

Sternal Closure

STRATOS 

STRASBOURG
THORACIC
OSTEOSYNTHESIS

2nd Edition

Two options.

A stable sternum.

STERNAL CLOSURE WITH A CLIP

Partial or full sternotomy provides access for operations in the mediastinum, for example during heart surgery, bypass procedures or transplants. This involves making a longitudinal incision from the manubrium to the xiphoid process.

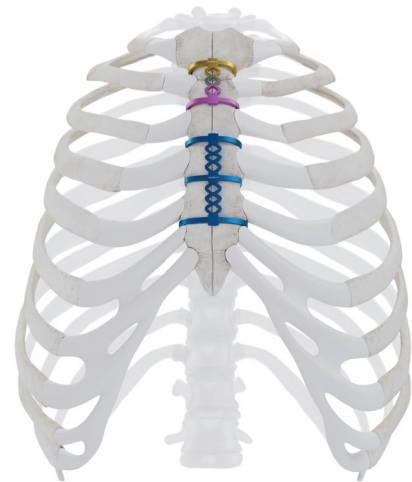
Following sternotomy, the sternal parts must be precisely repositioned and securely fixed in place. The titanium sternum clip provides load-bearing and functionally stable stabilization and allows for rapid mobilisation of the patient without restricting movement of the thorax.

ADVANTAGES

Titanium sternum clip

Technical advantages:

- A single component
 - No intraoperative configuration of multiple components
 - No loose implant fragments following implant failure (fracture)
- Different variants [2, 3]
 - Patient-specific selection of implants according to the width of the sternum
- Three-dimensional adaptability [1, 2, 3]
 - Can be individually adapted to the anatomical shape of the sternum
- Shortening or extending the rhombus bar [2, 3]
 - Patient-specific adjustment to the intervals between the intercostal spaces
- Shortening of the rhombus bar can also be performed after being fixed to the sternum [2]
 - Pressure can be exerted on the fracture / osteotomy
- Functional principle of the clipping mechanism [2]
 - No invasive effect on the sternum
 - Can be used in high-risk patients (e.g. those with poor bone structure or osteoporosis)
- Severing retrosternal preparation is not necessary [1, 2]
 - Reduced risk of injury to the heart or bypass grafts
- Wide contact surface between the bone and the implant [2]
 - Lower risk of cutting into the bone
 - Fixation of the sternum is possible in cases of poor bone structure
- Segment pairs of a titanium sternum clip are connected to each other [2]



→ Prevents axial and horizontal displacement of the sternal fragments; counteracts shear forces

- Functionally stable fixation of the sternum
 - Physiological movements of the chest wall are possible
- The implant can be removed using standard instruments (e.g. rasp, elevator, nipper cutting pliers)
 - Reopening of the sternum is possible even without an implant-specific extraction instrument

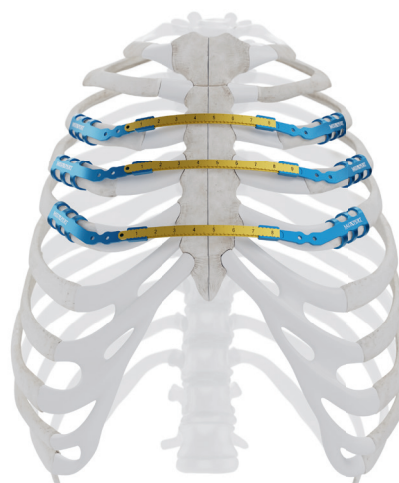
Clinical benefits of the titanium sternum clip:

- Ensures stability of the thorax [4]
- Osteosynthesis [2, 3, 4]
- Low complication rate [2]
- Shortened duration of surgery
- Shorter stay in hospital
- Accelerated healing process

STERNAL CLOSURE WITH AN IMPLANT BRIDGE

Primary stabilization following sternotomy – particularly in cases involving complex or off-axis approaches – is achieved using implant bridges. In this case, the osteotomised sternum is compressed and securely stabilized.

Alternatively, distance stabilisation allows leaving a gap between the two parts of the sternum to promote wound healing. The bridges are anchored laterally to the intact ribs, span the critical area and provide the necessary stability.



