

# WINSTA-C Clavicle Plating System

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**Note:**

The surgical technique outlined below reflects the surgical procedure usually chosen by the clinical advisor. However, each surgeon must decide which surgical method and which approach is the most successful for his patient.

## ► Introduction

### Implant Specifications

The Marquardt Clavicle Plating System **WINSTA-C** offers plates and screws in various shapes and lengths. According to their shape, the plates can be divided into four groups. Every plate is available as a right or left sided version. In order to facilitate identification of left and right types, the plates are color coded. Left plates are green and laser marked with “L”, right plates are blue and laser marked with “R”.

Plate holes are filled with self-tapping cortical screws. The screws are available either non-locking, locking and multiaxial locking (**ML**).



#### Clavicle Plate S-Shaped

- S-shaped plates are used in the middle part of the clavicle.
- In order to match different natural curvatures of the clavicle the plates are available in three different bend types: minimum, medium and maximum.
- The bending type is marked on the side of each plate.
- Medial and lateral ends of the plate are labelled with “MED” or “LAT” to ensure correct placement of the implant.



#### Clavicle Plate J-Shaped

- J-shaped plates are designed for fractures involving the transition zone between the middle and the lateral part of the clavicle.
- The plate has 9 holes and there are right and left versions.
- The medial and lateral ends of the plate are labelled with “MED” or “LAT” to ensure correct placement of the implant.



### **Lateral Clavicle Plate**

- Lateral plates are used in the lateral part of the clavicle.
- The lateral part of the plate has five screw holes which are provided for the Ø 2.7 mm cortical screws.
- Alongside locking and non-locking screws, it is also possible to use ML screws Ø 2.7 mm in lateral positions.



### **Clavicle Hook Plate**

- The clavicle hook plate is used for the fixation of lateral clavicle fractures and injuries to the acromioclavicular joint.
- The hook depth is 12, 15 and 18 mm with a hook angle of 100°.
- The lateral part of the plate contains three screw holes, which are provided for Ø 2.7 mm cortical screws.
- Alongside locking and non-locking screws, it is also possible to use ML screws Ø 2.7 mm in lateral positions.

## **Indications**

Clavicle Plate S- and J-shaped:

- Fixation of fractures and mal-unions of the clavicle shaft.

Lateral Clavicle Plate:

- Fixation of fractures and mal-unions of the lateral clavicle.

Clavicle hook plates:

- Fractures of the lateral clavicle.
- Acromioclavicular joint separation, type: Rockwood III, IV or V and Tossy III

## ► Surgical Technique

### Imaging

- Radiographic diagnostic with x-ray in AP and 45° plane.
- If necessary additional diagnostic with CT or MRI.

### Positioning

- The patient is placed in the beach chair position.
- A standard operating table with head up positioning may be used.
- A longitudinal sand bag placed just medial to the affected scapula, will assist in reduction.
- Before draping, check that adequate x-ray imaging is possible and that no metal is blocking the view of the clavicle.
- The patient's head is turned away from the operative site to improve access to the clavicle.
- The affected arm should be towed and kept free to enable intraoperative mobilization.
- The operative site is disinfected and towed.

### Access

- A transverse incision is recommended for accessing the clavicle.
  - A horizontal incision is made from medial to lateral and centered over the fracture site.
  - When using a lateral plate, the incision is centered over the fracture site and ending lateral to the AC joint.
  - When using a minimal invasive approach, locking drill guides can be used to insert the plate from medial to lateral.
- 
- As an alternative a vertical incision, which is placed over the fracture site and along Langer's lines, is possible.

### Please note:

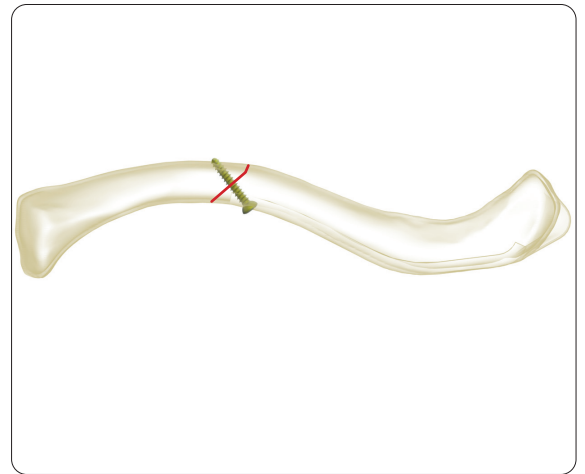
- Branches of the Supraclavicular nerves (usually 2) should be identified and protected during subcutaneous dissection.
- During subperiosteal preparation of the platysma muscle the fiber orientation should be considered.
- Small individual bone fragments should not be removed from their periosteum to protect their blood supply.

