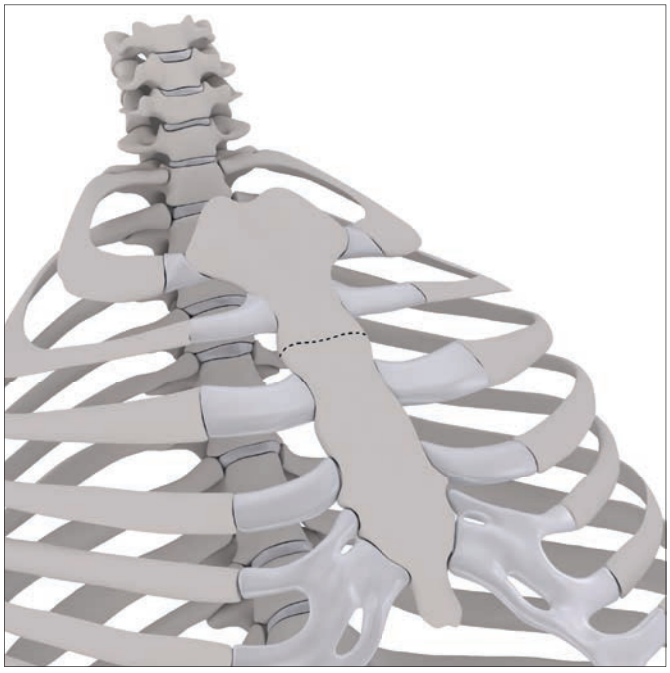
Option: Self-drilling screws may be used as an alternative to self-tapping screws. (See self-drilling screw selection and insertion instructions on page 60)

Sternal Plating Technique

1
Exposed fracture/osteotomy site on sternum

Expose ribs laterally if necessary.

Precaution: **Avoid significant muscle division to preserve as much respiratory function as possible.**

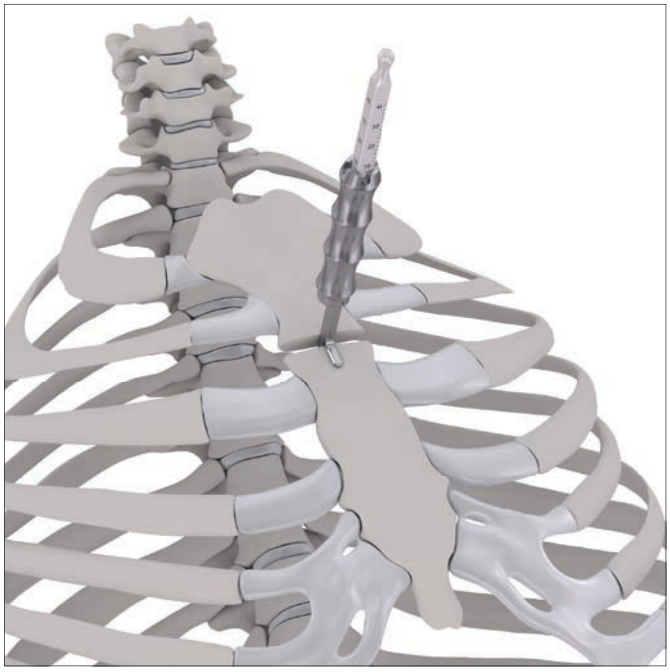


2
Determine sternal thickness

Instrument	
03.501.074	Universal Caliper
Optional Instruments	
03.501.065	Caliper

Using caliper, determine bone thickness.

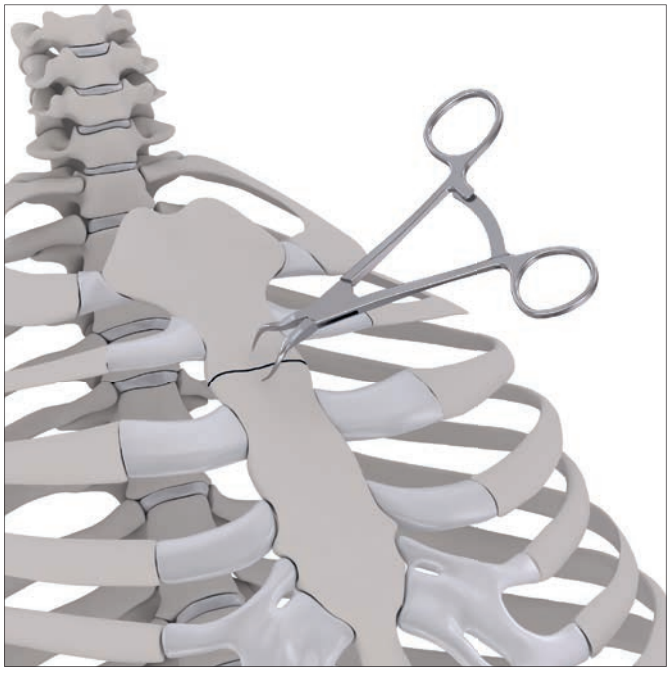
Add 2 mm to the thickness of the sternal edge to account for the plate thickness and to determine the appropriate length drill bit with stop.



3
Approximate sternum to desired position

Instrument	
398.400	Reduction forceps with points, narrow, ratchet

Optional instrument	
398.903	Sternal Reduction Forceps, angled, with teeth



Reduce sternum.

Note: **Sternum can also be reduced with stainless steel surgical wire, if desired.**

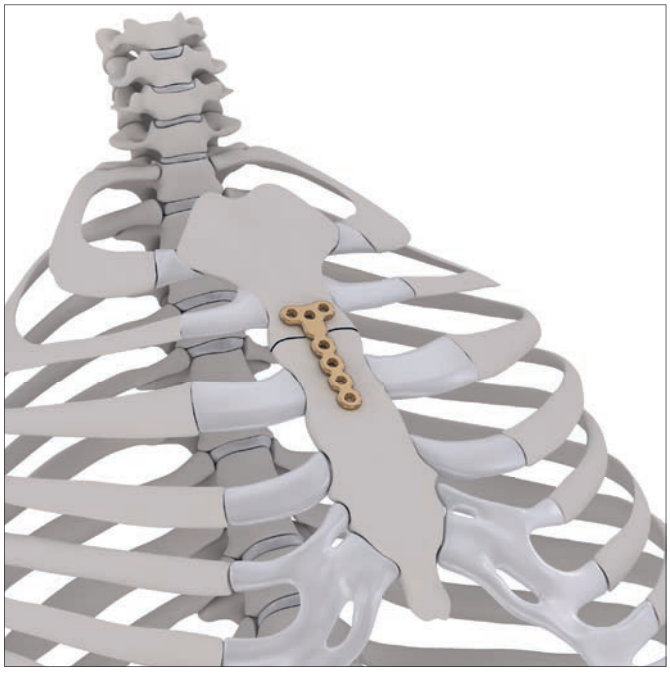
Precautions:
- **When placing forceps, care should be taken to avoid the intercostal and mammary vessels and nerves.**
- **Avoid direct contact of stainless steel wires with titanium implants to prevent galvanic corrosion.**

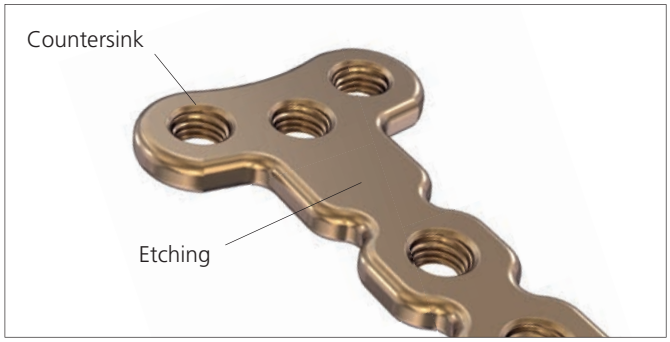
4
Select plate

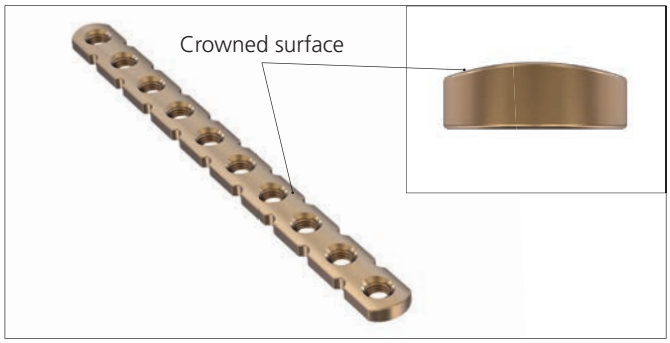
Select the appropriate plate allowing for a minimum of three screws on each side of the fracture/osteotomy to properly secure the plate. Orient the plate such that the etched surface faces the surgeon. The plate is etched with the part number, and the holes are countersunk on the etched surface to allow the screws to seat fully. Additionally, the straight plates have a crowned, curved top surface, which should be oriented to face the surgeon.

Precautions:

- **Incorrect orientation of the plate, where the etched surface contacts the sternal bone, may result in the inability to lock the screws to the plate, resulting in inadequate fixation.**
- **The MatrixRIB Sternal Plates, 2.8 mm thick, are not intended to be cut.**
- **Use a minimum of three screws on each side of the fracture, to properly secure the plate.**







5
Contour plate (optional)

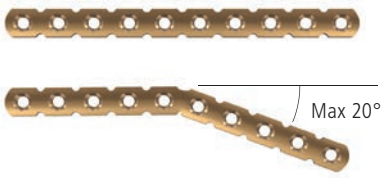
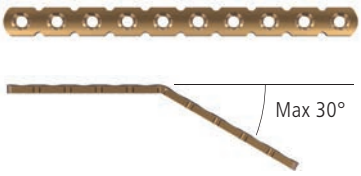
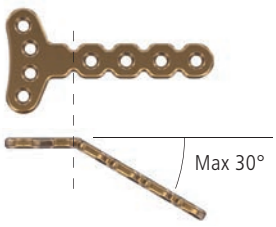
Instrument	
03.501.091	Combination Bending Pliers for MatrixRIB

Contour plate to match anatomy, if necessary.

