The right locking option for tough fractures
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# NCB Plating System – Proximal Humerus Surgical Technique

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Fracture Classifications

Indications for Open Technique (Deltoid Pectoral Incision)
- Neer classification: 2-, 3-, 4-part displaced fractures (anatomical neck, surgical neck, tuberculum majus, tuberculum minus and head splitting).
- AO classification: type 11 A, extracapsular, 2 fragments; type 11 B, partially intracapsular, 3 fragments; type 11 C, intracapsular.

Zimmer MIS Technique (Anterior/Lateral Deltoid Split Incision)
- Neer classification: 2-part displaced fractures.
- AO classification: type 11 A, extracapsular, 2 fragments.
Preoperative Planning and Patient Positioning

Preoperative Planning
An X-ray of the injured shoulder on the anteroposterior plane is essential for preoperative planning. In addition, a “Y” view, that is to say perpendicular to the anteroposterior view, of the scapula is also required.

A CT scan can also provide information concerning the tuberosities. The use of the X-ray template is recommended for preoperative planning.

Positioning of the Patient
The patient is placed on the operating table in the beachchair position (Fig. 1).

After the patient is in the correct position, the C-arm must be adjusted so as to achieve the widest possible view of the proximal humerus.
Open Technique (Deltoid Pectoral Incision)

Deltoid Pectoral Incision
For the open technique deltoid pectoral incision is recommended (Fig. 2).

Important: Care must be taken to avoid damaging the N. axillaris and to keep the blood supply of the bone fragments intact.

Reduce the Fracture
Reduce the fracture and confirm the reduction under image intensification.

The humeral head and tuberosity fragments may be manipulated and temporarily fixed with suture and/or 2mm Kirschner wires. K-wires should be placed where they will not interfere with plate application (Fig. 3).

Insert Plate
The plate can be temporarily fixed to the bone with a distal and a proximal 2mm K-wire through the small holes in the plate.

Positioning from A-P view
The plate should be placed approx. 10mm distal to the rotator cuff attachment on the upper edge of the greater tuberosity to avoid postoperative subacrominal impingement (Fig. 4).

Positioning from lateral view
The plate should be centered against the lateral aspect of the greater tuberosity (Fig. 5).

Note: The plate should not be bent since this might disrupt the function of the locking mechanism.

Fig. 2 Deltoid pectoral incision

Fig. 3 Fracture reduction

Plate alignment 10mm distally from the edge of greater tuberosity and centered against the lateral aspect.

Fig. 4

Fig. 5
**Bone Spacer (optional)**
You may insert bone spacer into the locking holes to avoid periosteum impairment (Fig. 6). Three lengths from 1 to 3mm are available.

**Bone Spacer**
<table>
<thead>
<tr>
<th>Color</th>
<th>Bone space</th>
</tr>
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<tbody>
<tr>
<td>red</td>
<td>1mm</td>
</tr>
<tr>
<td>blue</td>
<td>2mm</td>
</tr>
<tr>
<td>green</td>
<td>3mm</td>
</tr>
</tbody>
</table>

**NCB Screw Insertion**

1. **Screw Angulation**
Up to 30° screw angulation is possible for all plate holes (Fig. 7).

2. **Screw and Drill Dimensions**

**NCB Self-Tapping Screw and drill dimensions**

<table>
<thead>
<tr>
<th>Screw Type</th>
<th>Cortical</th>
<th>Cancellous</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>4.0mm</td>
<td>4.5mm</td>
</tr>
<tr>
<td>L 20-50mm</td>
<td>L 30-50mm</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Drill</th>
<th>3.3mm</th>
</tr>
</thead>
</table>
3. Insert Screws
The placement of the initial NCB Screw depends on the fracture type and the reduction achieved.

For screw insertion use the NCB Drill Guide Ø 3.3mm and the drill bit Ø 3.3mm (Fig. 8). The Drill Guide allows polyaxial screw placement. A stop is felt at 30° (Fig. 9).

a) Proximal screw setting
When drilling the proximal screw holes, the use of an image intensifier is recommended. Stop approximately 5mm before the subchondral bone.

The screw length is measured with the NCB Depth Gauge or with the calibration on the drill bit shaft (Fig. 10). The appropriate screw length is chosen from the screw rack. Insert the Self-Tapping Screw with the NCB Torque Screwdriver (Fig. 11). The screw can be used to apply compression if needed. For osteoporotic bone use Ø 4.5mm NCB Cancellous Screws. Repeat procedure to place all proximal bone screws.

Note: Bone screws should be hand tightened only.

Important: When determining the proximal screw length, the probability of bone resorption and screw, compression at the fracture site must be taken into account. Care should be taken to ensure that the screw tip is within an adequate distance away from the subchondral zone.
b) Distal screw insertion
Use the same screw procedure for distal screws as proximally. For optimal fixation, bicortical insertion is recommended (Fig. 12). Place at least 3 screws at the distal end.

4. Add Locking Screw Cap
To achieve angular stability, set NCB Locking Screw Caps at all screws with the Torque Screwdriver until the wrench declutches (clicking sound) (Fig. 13). This applies for all NCB Locking Screw Caps (Fig. 14).

Note: Bone spacers can be removed and replaced with NCB Screws.
Alternative Step: Fracture Reduction
1. Insert the plate before fracture reduction (Fig. 15).
2. Place first the distal screw closest to the fracture line (Fig. 16).
3. Tighten the screw and use the plate for fracture reduction (Fig. 17).
4. Place a K-wire at the proximal end of the plate and use the plate-K-wire construct to further reduce the fracture.
5. Finish the osteosynthesis with further screws as described in paragraph “NCB Screw Insertion”.