ADVANTAGES

Implant bridge:

Technical advantages

- Various components for combination [5]
 - Patient-specific selection of implants
- Three-dimensional adaptability [6, 7, 8]
 - Can be individually adapted to the anatomical shape of the chest wall
- Functional principle of the clipping mechanism [6, 8]
 - No invasive effect on the rib
 - Fixation on cartilage is possible
- Construction of an implant bridge on the ribs over the sternum
 - Secure sternal closure is possible

Clinical benefits implant bridge:

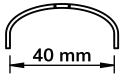
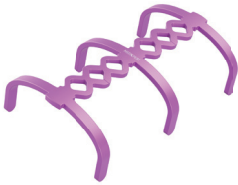
- Improved lung function [9, 10]
- Shorter stay in the intensive care unit [10]
- Pain reduction due to motion-stable fixation

■ IMPORTANT NOTE

MedXpert implants and instruments must only and exclusively be used for their intended purpose of use in the medical specialties by appropriately trained and qualified personnel. The treating physician is responsible for selecting the products for specific applications and for surgical application, as well as for appropriate training and information and adequate experience in the handling of the products.

► STERNAL CLOSURE WITH A STERNUM CLIP | IMPLANTS

The titanium sternum clip enables simple, anatomically adaptable and motion-stable fixation of the sternum in the case of a sternotomy, with a high degree of safety, a low complication rate and rapid patient mobilisation.

S 26 mm 	M 33 mm 	L 40 mm 
 015-01010 Titanium Sternum Single-clip, S	 015-01020 Titanium Sternum Single-clip, M	 015-01030 Titanium Sternum Single-clip, L
 015-01110 Titanium sternum Double-clip, S	 015-01120 Titanium sternum Double-clip, M	 015-01130 Titanium sternum Double-clip, L
 015-01310 Titanium sternum Triple-clip, S	 015-01320 Titanium sternum Triple-clip, M	 015-01330 Titanium sternum Triple-clip, L
 015-01210 Titanium sternum Double-clip, S/M	 015-01220 Titanium sternum Double-clip, M/L	
 015-01410 Titanium sternum Triple-clip, S/S/M	 015-01420 Titanium sternum Triple-clip, M/M/L	

► IMPLANTS | APPLICATION

INDICATION

- Fracture of the sternum
- Sternal osteotomy

FUNCTIONAL PRINCIPLE OF THE TITANIUM STERNUM CLIP

The titanium sternum clip is based on the clip principle:

- An open clip is placed on the bone (sternum). The segments of the clip are then bent around the bone using two special instruments. The segments are plastically deformed in this process. This results in a form-fitting connection between the segments and the bone, creating a stable connection between the titanium sternum clip and the sternum.
- This surgical stabilization of the sternum allows it to fuse back together.

APPLICATION

Sternotomy: treatment of at least five intercostal spaces

Possible combinations include:

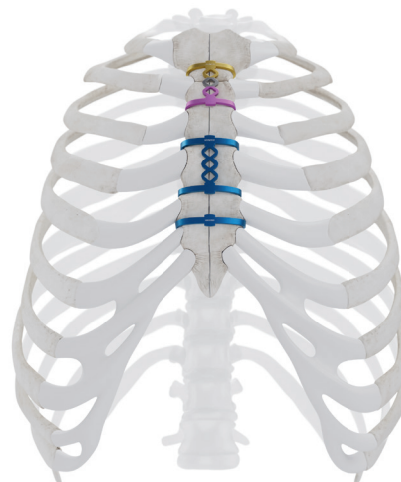
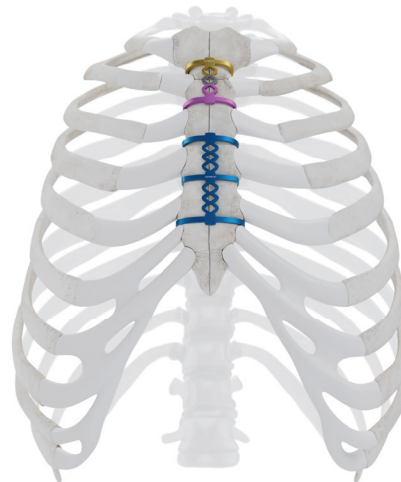
- 1 x Titanium sternum triple clip and 1 x Titanium sternum double-clip
- 2 x Titanium sternum triple clips and 1 x Titanium sternum single-clip

NOTE

- Trimming the titanium sternal clip by detaching one or more segments should be avoided, as this may compromise stable fixation.
- When closing the sternum following a sagittal sternotomy, MedXpert recommends securing at least five intercostal spaces with titanium sternum clips. It is not mandatory to use only titanium sternum single-clips.
- In the case of a sagittal fracture/sternotomy, one segment should be positioned on each side along the bony gap within an intercostal space.
- In the case of a transverse course of the fracture/sternotomy, a pair of segments of the titanium sternum clip should be placed following the intercostal space cranially and a pair of segments caudally.
- If the fracture or sternotomy runs obliquely, at least one segment of a titanium sternum clip should be positioned across the entire bone gap on each side of the affected intercostal space.