Note: **Bending template can be used to assist in contouring of plate.**

Precautions:

- **If contouring is necessary, avoid sharp bends, reverse bends, or bending the implant at a screw hole. Avoid notching or scratching the implant. These factors may produce internal stresses which may become the focal point for eventual breakage.**
- **Use of the incorrect instrumentation for bending may weaken the plate and lead to premature plate failure (e.g. breakage).**

Implant	Sharp bend limit for in-plane contouring	Sharp bend limit for out-of-plane contouring
MatrixRIB Straight Plates, 2.8 mm thick 04.501.068 8 holes 04.501.069 9 holes 04.501.095 10 holes		
MatrixRIB Plates, 2.8 mm thick 04.501.093 T Plate, 7 holes 04.501.094 I Plate, 9 holes 04.501.103 T Plate, wide, 8 holes 04.501.104 I Plate, wide, 11 holes	The Sternal T Plates and Sternal I Plates, 2.8 mm thick, are not intended to be contoured in-plane	

(i) In-Plane contouring

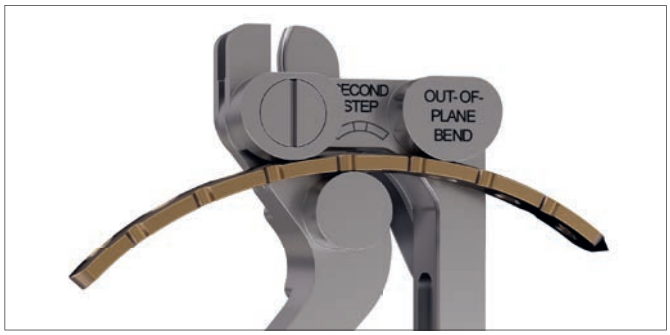
MatrixRIB System sternal straight plates, 2.8 mm thick (8, 9, and 10 holes) can be bent In-Plane using the In-Plane bend feature. Place the plate into the jaws marked "First Step" (as shown on the laser etch). Squeeze the handles together to achieve the desired in-plane bend. If additional contouring is desired, then continue sliding the plate through the bender, making small incremental bends.

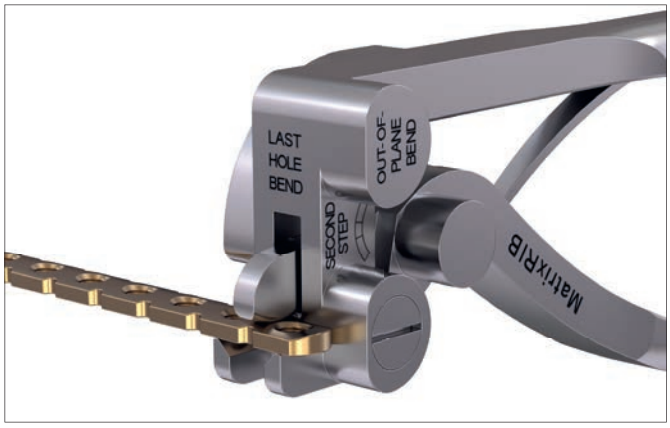
Precautions:

- **Do not contour the sternal straight plates, 2.8 mm thick, beyond the 20° limit In-Plane at a single location.**
- **The sternal T plates and sternal I plates, 2.8 mm thick, are not intended to be contoured In-Plane.**

(ii) Out-of-Plane contouring

MatrixRIB System sternal plates, 2.8 mm thick, can be bent Out-of-Plane along the straight section of the plate using either the Out-of-Plane bend feature or the Last Hole Bend feature. The crossbar of the T and I plates are not intended to be contoured. Place the plate into the feature marked "Second Step" or "Last Hole Bend" (as shown on the laser etch). Squeeze handles together to achieve the desired out-of-plane bend. If additional contouring is desired, then continue sliding the plate through the bender, making small incremental bends.





Precaution: **Do not contour the sternal plates beyond the 30° limit Out-of-Plane at a single location.**

6
Position plate

Optional Instruments

03.501.030	MatrixRIB Plate Holding Forceps, small with ball tip
03.501.031	MatrixRIB Plate Holding Forceps, large with ball tip
03.501.708	MatrixRIB Plate Holding Forceps, upright
03.501.709	MatrixRIB Plate Holding Forceps, large
03.501.704	2.2 mm Threaded Reduction Tool for MatrixRIB, AO Quick Coupling

Position plate, allowing for a minimum of three screws on each side of fracture/osteotomy.

If necessary, use plate-holding forceps to keep plate in place. Alternatively, the Threaded Reduction Tool can be used to maintain position of the plate following the Threaded Reduction Tool instructions on page 71.

7
Drill

Instruments	
03.501.033	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates
03.501.036– 03.501.050	2.2 mm Drill Bits with stop, Stryker J-Latch, 6 mm to 20 mm stop

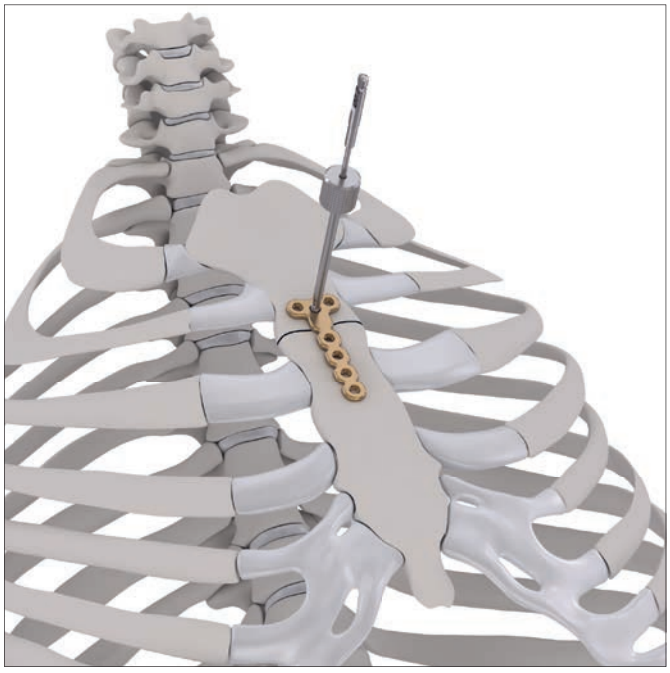
Thread the drill guide into the plate.
Use drill bit with stop of proper length as determined in Step 2. Recognize that the thickness of the adjacent ribs may be less than the sternal edge.

Drill bits with stop are available with stop lengths ranging from 6 to 20 mm, in 2 mm increments, matching the locking screws.

Precautions:
- **Irrigate during drilling to avoid thermal damage to the bone.**
- **Do not drill any deeper than necessary, to avoid the risk of pneumothorax.**
- **Drilling speed should never exceed 1800 rpm. Higher speeds can result in thermal necrosis of the bone and increased hole diameter and may lead to unstable fixation.**

Remove the 2.2 mm drill guide after drilling.

Option: Trocar Instrumentation for MatrixRIB Fixation System may be used for drilling.



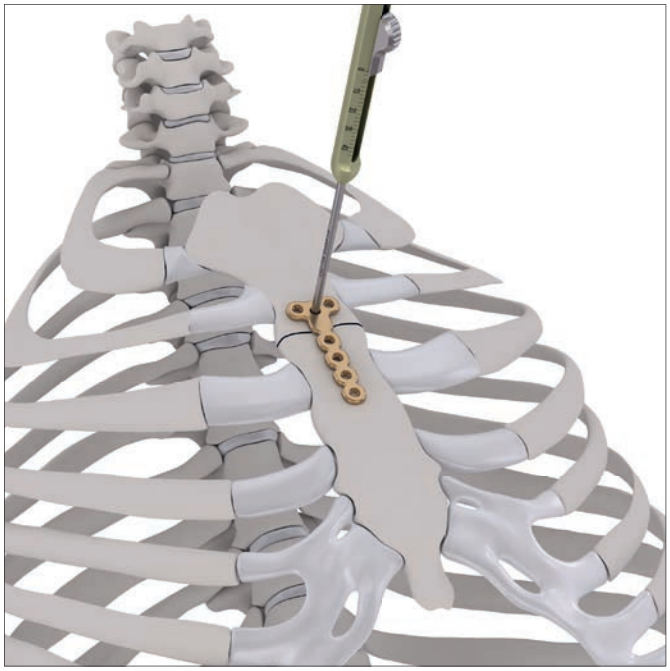
8
Confirm sternal thickness (optional)

Instrument	
03.501.001	Depth Gauge for Sternal Cable
Optional instrument	
03.503.085	Depth Gauge for 2.0 mm to 3.0 mm screws with polymer handle
03.501.702	Cannula for MatrixRIB

Use depth gauge through plate to confirm the appropriate screw length determined in Step 2.

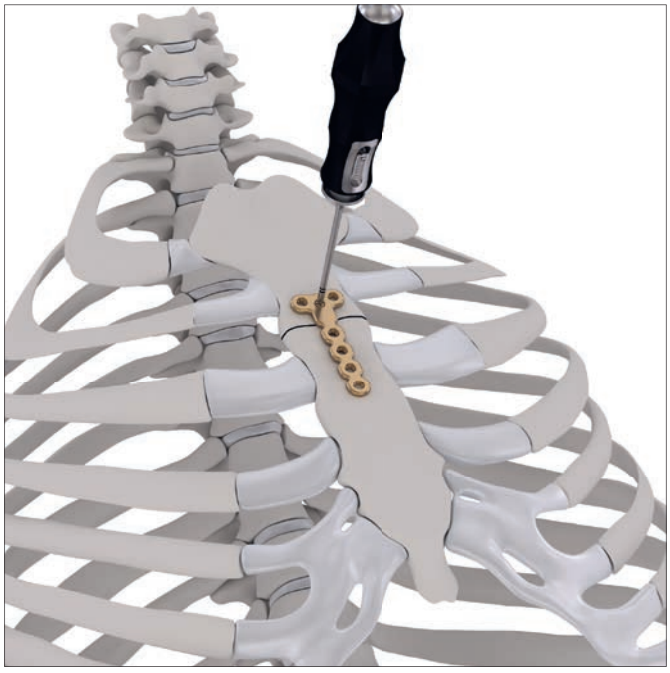
Precaution: **Do not extend the tip of the depth gauge too far beyond the posterior cortex of the sternum.**

Note: **When using the cannula, the 03.503.085 depth gauge must be used.**



9
Select and insert screw

Instrument	
03.503.071	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, medium
311.023	Ratcheting Screwdriver Handle
Optional instrument	
03.503.072	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, long



Select and insert the locking screw (with proper length determined in Step 2) through the plate and tighten until secure. The screw should sit below the top surface of the plate when fully inserted.