## Reduction and Positioning

### Instruments

|                  |                              |
|------------------|------------------------------|
| REF 14.40060.025 | Drill Bit Ø 2.5 mm           |
| REF 03.20010.035 | Drill Bit Ø 3.5 mm           |
| REF 03.20060.025 | Double Drill Guide 3.5 / 2.5 |

- Fracture ends are exposed and the fracture is reduced
- After restoration of the anatomical position, temporary fixation can be achieved with K-wires.
- Prior to the application of the plate, lag screw fixation perpendicular to the fracture line is often helpful to stabilize and compress the main fragments.
- There are Ø 3.5 mm and Ø 2.5 mm drills and a double drill guide to facilitate this.
- The clavicle plate can then be placed
- K-wires can be used for temporary fixation of the plate through the provided K-wire holes.



### Please note:

If plate contouring is necessary, the following aspects have to be considered:

### Instruments

|                  |   |
|------------------|---|
| REF 03.20110.035 | Bending Iron for Plates 2.7 to 3.5, right |
| REF 03.20110.135 | Bending Iron for Plates 2.7 to 3.5, left  |

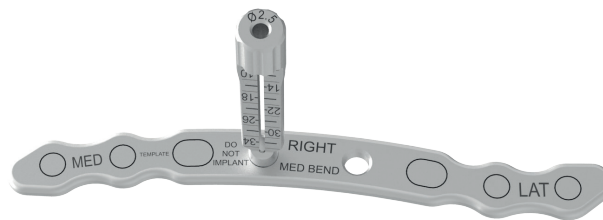
- For contouring of the plates the bending irons may be used.
- To avoid weakening of the implant material the plates should be bent only once and only in one direction.
- Bending of the implant across a screw hole should be avoided.
- To protect the threads of the plate during bending, drill sleeves should be inserted into the threads.



## Clavicle Plate S-Shaped

- The plate is placed on the middle part of the clavicle with its center located over the fracture site.
- The required plate size and the appropriate plate bend type can be determined using the templates. The templates are available in all variations. The top and bottom side of the template can be used for the left and right clavicle. By using the templates, it is possible to check which plate size and bend type corresponds to the anatomy and should be used.

### Please note:



- The drill guide can be attached to all templates for better handling.



## Clavicle Plate J-Shaped

- The J-shaped clavicle plate is placed in the transition zone between the middle and lateral parts of the clavicle.
- The plate should be placed so that the strengthened part of the plate is located over the fracture site.
- The plate positioning can also be determined with the help of a template.



## Lateral Clavicle Plate

- The fracture is reduced and the AC joint is identified. It may be helpful to mark this with a needle.
- The required plate size and the plate positioning can be determined with the help of templates.
- The plate is placed medial but close to the AC joint so as to gain maximum purchase in the lateral fragment. Ideally the part which is between the oval hole and the lateral holes is located over the fracture site.
- The final plate position should be checked with x-ray control. Guide wires which can be placed in the lateral K-wire holes of the plate can help to verify that the lateral screws do not penetrate into the AC joint.
- Multiaxial screws can help to prevent perforation of the joint space.

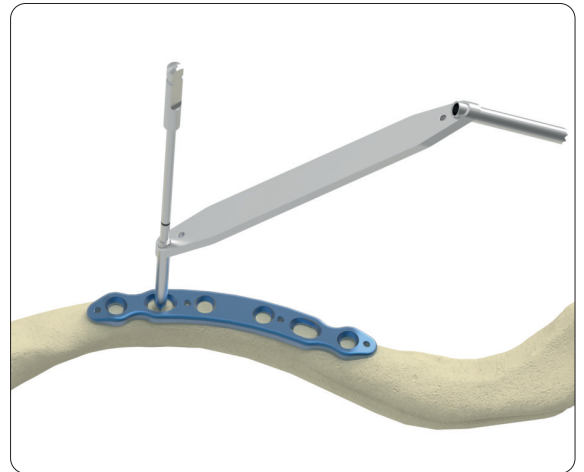


## Fixation with Clavicle Plates S-Shaped and J-Shaped

### Instruments

REF 14.40060.025      Drill Bit Ø 2.5 mm  
 REF 03.20060.025      Double Drill Guide 3.5 / 2.5