MATERIAL

The titanium sternum clips are made from Titanium Grade 2 in accordance with ASTM F 67 and ISO 5832-2.



► STERNAL CLOSURE WITH A STERNUM CLIP | INSTRUMENTS

The MedXpert instrument set has been specially developed for the use of implants and is matched to the products. MedXpert implants may only be used with the instruments specified by MedXpert.

010-01560

Sternum Implant Sizer

Instrument for determining and selecting the clip width of the titanium sternum clip

The working part of the instrument is inserted into the previously prepared intercostal spaces and closed as far as possible, so that the tips of the working part are positioned at the lateral edge of the sternum. The S / M / L scale is used to determine the appropriate clip width for this intercostal space. This procedure is repeated for each intercostal space in which a segment of the titanium sternum clip is to be inserted.

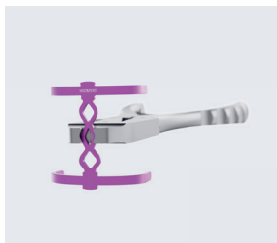
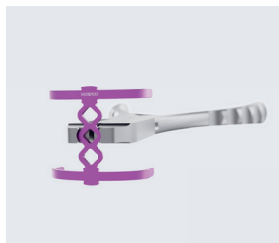


010-01530

Sternum clip Bar Elongation Pliers

Pliers for extending the distance between two segment pairs of the titanium sternum clip by reshaping the rhombus bar

The sternum clip bar elongation pliers are positioned on the rhombus bar such that the handle runs parallel to the segment pairs and the jaws enclose the rhomboid to be extended. Closing the pliers stretches the rhombus in the direction of the longitudinal axis, thereby increasing the distance between the two segment pairs. This procedure can be performed on all rhombi and extends the rhombus bar between two segment pairs by a maximum of 2.5 mm.

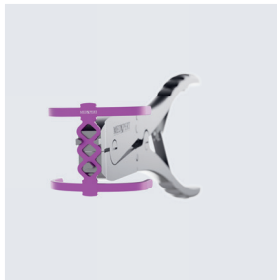


010-01540

Sternum clip Bar Shortening Pliers

Pliers for shortening the distance between two segment pairs of the titanium sternum clip by reshaping the rhombus bar

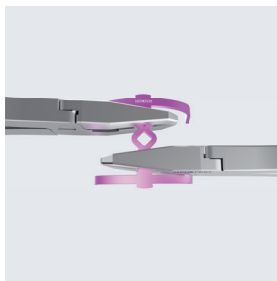
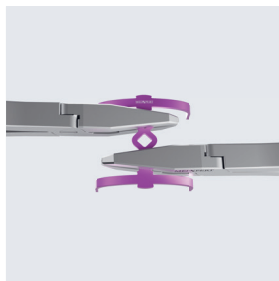
The sternum clip bar shortening pliers are positioned on the rhombus bar such that the handle runs vertical to the segment pairs and the bending pins enclose the rhombus bar to be shortened. Closing the pliers compresses the rhombus in the direction of the longitudinal axis, thereby shortening the distance between the two segment pairs. This procedure can be performed on all rhombi and shortens the rhombus bar between two segment pairs by a maximum of 2.5 mm.

**010-00025**

Flat-nosed bending pliers for rib clips and connecting bars,
13.5 cm

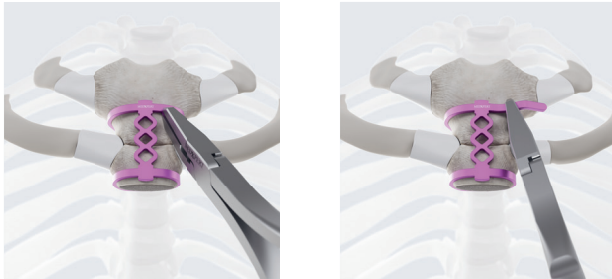
Pliers for adjusting the implants to the anatomical shape of the thorax

When bending with the flat bending forceps, they are used in pairs. The implant is then bent or torqued according to the required alignment.



Pliers for removing implants by detaching the segments

The flattened tip (wedge) of the flat-nose bending pliers is inserted beneath the section to be removed. By turning the flat-nose bending pliers, the segment is lifted and bent upwards. This procedure is repeated for each segment on one side. The clip can then be removed by a rotating motion.