Note: **The screw length indicator on the module can be used to select the appropriate screws.**

Precautions:

- **The screw should be placed bicortically. The tip of the screw should not extend too far beyond the posterior cortex to avoid deeper injury.**
- **The non-locking screws are for temporary fixation and will need to be replaced with locking screws before closure.**
- **Self-drilling screws for plating the rib should not be used with sternal plates. There are no self-drilling screws available for the 2.8 mm MatrixRIB sternal plates.**
- **In order to determine the appropriate amount of fixation for stability, the surgeon should consider the size and shape of the fracture or osteotomy. DePuy Synthes recommends at least three screws per plate per fracture side when repairing osteotomies and fractures with this system. Additional fixation is recommended to ensure stability of large fractures and osteotomies.**

Options:

- **The Trocar Instrumentation for MatrixRIB Fixation System may be used for screw insertion.**
- **10 and 12 mm non-locking screws are available to ensure the plate sits flush with the bone.**

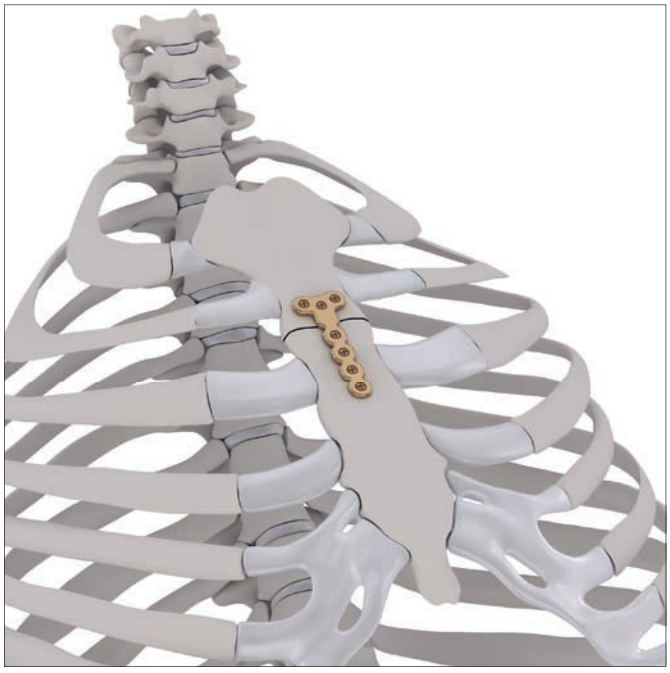
10
Drill and place remaining screws

Verify proper reduction of fracture/osteotomy. Insert a second screw on the opposite side of the sternum following Steps 7 through 9.

Insert all remaining screws in the same manner. If non-locking screws were used, remove and replace with a proper length locking screw.

Precautions:

- **If non-locking screws are not replaced with locking screws, the likelihood of implant loosening/ migration may be increased.**
- **Use a minimum of three screws on each side of the fracture, to properly secure the plate.**
- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**



11
Insert remaining plates (optional)

Place remaining plates, if necessary, following Steps 4 through 10.

12
Post-operative considerations

Avoid pulling or lifting the patient by the arms for 6 weeks.

Avoid raising arms higher than 90° at shoulder level.

Avoid contact sports and other activities for which there is the potential for high-velocity impact.

Alternative Techniques

Self-Drilling Screws

Self-drilling locking and non-locking screws are available as an alternative to self-tapping locking and non-locking screws.

Self-drilling screws have a pointed, cutting tip that enables the surgeon to fixate the plate or intramedullary splint in position without drilling a pilot hole.

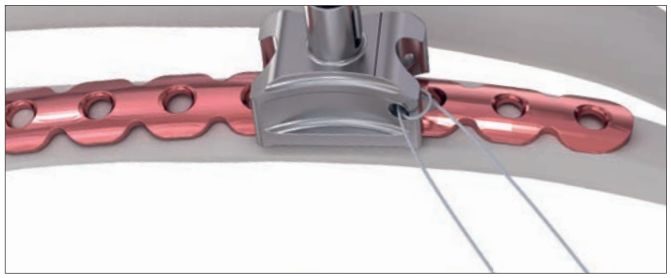
Self-drilling screw guide instruments are provided to ensure coaxial alignment of self-drilling screw in the screw hole. Self-drilling screw guide instruments have been designed for use with the 1.5 mm MatrixRIB Plates and MatrixRIB Intramedullary Splints.

Warnings:

- **Do not use self-drilling screws in 2.8 mm MatrixRIB Plates or in a 90º approach, which may result in misalignment of the screw during insertion resulting in higher insertion torque, debris formation, and/or inadequate screw locking.**
- **Improper screw length selection may lead to increased risk of screw protrusion or suboptimal cortex engagement. It's recommended to measure the thickness of each rib as it may vary between ribs.**

Self-drilling screw guide for 1.5 mm MatrixRIB Plates (03.501.718) has cut-outs to enable visualization of adjacent screw holes.

Additionally, this guide has a through hole to enable placement of a suture, which can be used as a tether for the screw guide in the event the guide is dropped in situ.

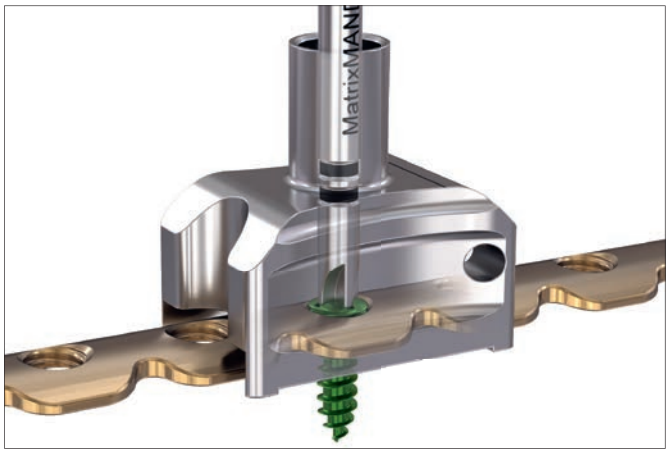


Self-drilling Screw Guide for 1.5 mm MatrixRIB Plates with suture placed as a tether.

Self-drilling
Non-Locking Screw

Self-drilling
Locking Screw

03.501.718 Self-drilling Screw Guide for 1.5 mm MatrixRIB Plates



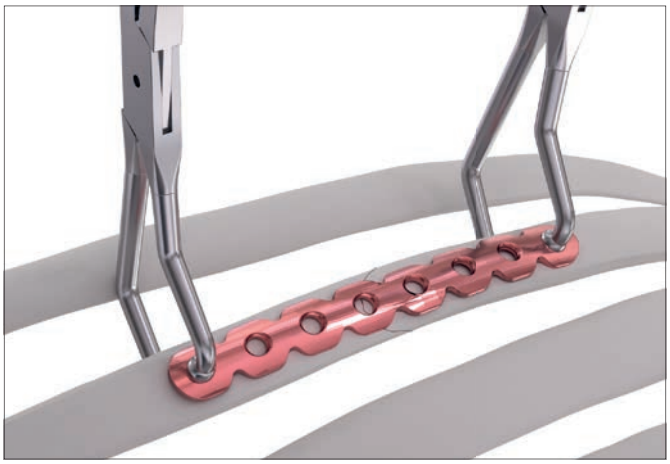
Self-drilling Screw insertion with Guide for 1.5 mm MatrixRIB Plates

Self-Drilling Screws Technique for 1.5 mm MatrixRIB Plates

1
Measure bone thickness and position Plate

Measure the rib bone thickness (using 03.501.065) and position the plate as described in Steps 1– 7 of the plating the rib section. Record measurement for use in screw selection in Step 3 below.

Precaution: **It is recommended to insert the forceps from the superior border of the rib to avoid damaging the nerve and vessel bundle located at the inferior border of the rib.**



2
Position Screw Guide on Plate

Instrument	
03.501.718	Self-Drilling Screw Guide for 1.5 mm MatrixRIB

With the plate positioned on the bone, align the screw guide with the plate. The screw guide should sit flush on the plate.

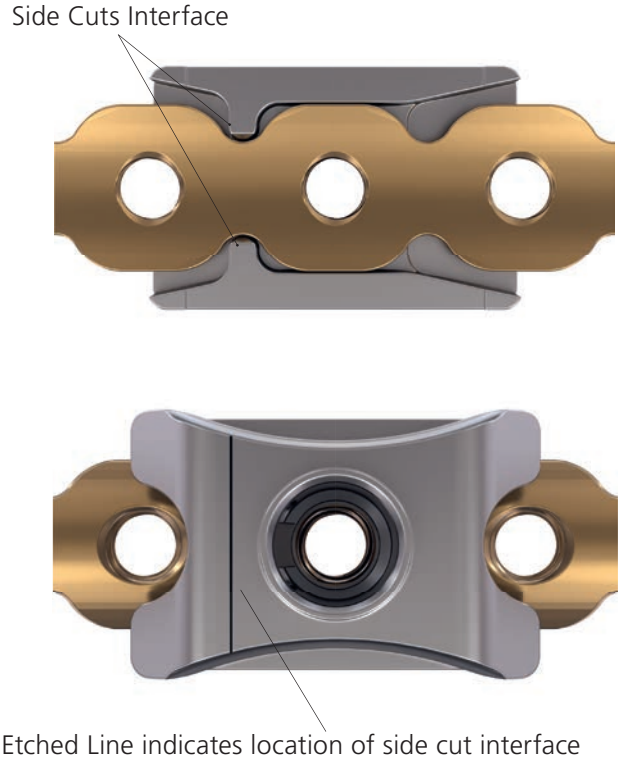
Additional contouring of the plate may affect the ability of the screw guide to engage the plate and align the screw, resulting in difficulty locking the screw.

The screw guide engages the plate along one pair of opposing side cuts. The etched line on the screw guide indicates the location of the side cuts. If the screw guide is difficult to engage the plate, rotating the screw guide to engage the opposite side cuts, may improve engagement.

Additionally, the presence of soft tissue in the side cuts of the plate may inhibit the engagement of the screw guide around the plate. Clearing the soft tissue may help improve engagement of screw guide to plate.

Precaution: **Improper alignment of the screw guide with the plate may result in off-axis insertion of the screw, resulting in inadequate locking of the screw and/or screw head sitting proud above the plate.**

Notes:
- **If there is difficulty or inability to engage the screw guide, self-tapping locking screws should be used.**
- **For additional stabilization of the screw guide on the plate, plate holding forceps can be used (03.501.071, 03.501.709).**
- **Ensure screw guide does not shift position during clamping.**



2a
Insert cannula (optional)

Instruments	
03.501.718	Self-Drilling Screw Guide for 1.5 mm MatrixRIB
03.501.702	Cannula for MatrixRIB
03.501.703	Trocar for MatrixRIB
03.506.003	Tissue Retractor Forceps
397.211	Universal Trocar Handle
Optional instruments	
03.501.071	MatrixRIB Plate Holding Forceps, small
03.501.709	MatrixRIB Plate Holding Forceps, large

If soft tissue flap or additional instrumentation interferes with proper placement of the screw guide, the cannula can be attached to the screw guide and used as a handle. The cannula can be used with or without the trocar handle.