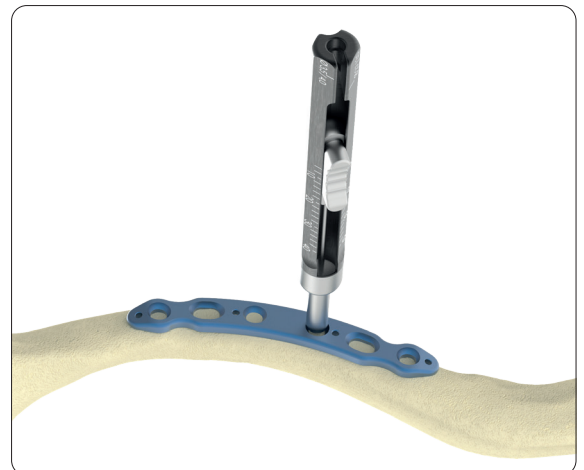
- It is recommended to place a non-locking Ø 3.5 mm screw into the oval hole as a first step. Minor adjustment of the plate position is possible by loosening that screw and moving the plate around the oval hole.
- The pilot hole for Ø 3.5 mm screws is drilled with a Ø 2.5 mm drill bit and the double drill guide.



### Instruments

REF 03.20100.040      Length Determination Instruments  
 for Screws up to 40 mm

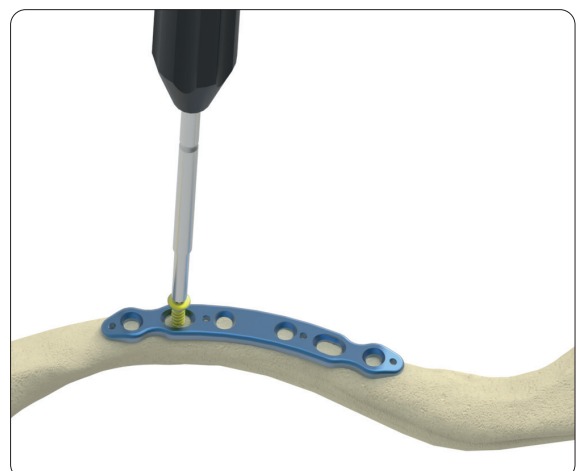
- The screw length is measured with the depth gauge.
- The hook of the measuring device is hooked into the far cortex and the appropriate screw length is given by the scale.
- The screws must be placed through both cortices in order to achieve bicortical fixation.

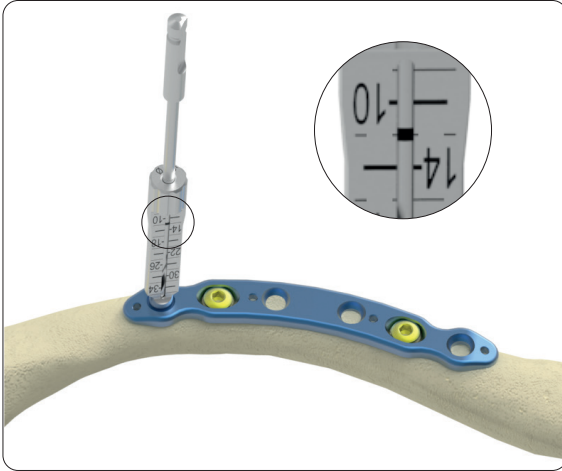


### Instruments

REF 03.20040.030      Screwdriver, hex 2.5 mm

- An appropriate screw can be inserted by using the screwdriver.
- If the value of the measured screw is between sizes, the longer screw option should be chosen but its length and position must be checked with the image intensifier and further adjustment made if necessary.
- After placing screws into the oval holes medial and lateral to the fracture site, the remaining screw holes can be filled with either locking or non-locking screws.
- If the insertion of a non-locking lag screw through the plate is planned, it is important to remember that the non-locking screw(s) should always be placed prior to any locking screws.