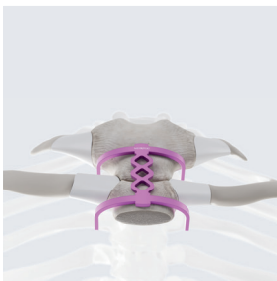


010-01510

Sternum clip Preforming Pliers

Pliers for preforming the titanium sternum clip by reshaping the segment pairs around the sternum

The sternum clip preforming pliers are positioned vertically in the centre of a pair of segments on the titanium sternum clip when closed, so that the tips of the pliers rest on the segments. The sternum clip preforming pliers are then opened gradually and the tips of the pliers are guided along the segments until the downholder rests on the rhombus block. When squeezing the handles of the sternum clip preforming pliers until they meet resistance from the bone, the ends of the segments are preshaped. The steps are repeated until all the segment pairs have been preformed around the sternum.

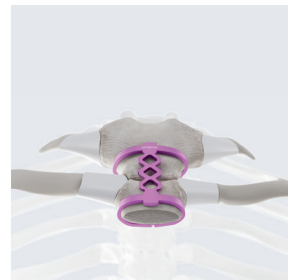


010-01520

Sternum clip Final Forming Pliers

Pliers for final reshaping the segment pairs around the sternum

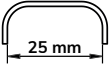
The sternum clip final forming pliers are positioned vertically on the titanium sternum clip in a semi-closed position, so that the shortened reshaper is hooked onto the rhombus block of the clip and the extended reshaper is situated laterally on the segment. The extended reshaper is guided step-by-step along the segment towards the end of the segment, and the pliers are closed with the handles until resistance from the bone is noticeable. This procedure is repeated for each segment until all segments have been shaped.

**IMPORTANT NOTE**

- All bending operations must be performed carefully and in a controlled manner to avoid corrections in the opposite direction to the initial bending direction.
- Avoid repeatedly bending the implants at the same point (bending them back and forth) and extreme angles / small bending radii.
- Manual bending without the use of instruments is preferable.

► STERNAL CLOSURE WITH AN IMPLANT BRIDGE | IMPLANTS

A stable and patient-specific sternal closure is crucial for the functional recovery of the chest wall following median sternotomy, particularly in cases of sternal instability, revision surgery, infection or poor bone quality. The objective is to achieve secure bony consolidation of the sternum whilst maintaining thoracic stability and respiratory mechanics.

TITANIUM RIB CLIPS	
STANDARD 17 mm Rigid connector 	XL 25 mm Rigid connector 
012-02225 Titanium rib clip, right, 22.5°, Standard	012-04225 Titanium rib clip, right, 22.5°, XL
 012-01225 Titanium rib clip, left, 22.5°, Standard	 012-03225 Titanium rib clip, left, 22.5°, XL
 012-02450 Titanium rib clip, right, 45°, Standard	 012-04450 Titanium rib clip, right, 45°, XL
 012-01450 Titanium rib clip, left, 45°, Standard	 012-03450 Titanium rib clip, left, 45°, XL
 014-01000 Titanium rib clip, straight, Standard	 014-01001 Titanium rib clip, straight, XL

TITANIUM CONNECTING BARS**014-10190**

Titanium connecting bar, completely serrated, 190 mm

**014-10230**

Titanium connecting bar, completely serrated, 230 mm

INDICATION

Need for stabilization of the chest wall in the case of:

Reconstruction

- Deep sternal wound infection (DSWI)

Trauma

- Sternal osteotomy

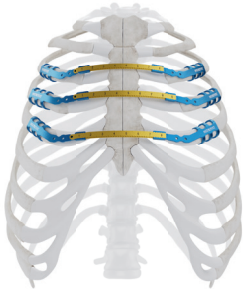
FUNCTIONAL PRINCIPLES OF CHEST WALL FIXATION:

The titanium rib clip is based on the clip principle:

An open clip is placed on the bone (rib). The segments of the clip are then bent around the bone using a special instrument. The segments are plastically deformed in the process. This results in a form-fitting connection between the segments and the rib, creating a stable connection between the titanium rib clip and the rib.

Two titanium rib clips can be connected with a titanium connecting bar to form an implant bridge. A special instrument is used to crimp the interlocking wave profiles of the connector of the titanium rib clip and the titanium connecting bar.