Additionally, the cannula can be placed percutaneously and attached to the screw guide in situ.

Note: When using the Cannula, the long screwdriver blade (03.503.072) must be used for screw insertion.

i. Percutaneous Placement

After creating a stab incision, pass the cannula with trocar carefully through the soft tissue over the plate hole, then remove the trocar.

Clamp the tissue retractor forceps around the cannula through the primary access incision to retract the soft tissue.

Insert the screw guide through the primary access incision and attach securely to the cannula. With the plate held in place on the bone, position the screw guide onto the plate by aligning it onto the plate hole.

3
Select and insert screw

Instruments	
03.501.065	Caliper
03.501.718	Self-drilling Screw Guide for 1.5 mm MatrixRIB Plates
03.503.072	MatrixMANDIBLE/THORAX Self-retaining Screwdriver Blade, long
311.023	Ratcheting Screwdriver Handle
Optional Instrument	
03.503.071	MatrixMANDIBLE/THORAX Self-retaining Screwdriver Blade, medium

To select the appropriate screw length, add 2 mm to the measurement recorded in Step 2 of the Plating Rib section to allow for plate thickness - round down according to the chart.

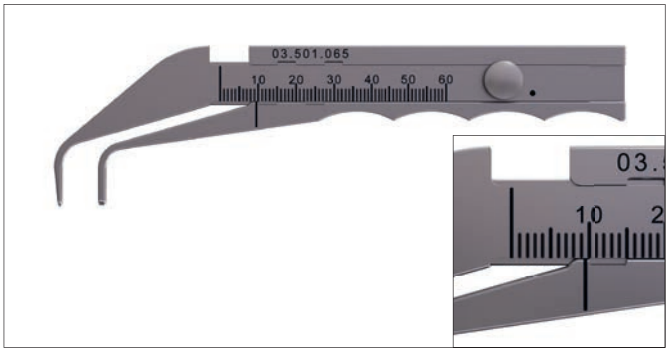
Self-drilling screws are provided in 1 mm increments to enable bicortical placement, such that the tip of the screw engages the inner cortex of the rib, with minimal or no protrusion.

The screw length indicator on the module can be used as a reference to confirm screw length.

Certain clinical factors may result in the need to reaffirm required screw length with the plate positioned on the bone (such as the presence of soft tissue and the amount of space, if any, between the plate and the bone).

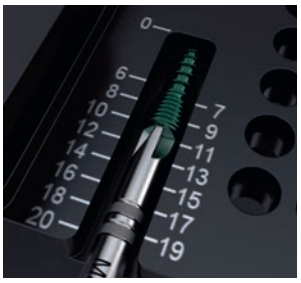
Warnings:

- **If the tip of the screw does not engage the inner cortex of the rib, the risk of screw pullout may be increased.**
- **If the tip of the screw extends too far beyond the inner cortex, the risk of injury to underlying tissues may be increased.**



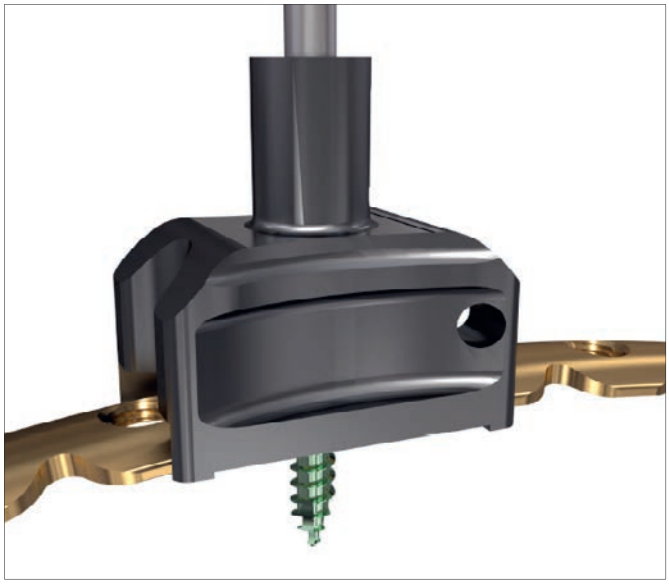
Example, bone thickness measurement = 9.5 mm.
Choose 11 mm screw length (03.501.065).

Measured Bone Thickness	Recommended Screw Length
6.0–7.0 mm	8 mm
7.0–8.0 mm	9 mm
8.0–9.0 mm	10 mm
9.0–10.0 mm	11 mm
10.0–11.0 mm	12 mm
11.0–12.0 mm	13 mm
12.0–13.0 mm	14 mm
13.0–14.0 mm	15 mm
14.0–15.0 mm	16 mm
15.0–16.0 mm	17 mm
16.0–17.0 mm	18 mm
17.0–18.0 mm	19 mm
18.0–19.0 mm	20 mm



Screw length indicator on module.

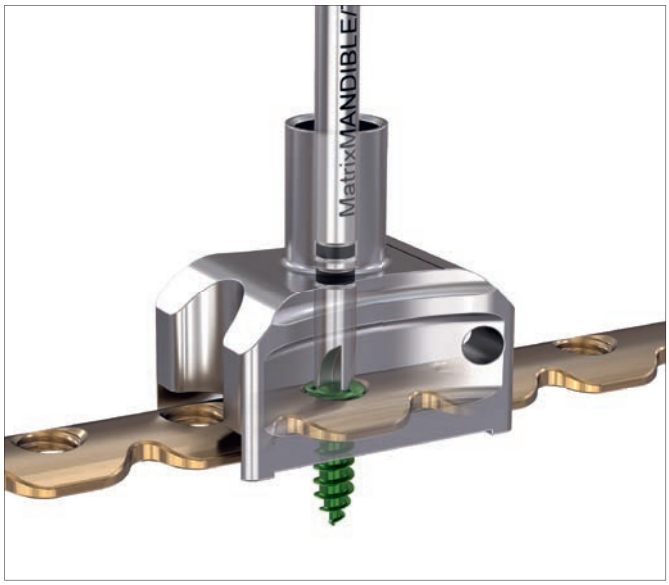
While holding the Screw Guide in position, insert the proper length self-drilling locking screw through screw guide and tighten until secure in the plate. Final tightening may be necessary after screw guide is removed. The screw head should seat flush with the surface of the plate.



Option: **10 and 12 mm non-locking self-drilling screws are available to ensure the plate sits flush with the bone.**

Notes:

- **If the measurement is taken with the plate positioned on the bone, choose the screw length that matches the measured thickness without adding 2 mm.**
- **If the measured bone thickness requires a screw length smaller than 8 mm, a 6 mm Self-Tapping Screw (and MatrixRIB Self-tapping Screw Instrumentation) should be used.**
- **If there is difficulty or inability to insert screws due to dense bone or inability to use the screw guide, self-tapping screws should be used.**
- **Once the screw is started in the bone, the screw guide can be lifted along the driver blade to ensure that the plate is flush with the bone.**



Precautions:

- **The non-locking screws are for temporary fixation and will need to be replaced with locking screws before closure.**
- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container, in accordance with hospital procedures.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**
- **Improper engagement of the screwdriver blade with the screw and/or overtightening during insertion may deform, strip or break the screw, which may make further tightening or eventual removal more difficult, and the screwdriver blade may deform or slip out of the screwhead drive recess.**

Self-Drilling Screws for Intramedullary Splints

1
Position Screw Guide on Splint

Instruments	
03.501.719	Self-Drilling Screw Guide for MatrixRIB Intramedullary Splints

Optional Instrument	
03.501.702	Cannula for MatrixRIB

With the splint placed in the bone as described in Steps 1–5 of the Splint Insertion technique, align the screw guide with the splint. The screw guide should sit flush on the splint.

The presence of soft tissue on the bone may affect the engagement of the screw guide to the splint. Clearing the soft tissue may help improve engagement of screw guide to plate.

Notes:

- **If there is difficulty or inability to engage the screw guide, a self-tapping locking screw can be used.**
- **Once the screw is started in the bone, the screw guide can be lifted along the driver blade to ensure that the splint is flush with the bone.**

Precaution: **Improper alignment of the screw guide with the splint may result in off-axis insertion of the screw, resulting in inadequate locking of the screw and/or screw head protrusion above the splint.**

Alternatively, if soft tissue or additional instrumentation interferes with proper placement of the screw guide, the cannula can be attached to the screw guide and used as a handle. The cannula can be used with or without the trocar handle.

03.501.719 Self-drilling Screw Guide MatrixRIB Intramedullary Splints

2
Select and insert screw

Instruments	
03.501.065	Caliper
03.501.719	Self-Drilling Screw Guide for MatrixRIB Intramedullary Splints
03.503.072	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, long
311.023	Ratcheting Screwdriver Handle
Optional Instrument	
03.501.702	Cannula for MatrixRIB
03.503.071	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, medium

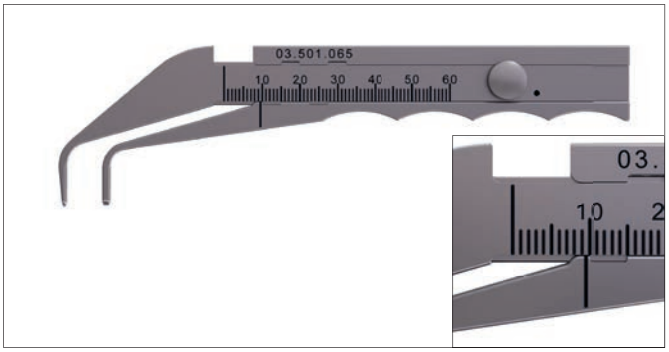
To select the appropriate screw length, add 1 mm to the measurement recorded in Step 2 of the Splint Insertion technique to allow for splint thickness - round down according to the chart.

Self-Drilling Screws are provided in 1 mm increments to enable bicortical placement, such that the tip of the screw engages the inner cortex of the rib, with minimal or no protrusion.

The screw length indicator on the module can be used to confirm screw length.

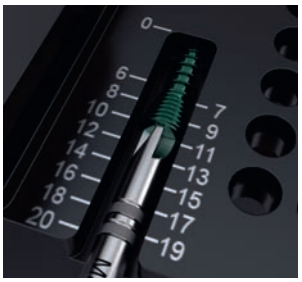
Warning:

- **If the tip of the screw does not engage the inner cortex of the rib, the risk of screw pullout may be increased.**
- **If the tip of the screw extends too far beyond the inner cortex, the risk of injury to underlying tissues may be increased.**



Example, bone thickness measurement = 9.5 mm.
Choose 10 mm screw length (03.501.065).