Fig. 15

Fig. 16

Fig. 17
Proximal ∅ 3.5mm Cortical Screw Placement (optional)
Additionally it is possible to set standard ∅ 3.5mm self-tapping cortical screws in the two top proximal plate holes.

1. Drill Screw Holes
Use the standard Double Drill Guide for screws ∅ 2.5/3.5/4.0mm and the drill bit ∅ 2.5mm, with quick coupling to drill the screw hole (Fig. 18).

2. Measure Screw Length
Measure the appropriate screw length with the standard Depth Gauge, small for screws ∅ 2.7/3.5/4.0mm (Fig. 19).

3. Set the ∅ 3.5mm Screws
Insert the ∅ 3.5mm Self-Tapping cortical Screw with the Hexagonal Screwdriver small, hex 2.5mm (Fig. 20).

Important: When determining the proximal screw length, the probability of bone resorption and compression at the fracture site must be taken into account. Care should be taken to ensure that the screw tip is within an adequate distance away from the subchondral zone.
1. Apply Tuberculum Minus Plate
For tuberculum minus fractures it is possible to apply a small bendable tuberculum minus plate with 7 screw holes. The plate is fixed to the bone using ∅ 3.5mm standard Self-Tapping Cortical Screws. The plate can be assembled to the NCB Humerus Plate with a prebent U-shaped cerclage wire ∅ 0.8mm through two holes at the side of the NCB Plate (Fig. 21).

The same plate can be used for the left and right humerus.

2. Drill Screw Holes
Use the standard Double Drill Guide for screws ∅ 2.5/3.5/4.0mm and the drill bit ∅ 2.5mm, with quick coupling to drill the holes (Fig. 22).

3. Measure Screw Length and Insert Screws
Measure the appropriate screw length with the standard Depth Gauge, small for screws ∅ 2.7/3.5/4.0mm.

Insert the ∅ 3.5mm Self-Tapping Cortical Screw with the Hexagonal Screwdriver small, hex 2.5mm (Fig. 23).
4. Twist the Wire
Twist the cerclage wire with the Wire-Bending Forceps and apply some tension to the tuberculum minus plate (Fig. 24).

5. Cut the Wire
Cut off the remaining twisted cerclage wire with the Wire Cutter and bend it along the side of the NCB Plate (Fig. 25).
Blind Screw Inserts and Sutures (optional)

NCB Blind Screw Insert
To prevent bone ingrowth into empty screw holes it is possible to use NCB Blind Screw Inserts (Fig. 26).

**Note:** Hand tighten only.

Sutures
Oblique holes $\varnothing$ 2mm can be used for sutures and reattachment of the rotator cuff (Fig. 27).
Zimmer MIS Technique (Anterior/Lateral Deltoid Split Incision)

High Anterior/Lateral Deltoid Split Incision
A high anterior/lateral deltoïd split incision is recommended (Fig. 28).

Important: Care must be taken to avoid damaging the axillary nerve and to keep the blood supply of the bone fragments intact.

1. Reduce the Fracture
Reduce the fracture and check correct reduction under image intensification.

The humeral head and tuberosity fragments may be manipulated and temporary fixed with 2mm Kirschner wires. K-wires should be placed where they will not interfere with the plate application.
Targeting Device

Plate Hole Numbering System
To target the correct plate holes there is a numbering system on the targeting module (Figs 29 & 30).

Targeting for screw holes with the numbers:
1–2–4–5–6–7–8

Turn for the number:
3 (Fig. 31)

Note: The plate should not be bent since this might disrupt the function of the locking mechanism.
Insert the Plate

1. Assemble the MIS radiolucent targeting device
Assemble the radiolucent handle to the proximal end of the plate. Use a 3.5mm hexagonal screwdriver to tighten moderately the fixation screw.

2. Inserting Plate
Insert the plate through the high anterior/lateral deltoid split incision subcutaneously along the proximal humerus (Fig. 32).

Note: Aim to get bone contact immediately. Insert the plate underneath the subdeltoid bursa. Care must be taken to avoid damaging the axillary nerve and the vascularization of the fragments.

3. Position Plate to Bone
Positioning from A-P view
The plate should be placed approx. 10 mm distal to the rotator cuff attachment on the upper edge of the greater tuberosity to avoid postoperative subacrominal impingement (Fig. 33).

Positioning from lateral view
The plate should be centered against the lateral aspect of the greater tuberosity (Fig. 34).

4. Assemble the Targeting Module
Attach the targeting module to the handle with the hole numbering 1–2–4–5–6–7–8 on the lateral side (Fig. 35). Fit the yellow arrowhead markings together for proper assembly (Fig. 36).
NCB Cannulated Screw Insertion

1. General Remarks
The placement of the initial NCB Screw depends on the fracture type and the reduction achieved. It is recommended to start with the distal screw Ø 4.5mm.

Two cannulated screw types are offered with the NCB Plating System. Cancellous NCB Screws preferably for the epi- and metaphysis as well as NCB Cortical Screws which are ideal for placement in the diaphysis. Both screw types are self-drilling and self-tapping. The screws can be precisely placed over K-wires. A tissue protection sleeve assembly is used for guidance. A cannulated drill bit can be used to predrill strong cortical bone.

Note: Use the cannulated screws only after inserting Ø 1.6mm, L 190mm K-wires.

MIS Technique
NCB Self-Drilling Screw and Drill Dimensions

<table>
<thead>
<tr>
<th>Screw Type</th>
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<tr>
<td>L 20-50mm</td>
<td>L 30-50mm</td>
</tr>
</tbody>
</table>

Drill
 Ø 3.3mm

K-wire
 Ø 1.6mm
 L 190mm