► IMPLANTS | APPLICATION

INDICATION	APPL. EXAMPLE	IMPLANTS
Sternal osteotomy		Three implant bridges, each consisting of • 2x Titanium rib clip, rigid connector • 1x Titanium connecting bar
Deep sternal wound infection (DSWI)		

NOTE

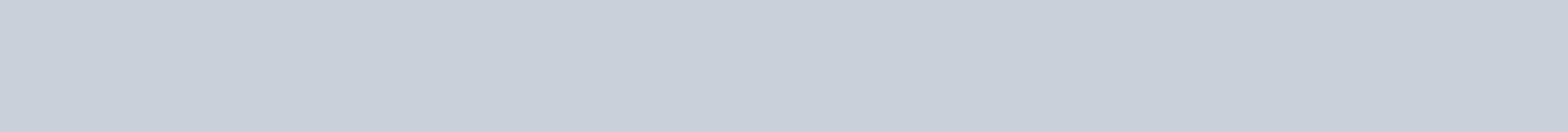
- When fixating the titanium rib clip onto the rib, the segments of the titanium rib clip may penetrate the rib if the pliers are closed beyond the resistance of the bone.
- The implants must not be cutted (exception: the titanium connecting bar).
- When shortening the titanium connecting bar, ensure that there is sufficient wave profile to allow an implant bridge to be constructed.
- The titanium connecting bar must not be bent in the area where it is to be inserted into the connector of the titanium rib clip. Once the titanium connecting bar has been bent, movement of the connector on the titanium rib clip is restricted on the titanium connecting bar.
- The titanium connecting bar must be positioned without tension in the connectors to prevent material fatigue during

the implant period.

- The connector must not be crimped until a titanium connecting bar has been inserted along the entire length of the connector within the wave profile and the wave profiles of the connector and the titanium connecting bar are interlocked.
- The connector on the titanium rib clip must be crimped at least four times along its entire length to form a connection with the titanium connecting bar inside.

MATERIAL

The implants are made of Titanium Grade 2 in accordance with ASTM F 67 and ISO 5832-2.



► CHEST WALL FIXATION | INSTRUMENTS

The MedXpert instrument set has been specially developed for the use of implants and is matched to the products. MedXpert implants may only be used with the instruments specified by MedXpert.

010-00020

Three-point bending pliers for rib clips, 18 cm

Pliers for adjustment of the angle

The three-point bending pliers are positioned such that the two guiding pins on the three-point bending pliers are located in two round holes in the implant. The position of the oval bending pin of the three-point bending pliers determines the direction in which the angle is adjusted. Closing the pliers changes the angle of the implant.

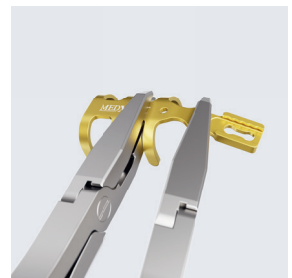
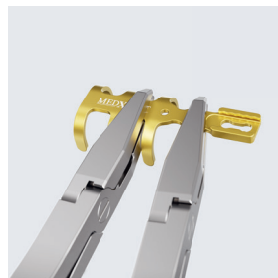


010-00025

Flat-nosed bending pliers for rib clips and connecting bars, 13.5 cm

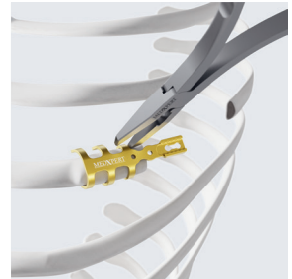
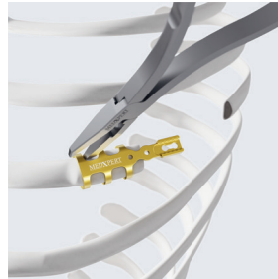
Pliers for adjusting the implants to the anatomical shape of the thorax

When bending with flat-nose pliers, these are used in pairs. The implant is then bent or torqued to achieve the required alignment.



Pliers for removing implants by detaching the segments

The flattened tip (wedge) of the flat-bending pliers is inserted beneath the segment to be removed. By turning the flat-nose pliers, the segment is lifted and bent upwards. This procedure is repeated for each segment on one side. The clip can then be removed by a rotating motion.