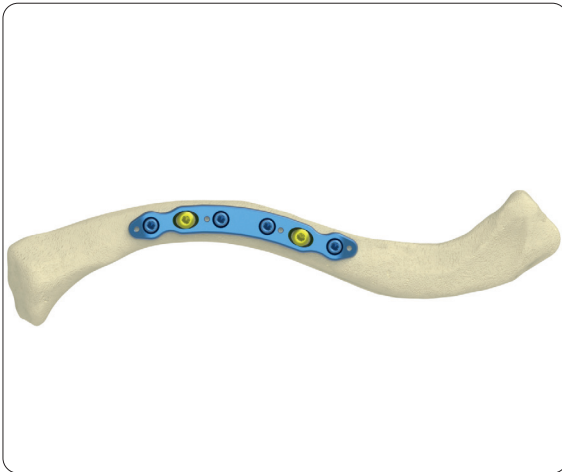




## Instruments

REF 14.40060.047      *Drill Guide 2.5, calibrated*

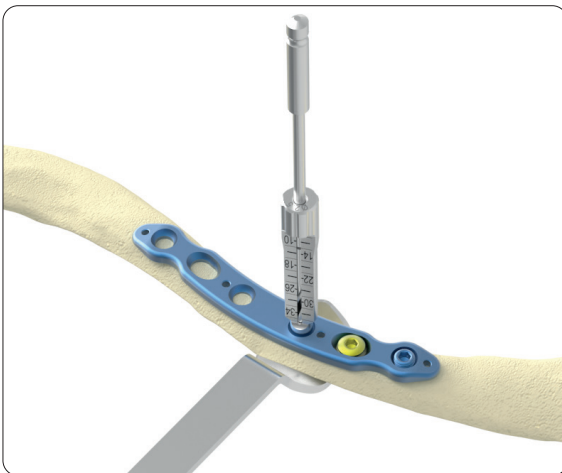
- In order to place Ø 3.5 mm locking screws into the circular holes, the scaled drill guide is screwed into the thread of the hole.
- Subsequently the pilot hole can be drilled and the screw length can be measured as described above.
- When using a scaled drill guide it is possible to read off the required screw length directly from the drill guide.



## Instruments

REF 03.20040.325      *Torque Screwdriver, hex 2.5 mm*

- Final tightening of the locking screws should be done by hand using the torque-limiting screwdriver.
- As soon as all desired screws are placed into the corresponding screw holes, an intraoperative radiograph is recommended to check the implant positions and the anatomical reduction of the fracture and the lengths of the screws.



## Instruments

REF 14.40060.010      *Clavicle Retractor*

### Please note:

- To avoid trauma to the subclavian artery and the brachial plexus, drilling should always be done with caution.
- The clavicle retractor (neurovascular protector) should be placed under the inferior cortex of the clavicle, to prevent over-penetration.

### Fixation with Lateral Clavicle Plates

- To achieve initial stabilization it is recommended to place first two screws, one medial and one lateral to the fracture site.
- As described above, a Ø 3.5 mm non-locking cortical screw is placed into the oval hole of the plate.
- Locking or non-locking screws can be used in the other holes of the plate according to the procedure described before.

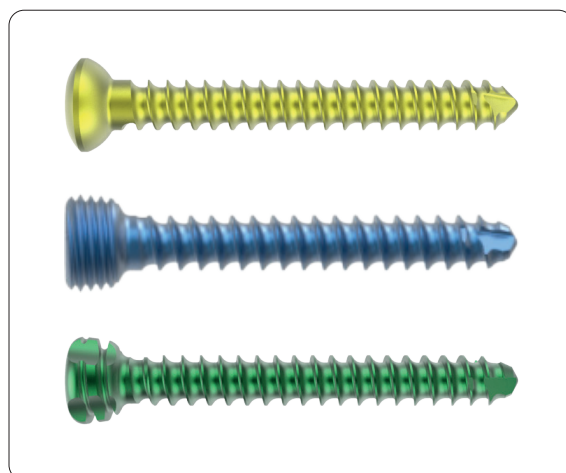


- There are three choices of self-tapping Ø 2.7 mm screws available to be used within the lateral screw holes:

**Yellow:** Non-locking cortical screws

**Blue:** Locking cortical screws

**Green:** Multiaxial locking cortical screws (**ML**)



### Instruments

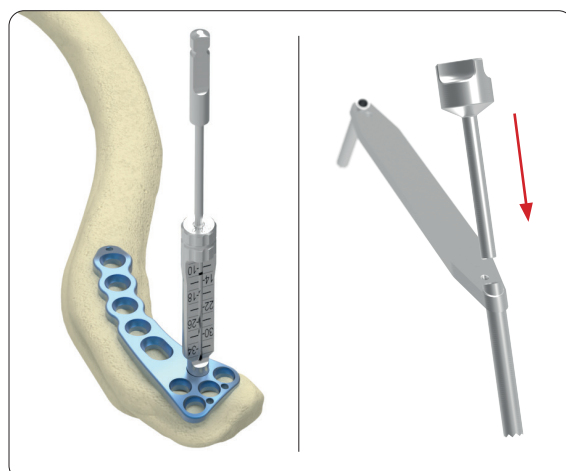
REF 03.20060.025 Double Drill Guide 3.5 / 2.5