Measured Bone Thickness	Recommended Screw Length
7.0–8.0 mm	8 mm
8.0–9.0 mm	9 mm
9.0–10.0 mm	10 mm
10.0–11.0 mm	11 mm
11.0–12.0 mm	12 mm
12.0–13.0 mm	13 mm
13.0–14.0 mm	14 mm
14.0–15.0 mm	15 mm
15.0–16.0 mm	16 mm
16.0–17.0 mm	17 mm
17.0–18.0 mm	18 mm
18.0–19.0 mm	19 mm



Screw length indicator on module.

While holding the Screw Guide in position, insert the proper length self-drilling locking screw through screw guide and tighten until secure in the splint. Final tightening may be necessary after screw guide is removed.

Precautions:

- **Improper engagement of the screwdriver blade with the screw and/or overtightening during insertion may deform, strip or break the screw, which may make further tightening or eventual removal more difficult, and the screwdriver blade may deform or slip out of the screwhead drive recess.**
- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container, in accordance with hospital procedures.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**

Note:

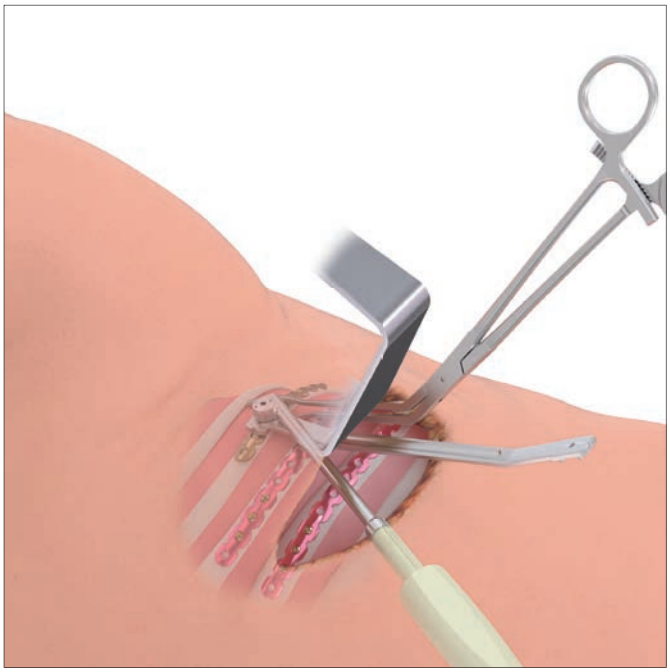
- **If the measurement is taken with the splint positioned on the bone, choose the screw length that matches the measured thickness without adding 1 mm.**
- **If the measured bone thickness requires a screw length smaller than 8 mm, a 6 mm Self-Tapping Screw is available.**
- **If there is difficulty or inability to insert screws due to dense bone or the inability to use the screw guide, self-tapping screws can be used.**

MIPO Instructions

Minimally Invasive Plate Osteosynthesis (MIPO)

MIPO instruments offer additional approach options that are less invasive than the original MatrixRIB Fixation System. These instruments overcome various access challenges by extending their reach without increasing incision size.[23]

The MIPO instrumentation includes the following: Trocar Instruments, Threaded Reduction Tool, and instruments for the 90° Screwdriver.



Caliper Forceps Instructions for MatrixRIB Fixation System

Measure rib thickness using caliper forceps

Instruments

03.501.715	Caliper Forceps

The caliper forceps can be used to measure the rib when surgical access to the bone is limited, such as in the percutaneous approach.
The tip of the caliper forceps can be inserted through an existing access in the intercostal space. The tip of the caliper forceps can also be used for blunt dissection of the intercostal muscle.

Align the tips of the caliper forceps along the midpoint of the bone to ensure proper measurement.

Precaution: **Be careful not to pinch hand or gloves, or injure yourself when using the caliper forceps.**

Precaution: **If the caliper forceps are clamped too tightly during measurement, the caliper forceps may flex, resulting in a rib thickness measurement that is smaller than the actual thickness of the rib.**

To select the appropriate drill bit with stop and / or the appropriate screw length, add 2 mm to the measurement to allow for the plate thickness.

If the bone is measured with the plate in place, do not add 2 mm.

Precaution: **Take care to avoid damaging the nerve and vessel bundle at the inferior border of the rib.**

Measuring rib thickness with the plate positioned on the bone.

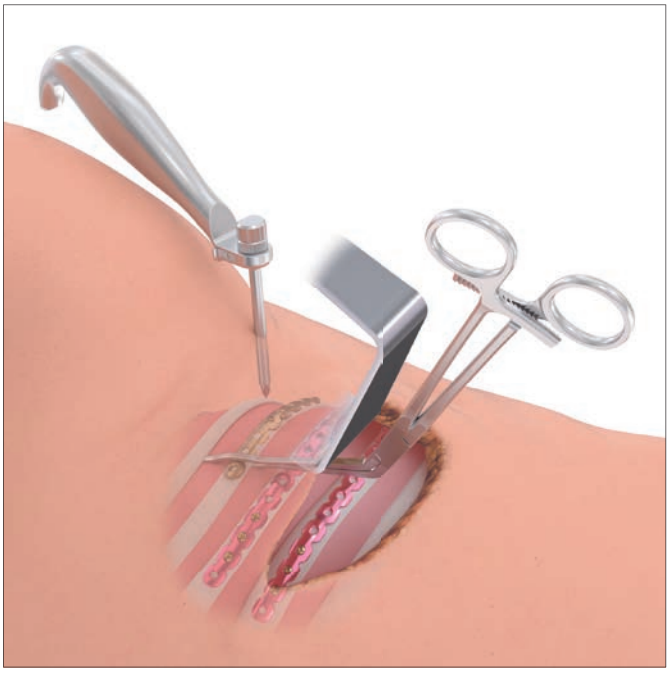
Trocar Instruments Instructions for MatrixRIB Fixation System

1
Insert cannula

Instruments	
397.211	Universal Trocar Handle
03.501.700	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates, long
03.501.702	Cannula for MatrixRIB System
03.501.703	Trocar for MatrixRIB System

After creating a stab incision, pass the cannula with trocar carefully through the soft tissue over the plate hole, then remove the trocar.

Note: **The cannula can be used with or without the universal trocar handle.**



*Length determined in Step 2 of the plating rib or plating sternum instructions.

2
Drill

Instrument	
03.501.700	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates, long
Optional instrument	
03.506.003	Tissue Retractor Forceps

Thread drill guide into the plate through the cannula.

Select the appropriate drill bit with stop* and drill.

Precautions:

- **Irrigate during drilling to avoid thermal damage to the bone.**
- **Do not drill any deeper than necessary, to avoid risk of pneumothorax.**
- **Drilling speed should never exceed 1800 rpm. Higher speeds can result in thermal necrosis of the bone and increased hole diameter and may lead to unstable fixation.**

Remove drill guide.

Note: **Retraction forceps may be used to retract soft tissue.**

3
Select and insert screw

Select the appropriate length screw* and insert into the cannula and through the plate, and tighten until secure.

Precautions:

- **The screw should be placed bicortically. The tip of the screw should not extend too far beyond the posterior cortex to avoid deeper injury.**
- **In order to determine the appropriate amount of fixation for stability, the surgeon should consider the size and shape of the fracture or osteotomy. DePuy Synthes recommends at least three screws per plate per fracture side when repairing osteotomies and fractures with this system. Additional fixation is recommended to ensure stability of large fractures and osteotomies.**
- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**

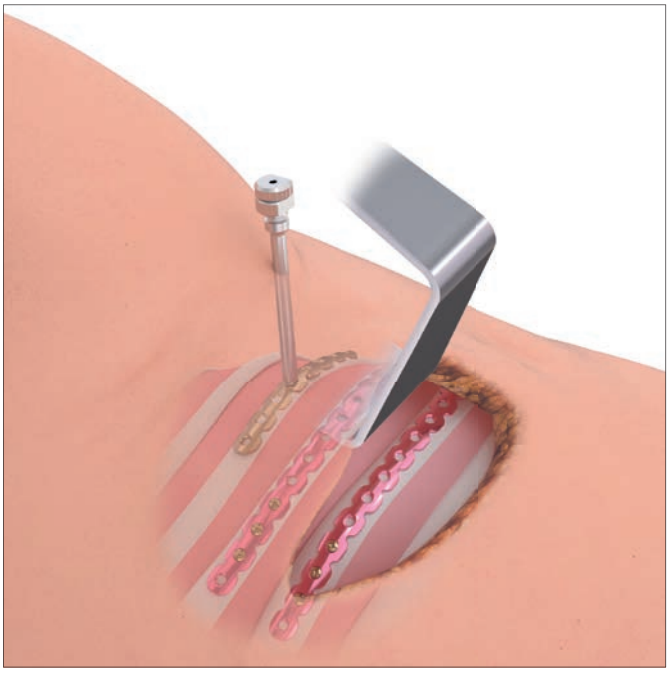
Note: **Screws can be measured using the screw length indicator on the module.**

*Length determined in Step 2 of the plating rib or plating sternum instructions.

Threaded Reduction Tool Instructions

1
Thread drill guide to plate

Instrument	
03.501.700	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates, long
03.501.702	Cannula for MatrixRIB System
03.501.703	Trocar for MatrixRIB System
Optional instrument	
03.501.033	2.2 mm Threaded Drill guide for MatrixRIB Locking Plates (for open approach)



Create a stab incision and pass cannula with trocar carefully through the soft tissue over the plate hole, then remove the trocar.

Thread the drill guide into the plate hole.

The Threaded Reduction Tool can be also be used where direct access to the plate exists without the need to use the cannula and trocar. In an open approach, the drill guide is still needed.