**010-00050**

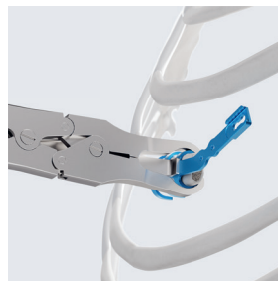
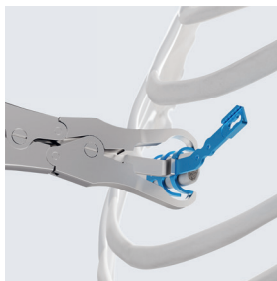
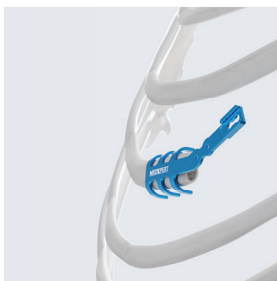
Rib clip fixation pliers, Universal

Pliers for applying rib clips by forming the segments around the rib

The Rib clip fixation pliers is positioned in the closed state vertically in the center of a segment pair of the rib clip so that the tips of the pliers rest on the segments.

The Rib clip fixation pliers is then opened step by step and the tips of the pliers are guided along the segments. For pliers with a downholder, this must rest on the inter segment. Sliding the forming jaws along the segments reduces the lateral space requirement of the pliers.

When the handles of the Rib clip fixation pliers are pressed together until resistance is felt from the bone, the segments are formed around the rib.



010-00053

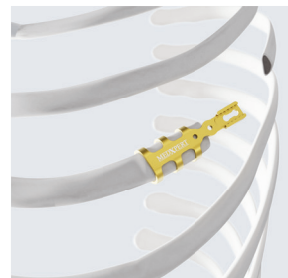
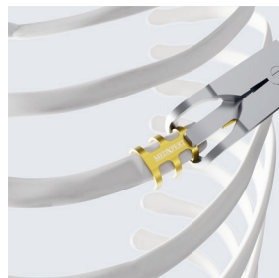
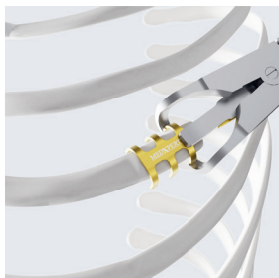
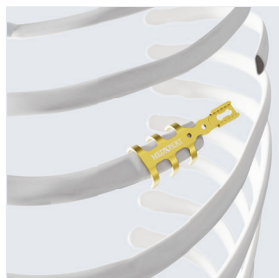
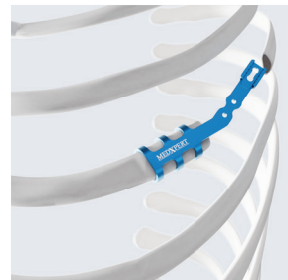
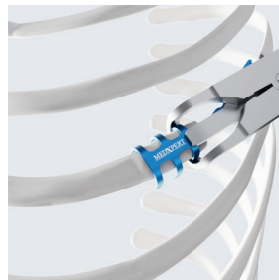
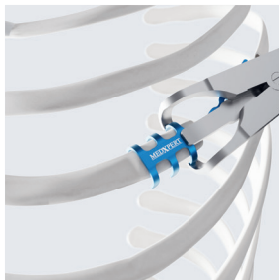
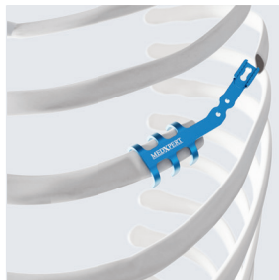
Rib clip fixation pliers, Universal, angled 100°

Pliers for applying rib clips by forming the segments around the rib

The Rib clip fixation pliers is positioned in the closed state at an angle in the center of a segment pair of the rib clip so that the tips of the pliers rest on the segments.

The Rib clip fixation pliers is then opened step by step and the tips of the pliers are guided along the segments. For pliers with a downholder, this must rest on the inter segment. Sliding the forming jaws along the segments reduces the lateral space requirement of the pliers.

When the handles of the Rib clip fixation pliers are pressed together until resistance is felt from the bone, the segments are formed around the rib.



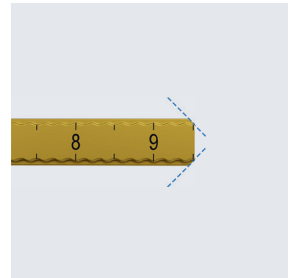
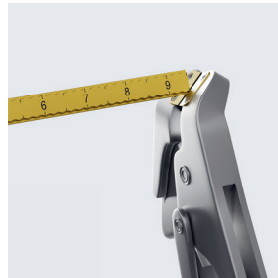
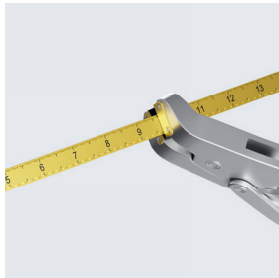
010-00010

Implant cutting pliers with exchangeable jaw inserts, 22 cm

Pliers for shortening the titanium connecting bar

The titanium connecting bar is positioned in the implant cutting pliers at the point to be shortened, and the implant cutting pliers are closed.