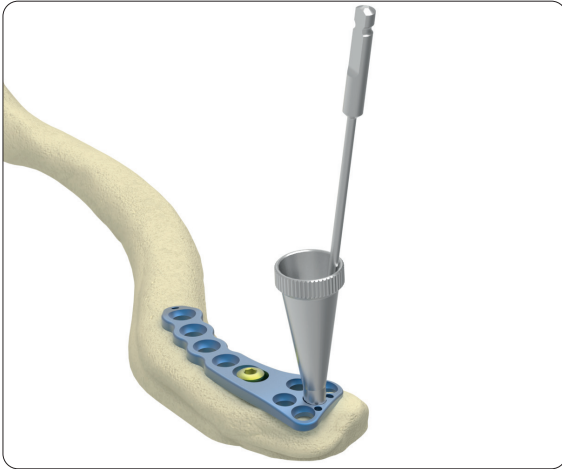
REF 10.20010.020 Drill Bit Ø 2.0 mm

REF 10.20060.047 Drill Guide 2.0, calibrated

REF 14.40060.030 Drill Sleeve Insert 3.5 / 2.0

- To drill the hole for a locking Ø 2.7 mm cortical screw the locking drill sleeve is placed into the desired hole and screwed into the thread of the plate (left).
- A Ø 2.0 mm drill bit is used and precautions should be taken to avoid over-penetration of the inferior cortex of the clavicle.
- For non-locking Ø 2.7 mm cortical screws it is also possible to use the locking drill sleeve (left). Alternatively the reduction drill sleeve insert for Ø 2.0 mm drills can be placed into the double drill guide (right).





## Instruments

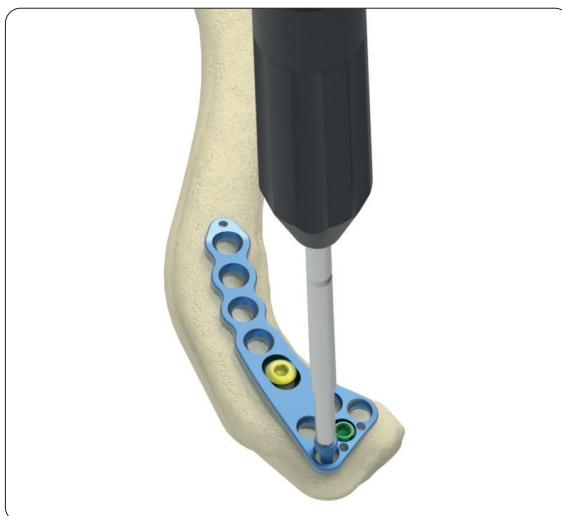
REF 10.20010.020

Drill Bit Ø 2.0 mm

REF 10.20050.025

ML Drill Guide 2.0

- To ensure a proper and safe locking of the screw into the plate, the angulation of the screw should not be more than 20°.
- Drilling of the Ø 2.7 mm multiaxial screw holes is performed with the specific ML drill guide which is screwed into the desired plate hole.
- With the ML drill guide in place, it is possible to drill using the drill bit Ø 2.0 mm within 20° of the original screw axis.
- When using the ML drill guide it is necessary to ensure that the axis of drilling is chosen correctly and that the AC joint is not penetrated with the drill.
- Multiaxial Ø 2.7 mm screws can be used in order to reach certain bone fragments, if the defined screw axis is not sufficient.
- When using multiaxial locking screws, it is possible to place and lock the screw within a cone of 20° around the original screw axis.



## Instruments

REF 03.20040.030

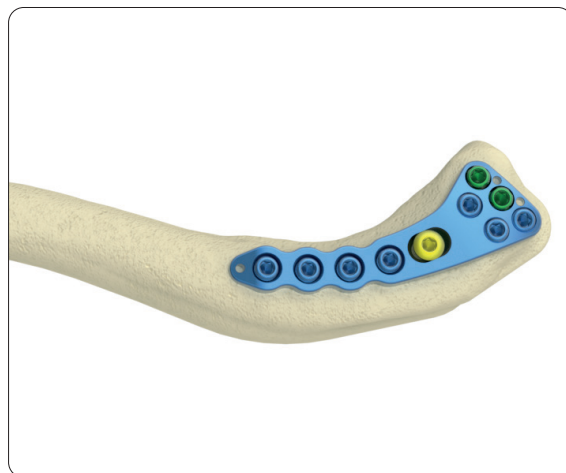
Screwdriver, hex 2.5 mm

REF 03.20040.325

Torque Screwdriver, hex 2.5 mm

- The ML drill guide is removed, and the screw length is then determined as described above via the depth gauge.
- In the event that screws are positioned near the AC joint and the measured value is between two available screw lengths, choose the shorter one and then check the length and position with the aid of an X-ray and make any corrections as required.
- The insertion of the Ø 2.7 mm screws is done using the screwdriver.
- Final tightening of the locking screws should be done by using the torque-limiting screwdriver.