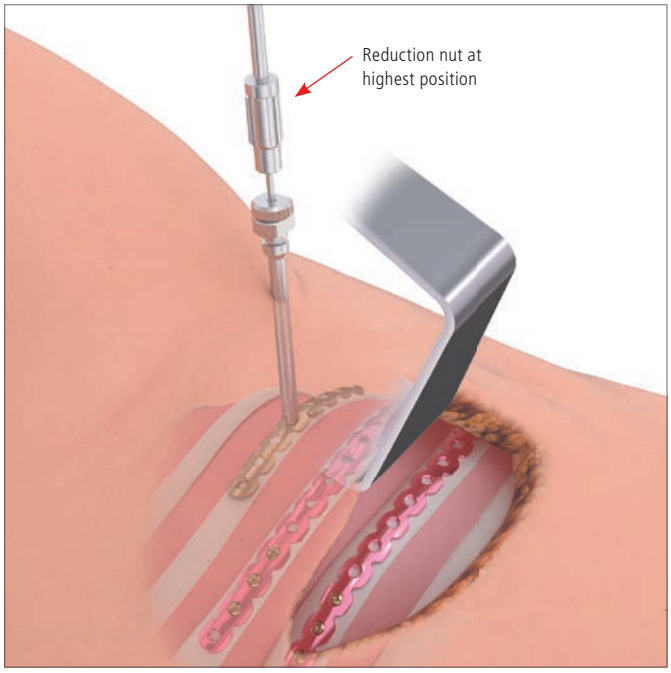
2
Insert Threaded Reduction Tool through drill guide

Instrument	
03.501.704	2.2 mm Threaded Reduction Tool for MatrixRIB System, AO Quick Coupling

With the Threaded Reduction Tool attached to a power source, place it in drill guide.

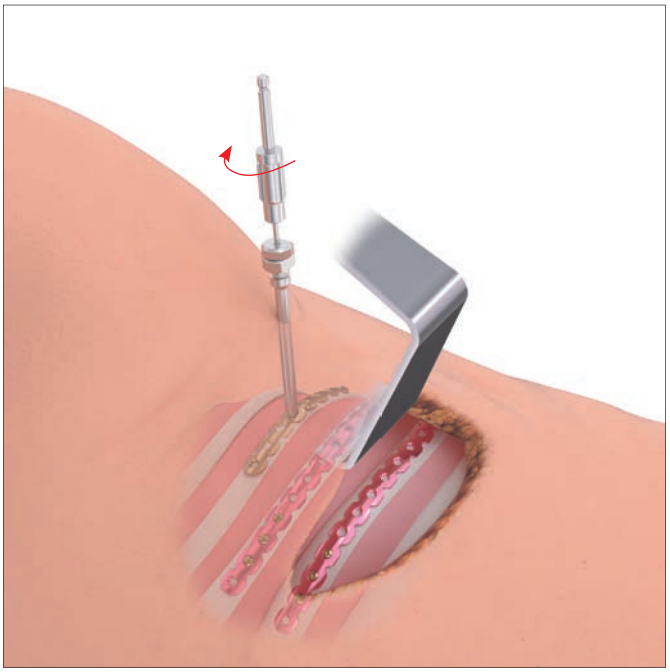
With the reduction nut in the highest position possible, begin power insertion of the Threaded Reduction Tool slowly.

Precaution: **The Threaded Reduction Tool has a maximum insertion length of 15 mm. To avoid injuries, limit the insertion depth according to the patient's rib thickness. Stop insertion before the Threaded Reduction Tool contacts the top surface of the drill guide. Continuing to power after contacting the top surface of the drill guide may cause the Threaded Reduction Tool threads to strip in the bone.**



3
Remove the power source

Remove the power source and begin tightening the reduction nut toward the drill guide while monitoring progress of bone/plate contact.



4
Reduce bone to plate

Stop when the desired reduction is achieved.

Note: **The Threaded Reduction Tool is designed to allow later placement of a 2.9 mm MatrixRIB Locking Screw in the same hole–after removal of the Threaded Reduction Tool.**

Precautions:

- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**

90° Screwdriver Instructions for MatrixRIB Fixation System

1
Drilling with 90° Screwdriver

Instrument	
03.501.751 03.501.752	2.2 mm MatrixRIB Drill Guide for 90° Screwdriver with 0–90° with 45–45°
03.501.756- 03.501.770	2.2 mm Drill Bits with stop for 90° Screwdriver, 6 mm to 20 mm

Engage and hold the desired angled drill guide on the desired plate hole.

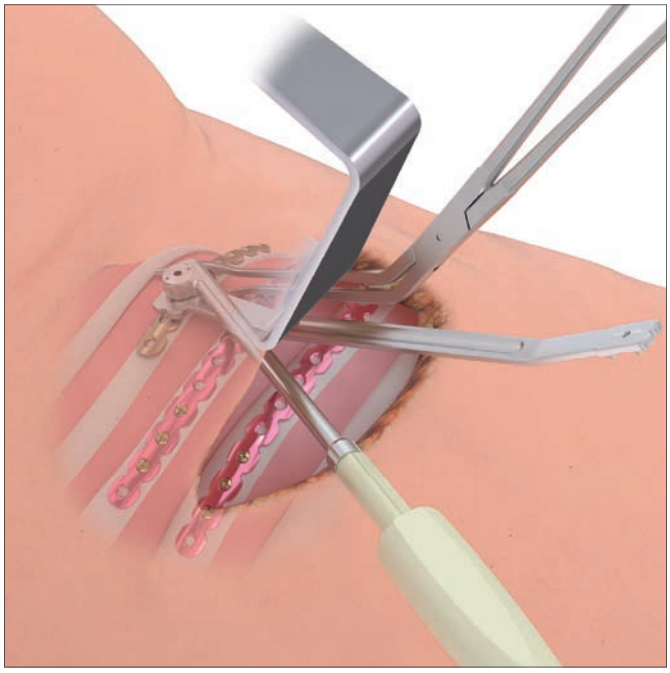
Note: **Ensure the head of drill guide is seated flat on top of the plate to ensure proper engagement.**

Select the appropriate drill bit with stop* and drill. Drill bits can be measured using the drill bit length indicator on the module.

Precautions:
- **Do not drill any deeper than necessary to avoid the risk of pneumothorax.**
- **Irrigate during drilling to avoid thermal damage to the bone.**
- **Drilling speed should never exceed 1800 rpm. Higher speeds can result in thermal necrosis of the bone and increased hole diameter and may lead to unstable fixation.**

Remove drill guide after drilling.

Note: **90° Screwdriver may stall during drilling if drill bit is misaligned with the drill guide.**



* Length determined in Step 2 of the plating rib instructions on page 11.

2
Insert screw

Instrument	
03.501.750	MatrixRIB Screwdriver Blade for 90° Screwdriver, self-retaining

Select the appropriate length screw* and insert it through the plate and tighten until secure.

Precautions:

- **The screw should be placed bicortically. The tip of the screw should not extend too far beyond the posterior cortex to avoid deeper injury.**
- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**

Note: **Screws can be measured using the screw length indicator on the module.**

*Length determined in Step 2 of the plating rib instructions on page 11.

Chest Wall Reconstruction

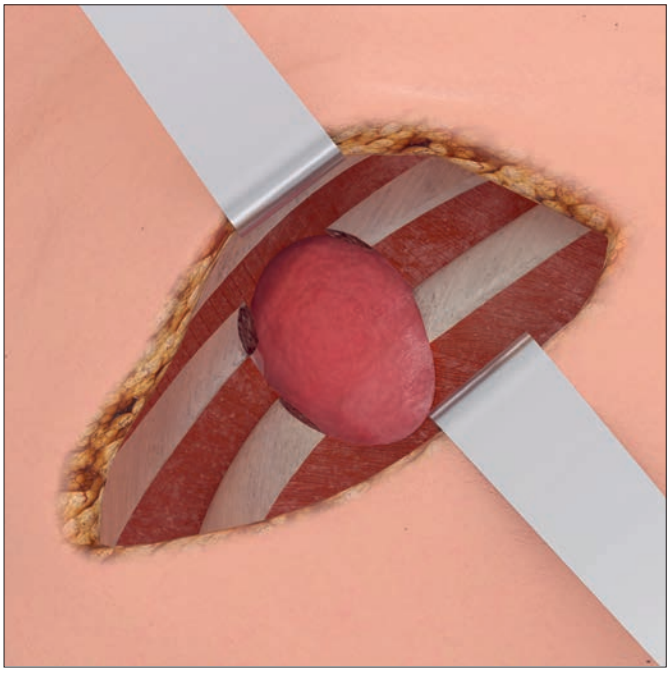
Chest Wall Reconstruction, Including Spanning Gaps

1
Expose surgical site

Incise and elevate soft tissues as required to gain access to the surgical site.

Excise non-viable soft tissues and boney structures. Ensure enough viable bone is available for a minimum of three screws on either side of the osteotomy.

Warning: **When implants are used to bridge gaps after chest wall resections there is potential risk for herniation and adhesion of the underlying organs/soft tissue.**



2
Determine rib/sternal thickness

Instrument	
03.501.074	Universal Caliper
Optional instrument	
03.501.065	Caliper

Determine rib/sternal thickness with the caliper.

To select the appropriate drill bit with stop and the appropriate screw length, add 2 mm to allow for the plate thickness.

Precaution: **Take care to avoid damaging the nerve and vessel bundle at the inferior border of the rib.**

3
Cut and contour bending template (optional)

Instrument	
03.501.090	Bending Template for MatrixRIB Locking Plates, 300 mm length

Cut the bending template to a length that allows placement of a minimum of three screws on the rib/sternum on either side of the osteotomy.

Contour the template to the desired anatomical result.

4
Select and cut plate (optional)

Instrument	
03.503.057	Short Cut Plate Cutter (2 required)

Use the plate template contoured in Step 4 to select the best matching plate.

Note: **Position the precontoured plate with the marking toward the sternum.**

If necessary, cut the plate to the desired length.

Precaution: **In order to determine the appropriate amount of fixation for stability, the surgeon should consider the size and shape of the fracture or osteotomy. DePuy Synthes recommends at least three screws per plate per fracture side when repairing osteotomies and fractures with this system.**
Additional fixation is recommended to ensure stability of large fractures and osteotomies.

5
Contour plate (optional)

Instrument	
03.501.091	Combination Bending Pliers for MatrixRIB

Using the bending pliers, contour the plate to match the template.

Precaution: **If contouring is necessary, avoid sharp bends, reverse bends, or bending the implant at a screw hole. Avoid notching or scratching the implant. These factors may produce internal stresses which may become the focal point for eventual breakage of the implant.**

6
Position plate

Instrument	
03.501.071	MatrixRIB Plate Holding Forceps, small
Optional instruments	
03.501.030	MatrixRIB Plate Holding Forceps, small, with ball tips
03.501.031	MatrixRIB Plate Holding Forceps, large, with ball tips
03.501.704	Threaded Reduction Tool for MatrixRIB, AO Quick Coupling (see page 54 for instructions)
03.501.708	MatrixRIB Plate Holding Forceps, upright with ball tip
03.501.709	MatrixRIB Plate Holding Forceps, large

Position the plate over the osteotomy, allowing for the placement of a minimum of three screws on the rib/sternum on either side of the defect.