The sharp edges formed on the titanium connecting bar must then be deburred using the implant cutting pliers. This involves removing the two corners of the shortened side (base plate only) using the implant cutting pliers.



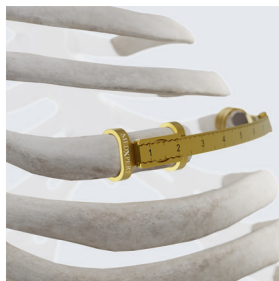
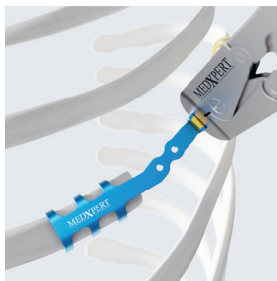
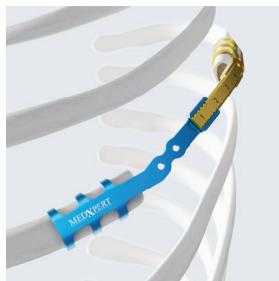
010-00030

Implant crimping pliers, 18 cm

Pliers for closing (crimping) the connector of the titanium rib clip with the titanium connecting bar inserted

The working part of the implant crimping pliers is placed vertically on the connector of the titanium rib clip with the titanium connecting bar inserted. Squeezing the handles of the implant crimping pliers closes the connector.

This procedure is repeated at least four times along the entire length of the connector.

**010-00032**

Implant crimping pliers, angled 100°, 20.5 cm

Pliers for closing (crimping) the connector of the titanium rib clip with the titanium connecting bar inserted

The working part of the implant crimping pliers is placed at an angle on the connector of the titanium rib clip with the titanium connecting bar inserted. Squeezing the handles of the implant crimping pliers closes the connector.

This procedure is repeated at least four times along the entire length of the connector.



■ IMPORTANT NOTE

- All bending operations must be performed carefully and in a controlled manner to avoid corrections in the opposite direction to the initial bending direction.
 - Avoid repeatedly bending the implants at the same point (bending them back and forth) and extreme angles / small bending radii.
 - Manual bending without the use of instruments is preferable.
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► INSTRUMENTS | STERI-RACKS

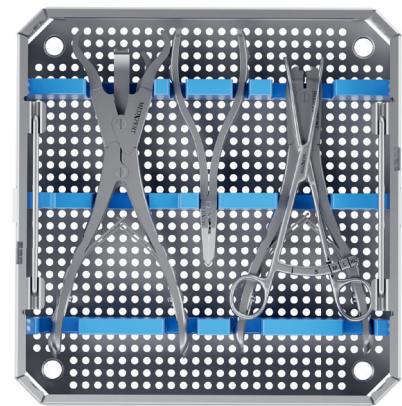
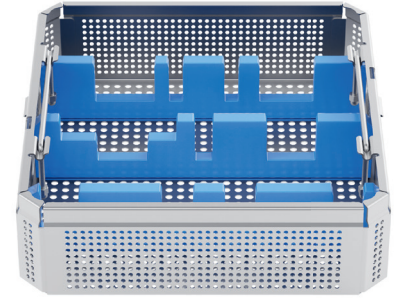
001-10025

Steri-Rack instruments, 30x30cm

Steri-Rack for the storage, transport and sterilisation of instruments

For cleaning and disinfection, all instruments must be removed from the Steri-Racks and placed in position on suitable cleaning trays.

Sterilisation is performed with the Steri-Rack loaded with instruments.



Set recommendation

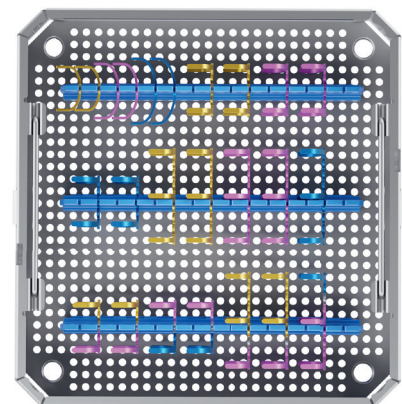
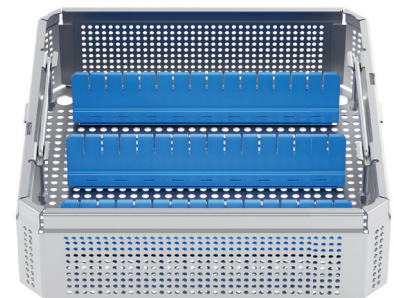
001-20025

Steri-Rack implants 30x30cm

Steri-Rack for the storage, transport and sterilisation of implants

For cleaning and disinfection, all implants must be removed from the Steri-Racks and placed in position on suitable cleaning trays.