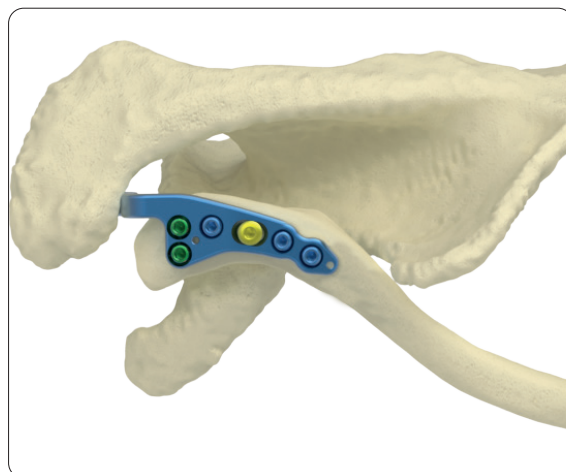
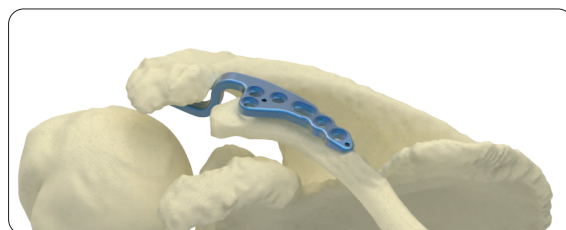
- As soon as all desired screws are placed into the corresponding screw holes an intraoperative radiograph should be performed to check the plate and screw positions and the anatomical reduction of the fracture.



## Fixation with Hook Plates

### Access, Reduction and Positioning of the Clavicle Hook Plate

- The exposure of the delto trapezial fascia is performed via a transacromial incision; the lateral supraclavicular nerves must not be damaged in the process.
  - Temporary fixing of the fracture can be performed with K-wires or reduction forceps.
  - Afterwards the capsule of the acromioclavicular joint is identified.
  - In order to enable positioning of the hook under the acromion, the insertion of the trapezius muscle must be detached from the medial edge of the acromion.
  - The required plate size and the exact plate positioning can be determined with the help of templates.
  - The hook can now be positioned under the acromion and the shaft of the plate can be positioned on the lateral clavicle.
  - The clavicle hook plate can be temporarily fixed with K-wires.
- 
- The oval hole of the plate is filled with a Ø 3.5 mm cortical screw according to the procedure described above.
  - Locking or non-locking screws can also be placed in the shaft holes according to the procedure described above.
  - For the lateral screw holes, non-locking, locking and multiaxial locking Ø 2.7 mm screws are available.



### **Post-OP Protocol**

- Postoperative management will be determined by various factors such as fracture type, bone quality or age of the patient.
- Generally, passive movement only is recommended during the first four weeks.
- Heavy lifting, pushing or pulling must be avoided by the patient.
- Depending on the healing process the patient can start with supported active exercises from four to six weeks postoperatively.
- Depending on the stability of the fixation and after radiological assessment, it is possible to start with an active physical load increase from the eighth week.

### **Implant Removal**

#### **Instruments**

*REF 03.20040.030     Screwdriver, hex 2.5 mm*

- The removal of the implant takes place via one of the accesses described.
- When removing a plate located in the middle area of the clavicle, special care should be taken to avoid damaging any cutaneous nerves.
- After loosening and removal of all screws with the screwdriver, the plate can be removed.

## ► Product Information

### Implants

| Article Number *<br>left | Article Number *<br>right | Holes | Bend |
|--------------------------|---------------------------|-------|------|
| 14.15100.106             | 14.15100.006              | 6     | min  |
| 14.15100.108             | 14.15100.008              | 8     | min  |
| 14.15100.110             | 14.15100.010              | 10    | min  |
| 14.15101.106             | 14.15101.006              | 6     | med  |
| 14.15101.108             | 14.15101.008              | 8     | med  |
| 14.15101.110             | 14.15101.010              | 10    | med  |
| 14.15102.106             | 14.15102.006              | 6     | max  |
| 14.15102.108             | 14.15102.008              | 8     | max  |
| 14.15102.110             | 14.15102.010              | 10    | max  |

| Article Number *<br>left | Article Number *<br>right | Holes |
|--------------------------|---------------------------|-------|
| 14.15100.109             | 14.15100.009              | 9     |

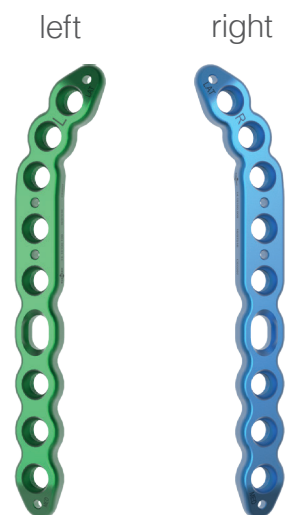
### Clavicle Plate S-shaped

- Material: Ti6Al4V



### Clavicle Plate J-shaped

- Material: Ti6Al4V



\* All implants are also available in sterile. Therefor, add suffix "S" to article number.