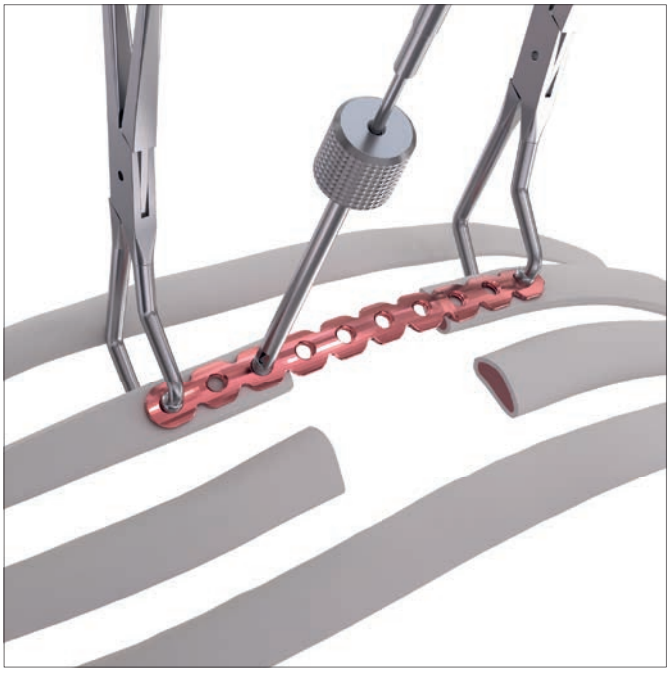
Verify the contour of the plate matches the desired anatomical result.

Using the plate holding forceps, hold the plate on the bone.

Precaution: **It is recommended to insert the forceps from the superior border of the rib to avoid damaging the nerve and vessel bundle located at the inferior border of the rib.**

7
Drill

Instrument	
03.501.033	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates
03.501.036– 03.501.050	2.2 mm Drill Bits with stop, Stryker J-Latch, 6 mm to 20 mm stop
Optional instruments	
03.501.700	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates, long



Thread the drill guide into the plate.

Select the drill bit with stop as determined in Step 3 and drill.

Drill bits with stop are available with stop lengths ranging from 6 mm to 20 mm, in 2 mm increments, matching the locking screw lengths.

Precautions:
- **Irrigate during drilling to avoid thermal damage to the bone.**
- **Do not drill any deeper than necessary to avoid the risk of pneumothorax.**
- **Drilling speed should never exceed 1800 rpm. Higher speeds can result in thermal necrosis of the bone and increased hole diameter and may lead to unstable fixation.**

Remove the 2.2 mm drill guide after drilling.

Options:
- **The Trocar Instrumentation for MatrixRIB Fixation System may be used for drilling (see Trocar Instrument Instructions for MatrixRIB Fixation System on page 68).**
- **The 90° Screwdriver for MatrixRIB Fixation System may be used for drilling (see 90° Screwdriver instructions for MatrixRIB Fixation System on page 74).**

8
Confirm rib/sternal thickness (optional)

Instruments	
03.501.001	Depth Gauge for Sternal Cable

Optional instrument	
03.503.085	Depth Gauge for MatrixMANDIBLE, measuring range up to 40 mm
03.501.702	Cannula for Matrix RIB

Use the depth gauge through the plate to confirm the appropriate screw length determined in Step 3.

Precaution: **Do not extend the tip of the depth gauge too far beyond the posterior cortex of the rib.**

Note: **When using the cannula, the 03.503.085 depth gauge must be used.**

9
Select and insert screw

Instruments	
03.503.071	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, medium
311.023	Ratcheting Screwdriver Handle
Optional instrument	
03.503.072	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, long

Select and insert the locking screw (with proper length determined in Step 3) through the plate and tighten until secure.

Note: **The screw length indicator on the module can be used to select the appropriate screws.**

Precautions:

- **The screw should be placed bicortically. The tip of the screw should not extend too far beyond the posterior cortex to avoid deeper injury.**
- **In order to determine the appropriate amount of fixation for stability, the surgeon should consider the size and shape of the fracture or osteotomy. DePuy Synthes recommends at least three screws per plate per fracture side when repairing osteotomies and fractures with this system. Additional fixation is recommended for stability of large fractures and osteotomies.**

Options:

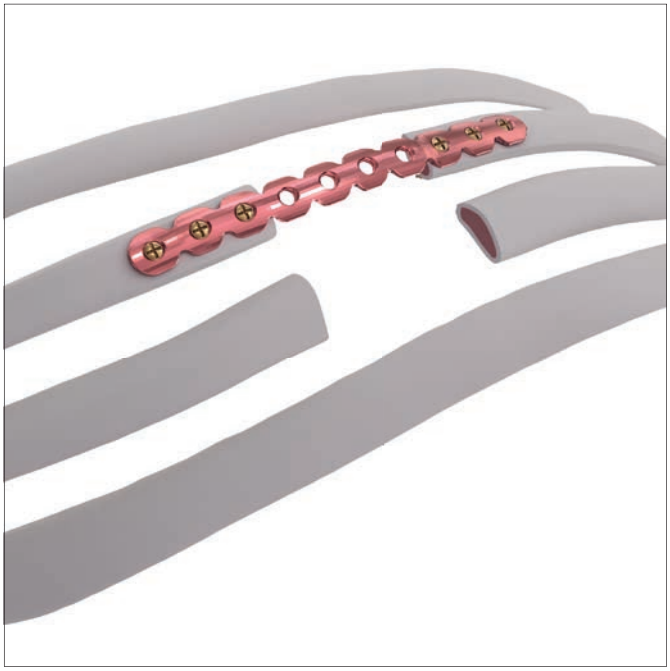
- **The MatrixRIB Trocar Instruments may be used for screw insertion (see Trocar Instrument Instructions for MatrixRIB Fixation System on page 68).**
- **The 90° Screwdriver for MatrixRIB Fixation System may be used for screw insertion (see 90° Screwdriver instructions for MatrixRIB Fixation System on page 74).**
- **10 and 12 mm non-locking screws are available to ensure the plate sits flush with the bone.**
- **Self-drilling screws may be used as an alternative to self-tapping screws in 1.5 mm plates. (See self-drilling screw selection and insertion instructions on page 55)**

Precaution:
The non-locking screws are for temporary fixation and will need to be replaced with locking screws before closure.

10
Drill and place remaining screws

Insert a second screw on the opposite side of the osteotomy following Steps 8 and 10. Insert remaining screws in the same manner.

Precaution: **If non-locking screws are not replaced with locking screws, the likelihood of implant loosening/migration may be increased.**



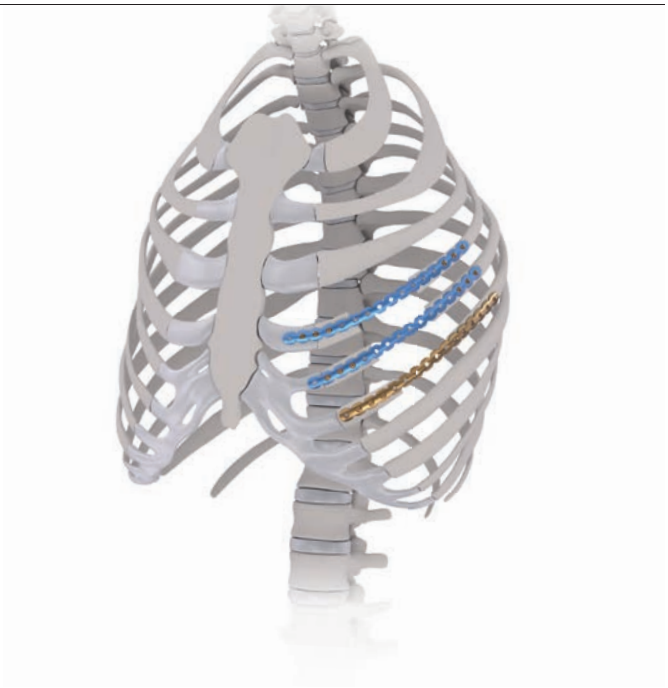
11
Insert remaining plates (optional)

Insert remaining plates as per Steps 3 through 11.

A minimum of three long MatrixRIB straight plates (24 or 30 holes) is recommended for transverse sternal reconstruction.
In order to determine the appropriate amount of fixation for stability, the surgeon should consider the size and shape of the fracture or osteotomy. DePuy Synthes recommends at least three screws per plate per fracture side when repairing osteotomies and fractures with this system. Additional fixation is recommended to ensure stability of large fractures and osteotomies.

Precaution:

- **A minimum of three plates is recommended for sternal reconstruction.**
- **After implant placement is complete, discard any fragments or modified parts in an approved sharps container.**
- **Irrigate and apply suction for removal of debris potentially generated during implantation.**



12
Post-operative Considerations

Avoid pulling or lifting the patient by the arms for six weeks.

Avoid raising arms higher than 90° at shoulder level.

Chest Wall Deformity Repair

1
Expose surgical site

Incise and elevate soft tissues as required to gain access to the surgical site.

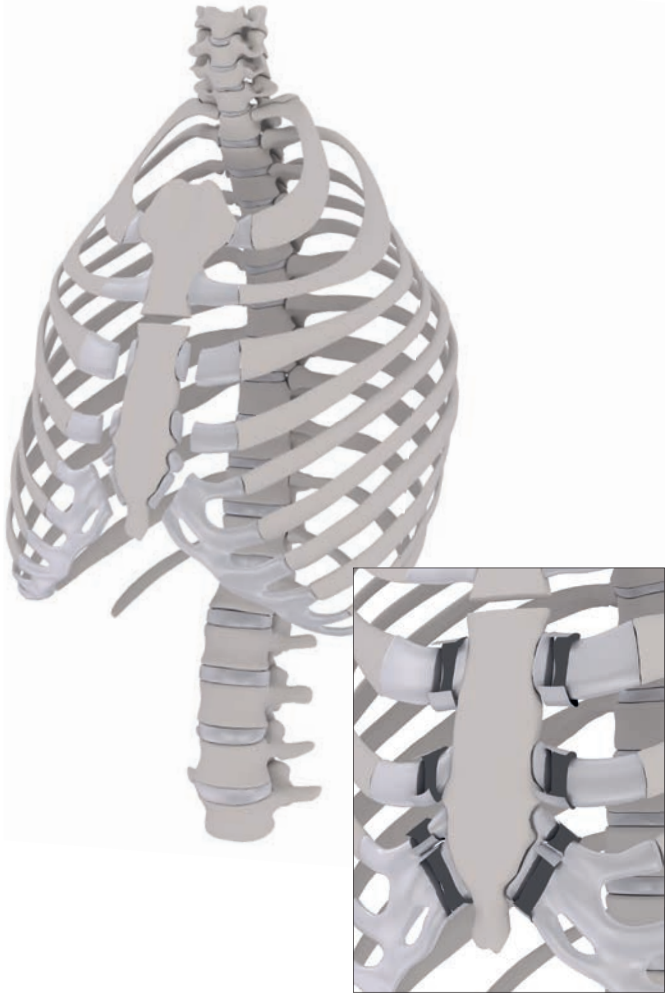
2
Release deformed sections of chest wall

Perform transverse wedge osteotomy(ies) across the anterior table of the sternum to elevate and twist the sternum to the desired anatomic position.