Sterilisation is performed with the Steri-Rack loaded with implants.



Set recommendation

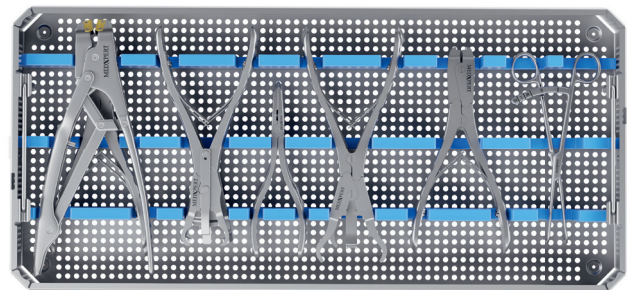
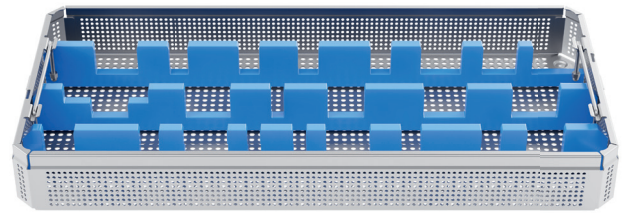
001-10020

Steri-Rack instruments, 60x30cm

Steri-Rack for the storage, transport and sterilisation of instruments

For cleaning and disinfection, all instruments must be removed from the Steri-Racks and placed in position on suitable cleaning trays.

Sterilisation is performed with the Steri-Rack loaded with instruments.



Set recommendation

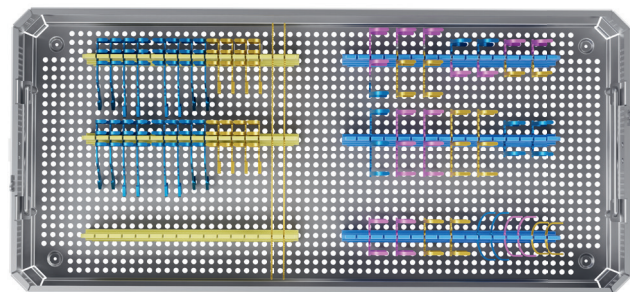
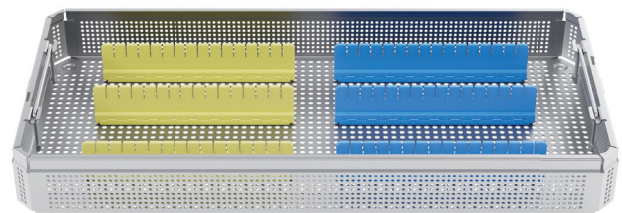
001-20020

Steri-Rack implants 60x30cm

Steri-Rack for the storage, transport and sterilisation of implants

For cleaning and disinfection, all implants must be removed from the Steri-Racks and placed in position on suitable cleaning trays.

Sterilisation is performed with the Steri-Rack loaded with implants.



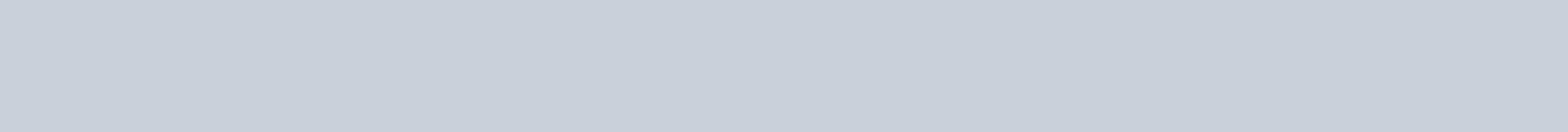
Set recommendation

► STERNAL FIXATION | REFERENCE LIST

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- 3 Reindl, S.; Schuller, P.; Meller, M.; Beyer, M.; Decker, J.; Raab, S. (2022): Morphometry of the sternum in osteosynthetic reconstruction. In: Journal of Orthopedic Research and Therapy 7 (6). DOI: 10.29011/2575-8241.001242.
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