## Lateral Clavicle Plate

- Material: Ti6Al4V

| Article Number *<br>left | Article Number *<br>right | Holes |
|--------------------------|---------------------------|-------|
| 14.15103.105             | 14.15103.005              | 5     |
| 14.15103.107             | 14.15103.007              | 7     |
| 14.15103.109             | 14.15103.009              | 9     |



## Clavicle Hook Plate

- Hook angle: 100°
- Hook depth: 12mm, 15mm, 18mm
- Material: Titan

| Article Number *<br>left | Article Number *<br>right | Holes | Depth<br>in mm |
|--------------------------|---------------------------|-------|----------------|
| 14.15105.103             | 14.15105.003              | 3     | 12             |
| 14.15105.105             | 14.15105.005              | 5     | 12             |
| 14.15104.103             | 14.15104.003              | 3     | 15             |
| 14.15104.105             | 14.15104.005              | 5     | 15             |
| 14.15106.103             | 14.15106.003              | 3     | 18             |
| 14.15106.105             | 14.15106.005              | 5     | 18             |

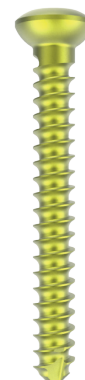
\* All implants are also available in sterile. Therefor, add suffix "S" to article number.



| Article Number<br>3.5 mm | Article Number<br>2.7 mm | Length |
|--------------------------|--------------------------|--------|
| 03.03612.010             | 03.03527.010             | 10 mm  |
| 03.03612.012             | 03.03527.012             | 12 mm  |
| 03.03612.014             | 03.03527.014             | 14 mm  |
| 03.03612.016             | 03.03527.016             | 16 mm  |
| 03.03612.018             | 03.03527.018             | 18 mm  |
| 03.03612.020             | 03.03527.020             | 20 mm  |
| 03.03612.022             |                          | 22 mm  |
| 03.03612.024             |                          | 24 mm  |

### Cortical Screw, self-tapping

|                    | 3.5 mm  | 2.7 mm |
|--------------------|---------|--------|
| • Thread diameter: | 3.5 mm  | 2.7 mm |
| • Core diameter:   | 2.4 mm  | 1.9 mm |
| • Head diameter:   | 6.0 mm  | 5.0 mm |
| • Hexagon socket:  | 2.5 mm  | 2.5 mm |
| • Material:        | Ti6Al4V |        |



| Article Number<br>3.5 mm | Article Number<br>2.7 mm | Length |
|--------------------------|--------------------------|--------|
| 03.05612.010             | 03.05527.010             | 10 mm  |
| 03.05612.012             | 03.05527.012             | 12 mm  |
| 03.05612.014             | 03.05527.014             | 14 mm  |
| 03.05612.016             | 03.05527.016             | 16 mm  |
| 03.05612.018             | 03.05527.018             | 18 mm  |
| 03.05612.020             | 03.05527.020             | 20 mm  |
| 03.05612.022             |                          | 22 mm  |
| 03.05612.024             |                          | 24 mm  |

### Locking Cortical Screw, self-tapping

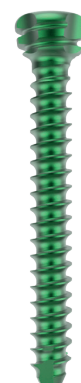
|                    | 3.5 mm  | 2.7 mm  |
|--------------------|---------|---------|
| • Thread diameter: | 3.5 mm  | 2.7 mm  |
| • Core diameter:   | 2.4 mm  | 1.9 mm  |
| • Head diameter:   | 4.75 mm | 4.75 mm |
| • Hexagon socket:  | 2.5 mm  | 2.5 mm  |
| • Material:        | Ti6Al4V |         |



| Article Number<br>2.7 mm | Length |
|--------------------------|--------|
| 03.03540.010             | 10 mm  |
| 03.03540.012             | 12 mm  |
| 03.03540.014             | 14 mm  |
| 03.03540.016             | 16 mm  |
| 03.03540.018             | 18 mm  |
| 03.03540.020             | 20 mm  |

### ML Screw, self-tapping

|                    | 2.7 mm  |
|--------------------|---------|
| • Thread diameter: | 2.7 mm  |
| • Core diameter:   | 1.9 mm  |
| • Head diameter:   | 4,75 mm |
| • Hexagon socket:  | 2.5 mm  |
| • Material:        | Ti6Al4V |