Make rib osteotomies and resect the deformed costal cartilage subperichondrially as needed to facilitate the realignment of the chest wall.

Precaution: **Avoid significant muscle division to preserve as much respiratory function as possible.**

Notes:
- **The perichondrium should be preserved.**
- **Several wedge osteotomies on a rib may be required for full anatomical repositioning.**
- **Division of the xiphoid process, bilateral subperichondrial dissection of the cartilage, osteotomy of the anterior sternal cortex and retrosternal dissection may help facilitate to release the tension required to elevate the sternum into the desired anatomic position.**
- **Minimally invasive instrumentation is available (page 66) for drilling and screw insertion.**



3
Realign the anterior chest wall into desired anatomic position

Reduction forceps can be used to manipulate segments into desired anatomic position.

4
Position and fixate plate(s)

For sternal body plating, follow the Sternal Plating Technique starting on page 42.

If the sternum needed to be osteomized on different locations, more sternal plates can be used.

For rib or rib/sternal plating, follow the Rib Plating Technique starting on page 18.

The chest wall reconstruction approach on page 78 can also be referenced.

If long MatrixRIB System straight plates (24 or 30 holes) are used for rib-to-sternum-to-rib plating, more intensive plate contouring is required.

Precautions:

- **If contouring is necessary, avoid sharp bends, reverse bends, or bending the implant at a screw hole. Avoid notching or scratching the implant. These factors may produce internal stresses which may become the focal point for eventual breakage of the implant.**
- **Use of the incorrect instrumentation for bending may weaken the plate and lead to premature plate failure (e.g. breakage).**
- **Do not bend the plate beyond what is required to match the anatomy.**
- **Use a minimum of three screws on each side of the osteotomy to properly secure the plate.**

Note: **Number, type, and orientation of plates is based on individual patient anatomy, severity of deformity, and surgeon preference.**

5
Post-operative considerations

Avoid pulling or lifting the patient by the arms for 6 weeks.

Avoid raising arms higher than 90° at shoulder level.

Avoid contact sports and other activities for which there is the potential for a high-velocity impact.

Implant Removal

1
Preoperative Planning

To ensure that the appropriate instruments are available for screw removal, the surgeon should have the following information before implant removal:

- **Implant type**
- **Time of implantation**
- **Material**
- **Any visible damage to the implant**
- **(e.g. broken plate)**

2
Clean Recess

Before removing screws, clean the screw recess. Free the screw recess from ingrown bone and tissue to ensure the screwdriver can be fully inserted. Check the condition and geometry of the recess of the exposed screwhead.

3
Implant removal

Instruments	
03.503.072	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blade, long
311.023	Ratcheting Screwdriver Handle

To remove locking screws, ensure screwdriver blade is fully seated into the screwhead by applying some downward pressure on the screwdriver.

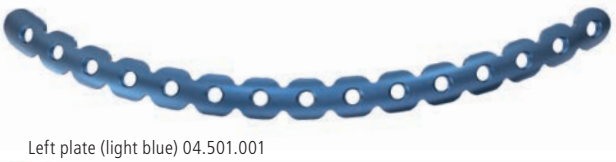
Slowly, turn the screwdriver counterclockwise until the screw unlocks from the plate. Then, fully remove the screw.

Note: **To remove screws with damaged recesses, refer to screw removal set with hardened drill bits.**

Product Information

Implants

	Titanium MatrixRIB Pre-Contoured Plates
04.501.001	15 holes, for left rib 3
04.501.002	15 holes, for right rib 3
04.501.003	16 holes, for left ribs 4 and 5
04.501.004	16 holes, for right ribs 4 and 5
04.501.005	17 holes, for left ribs 6 and 7
04.501.006	17 holes, for right ribs 6 and 7
04.501.007	18 holes, for left ribs 8 and 9
04.501.008	18 holes, for right ribs 8 and 9



Left plate (light blue) 04.501.001

Right plate (rose red) 04.501.002

04.501.009	Titanium MatrixRIB Universal Plate, 8 holes

	Titanium MatrixRIB Intramedullary Splints
04.501.010	Small, 3 mm width
04.501.011	Medium, 4 mm width
04.501.012	Large, 5 mm width

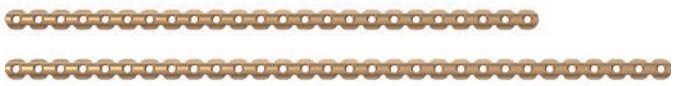
	2.7 mm Titanium MatrixRIB Locking Screws, self-drilling
04.501.208.01	8 mm
04.501.209.01	9 mm
04.501.210.01	10 mm
04.501.211.01	11 mm
04.501.212.01	12 mm
04.501.213.01	13 mm
04.501.214.01	14 mm
04.501.215.01	15 mm
04.501.216.01	16 mm
04.501.217.01	17 mm
04.501.218.01	18 mm
04.501.219.01	19 mm
04.501.220.01	20 mm

	2.7 mm Titanium MatrixRIB Non-locking Screws, self-drilling
04.501.250.01	10 mm
04.501.252.01	12 mm

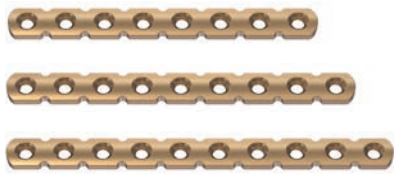
	2.9 mm Titanium MatrixRIB Locking Screws,* self-tapping
04.501.016.01	6 mm
04.501.018.01	8 mm
04.501.020.01	10 mm
04.501.022.01	12 mm
04.501.024.01	14 mm
04.501.026.01	16 mm
04.501.028.01	18 mm
04.501.030.01	20 mm

	2.9 mm Titanium MatrixRIB Non-locking Screws,* self-tapping
04.501.040.01	10 mm
04.501.042.01	12 mm

	1.5 mm Titanium MatrixRIB Straight Plates
04.501.096	24 holes, 240 mm length
04.501.097	30 holes, 300 mm length



	Titanium MatrixRIB Straight Plates, 2.8 mm Thick**
04.501.068	8 holes
04.501.069	9 holes
04.501.095	10 holes



	Titanium MatrixRIB Plates, 2.8 mm Thick**
04.501.093	T Plate, 7 holes
04.501.094	I Plate, 9 holes
04.501.103	T Plate, Wide, 8 holes
04.501.104	I Plate, Wide, 11 holes

*For screws in packs of 5, replace suffix .01 with .05.
**Available in non-sterile or sterile packed. Add S to product number for sterile product.

Instruments

03.503.085	Depth Gauge for 2.0 mm to 3.0 mm screws with polymer handle	
03.501.030	MatrixRIB Plate Holding Forceps, small, with ball tips	
03.501.031	MatrixRIB Plate Holding Forceps, large, with ball tips	
03.501.032	MatrixRIB Intramedullary Splint Driver	
03.501.033	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates	
03.501.036 – 03.501.050	2.2 mm with stop, Stryker J-Latch 6 mm to 20 mm stops (2 mm increments)	

03.501.055	5.5 mm Drill Guide for MatrixRIB Intramedullary Splints	
03.501.061	MatrixRIB Intramedullary Splint Template, small	
03.501.062	MatrixRIB Intramedullary Splint Template, medium	
03.501.065	Caliper	
03.501.066	Mallet, 200 g	
03.501.070	5.5 mm Drill Bit with stop, Stryker J-Latch, 125 mm	
03.501.718	Self-drilling screw guide for 1.5 mm MatrixRIB Plates	
03.501.719	Self-drilling screw guide for MatrixRIB Intramedullary Splints	

03.501.085	MatrixRIB Drill Bit ∅ 5.5 mm, with Stop, length 125 mm, 2-flute, for AO/ASIF Quick Coupling*	
03.501.071	MatrixRIB Plate Holding Forceps, small	
03.501.090	Bending Template for MatrixRIB Locking Plates, 300 mm length	
03.501.074	Universal Caliper	
03.501.075*	5.5 mm Drill Guide for MatrixRIB Intramedullary Splints, without handle	
	MatrixMANDIBLE/THORAX Self-Retaining Screwdriver Blades	
03.503.071	Medium	
03.503.072	Long	

311.023	Ratcheting Screwdriver Handle	
03.501.091	Combination Bending Pliers for MatrixRIB	
03.503.057	Shortcut Plate Cutter	
398.400	Reduction Forceps with points, narrow, ratchet, 132 mm length	
397.211	Universal Trocar Handle	

03.506.003	Tissue Retractor Forceps for Basic Trocar System	
03.501.700	2.2 mm Threaded Drill Guide for MatrixRIB Locking Plates	
03.501.702	Cannula for MatrixRIB System	
03.501.703	Trocar for MatrixRIB	
03.501.704	Threaded Reduction Tool for MatrixRIB System, AO Quick Coupling	
03.501.708	MatrixRIB Plate Holding Forceps, upright with ball tip	
03.501.709	MatrixRIB Plate Holding Forceps, large	

03.505.003	Shaft for Screwdriver 90°	
03.505.004	Handle for Screwdriver 90°	
03.505.005	Turning Handle for Screwdriver 90°	
03.501.750	MatrixRIB Screwdriver Blade, self-holding, for Screwdriver 90°	
03.501.751	MatrixRIB Drill Guide 2.2 mm for Screwdriver 90° with 0°/90° angle	
03.501.752	MatrixRIB Drill Guide 2.2 mm, for Screwdriver 90° with 45°/45° angle	

MatrixRIB Drill Bits* ∅ 2.2 mm, with Stop, 2-flute, for Screwdriver 90°

03.501.756	length	6 mm
03.501.758	lengths	8 mm
03.501.760	length	10 mm
03.501.762	length	12 mm
03.501.764	length	14 mm
03.501.766	length	16 mm
03.501.767	length	18 mm
03.501.770	length	20 mm

391.990 Cutting Pliers for Plates and Rods

03.501.715 MatrixRIB Caliper Forceps

*For sterile drill bits add suffix "S".

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