## Instruments

11.90016.150 Kirschner Wire Ø 1.6 mm,  
trocar tip, L 150 mm, steel



10.20010.020 Drill Bit Ø 2.0 mm, 2-flute, AO Coupling,  
L 112 / 82 mm



14.40060.025 Drill Bit Ø 2.5 mm, 2-flute, AO Coupling,  
L 112 / 82 mm



03.20010.035 Drill Bit Ø 3.5 mm, 2-flute, AO Coupling,  
L 110 / 80 mm



10.20060.047 Drill Guide 2.0, calibrated



14.40060.047 Drill Guide 2.5, calibrated



14.40060.030 Drill Sleeve Insert 3.5 / 2.0



03.20060.025 Double Drill Guide 3.5 / 2.5



10.20050.025 ML Drill Guide 2.0



03.20100.040 Length Determination Instruments  
for Screws up to 40 mm



03.20040.030 Screwdriver, hex 2.5 mm, ball handle,  
L 200 / 85 mm



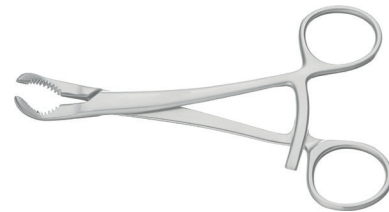
03.20040.325 Torque Screwdriver, hex 2.5 mm short



03.20080.006 Periosteal Elevator, curved blade, round  
edge, width 6 mm



03.20070.133 Reduction Forceps, toothed, ratchet lock,  
L 140 mm



02.20120.015 Screw Forceps, self-holding



03.20110.035 Bending Iron for Plates 2.7 to 3.5, right  
03.20110.135 Bending Iron for Plates 2.7 to 3.5, left



14.40060.010 Clavicle Retractor



## Templates

| Article Number<br>Left / Right | Holes | Bend |
|--------------------------------|-------|------|
| 14.25100.006                   | 6     | min  |
| 14.25100.008                   | 8     | min  |
| 14.25100.010                   | 10    | min  |
| 14.25101.006                   | 6     | med  |
| 14.25101.008                   | 8     | med  |
| 14.25101.010                   | 10    | med  |
| 14.25102.006                   | 6     | max  |
| 14.25102.008                   | 8     | max  |
| 14.25102.010                   | 10    | max  |

| Article Number<br>Left / Right | Holes |
|--------------------------------|-------|
| 14.25100.009                   | 9     |

| Article Number<br>Left / Right | Holes |
|--------------------------------|-------|
| 14.25103.005                   | 5     |
| 14.25103.007                   | 7     |
| 14.25103.009                   | 9     |

| Article Number<br>left | Article Number<br>right | Holes | Depth<br>in mm |
|------------------------|-------------------------|-------|----------------|
| 14.25105.103           | 14.25105.003            | 3     | 12             |
| 14.25104.103           | 14.25104.003            | 3     | 15             |
| 14.25106.103           | 14.25106.003            | 3     | 18             |

### Clavicle Plate S-Shaped Templates



### Clavicle Plate J-Shaped Templates



### Lateral Clavicle Plate Templates



### Clavicle Hook Plate Templates





## **MRI Safety Information**

Non-clinical testing has demonstrated that the plates range from Marquardt Medizintechnik is MR Conditional in accordance with the ASTM F2503 standard definitions. A patient with this device can be safely scanned in an MR system meeting the following conditions:

- Cylindrical-bore
- Horizontal magnetic field ( $B_0$ )
- Spatial field gradient lower than or equal to
  - **1.5 T:** 23.45 T/m (2345 G/cm)
  - **3.0 T:** 11.75 T/m (1175 G/cm)
- Radiofrequency (RF) field exposure:
  - RF excitation: Circularly Polarized (CP)
  - RF transmit coil: whole-body transmit coil
  - RF receive coil type: whole-body receive coil
  - Maximum permitted whole-body averaged specific absorption rate (SAR):  
Normal Operating Mode, 2 W/kg.
  - Scan duration and wait time:
    - 1.5 T:** 2 W/kg whole-body average SAR for **8min and 15s** of continuous RF (a sequence or back-to-back series/scan without breaks) followed by a wait time of **8min and 15s** if this limit is reached.
    - 3.0 T:** 2 W/kg whole-body average SAR for **6min and 19s** of continuous RF (a sequence or back-to-back series/scan without breaks) followed by a wait time of **6min and 19s** if this limit is reached.
- The plates are expected to produce a maximum temperature rise of 8.5 °C at 1.5 T and 6.9 °C at 3 T both after the scanning periods presented above.
- The presence of this implant may produce an image artifact. Some manipulation of scan parameters may be needed to compensate for the artifact. In non-clinical testing, the image artifact caused by the device extends approximately 83 mm from the device edge when imaged with a spin echo pulse sequence and 65 mm with a gradient echo, both at 1.5 T.
- Patients with uncompromised thermoregulation and under uncontrolled conditions or patients with compromised thermoregulation (all persons with impaired systemic or reduced local thermoregulation) and under controlled conditions (a medical doctor or a dedicated trained person can respond instantly to heat induced physiological stress).

### **Note:**

Undergoing an MRI scan, there is a potential risk for patients with a metallic implant. The electromagnetic field created by an MRI scanner can interact with the metallic implant, resulting in displacement of the implant, heating of the tissue near the implant, or other undesirable effects.









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