



**Zimmer®  
MotionLoc™ Screw  
for the NCB®  
Polyaxial Locking  
Plate System**

Periprosthetic Surgical  
Technique





## Background

Three recent studies examining supracondylar femur fractures show concern for the high degree of stiffness of locked plating constructs and report nonunion rates as high as 23%.<sup>1,2,3</sup> A plating construct needs to be strong enough to support the damaged bone while the fracture heals, but too much stiffness forces the body to heal through osteonal or primary/direct healing. Primary healing requires nearly-perfect anatomic reduction and rigid compression for absolute stability and has proven to be a very complex and unforgiving procedure.<sup>4</sup> In animal studies, Far Cortical Locking Technology provides controlled axial flexibility to promote fracture healing through callus formation, or secondary healing, by stressing the fracture with micromotion at the fracture site.<sup>5</sup> The idea of Far Cortical Locking Technology motivated Zimmer to create *Zimmer® MotionLoc™* Screws.

## Zimmer MotionLoc Screw Design

*MotionLoc* Screws look different than most cortical screws. The picture below outlines the different design aspects (Fig. 1) The following pages explain each labeled element of the screw.

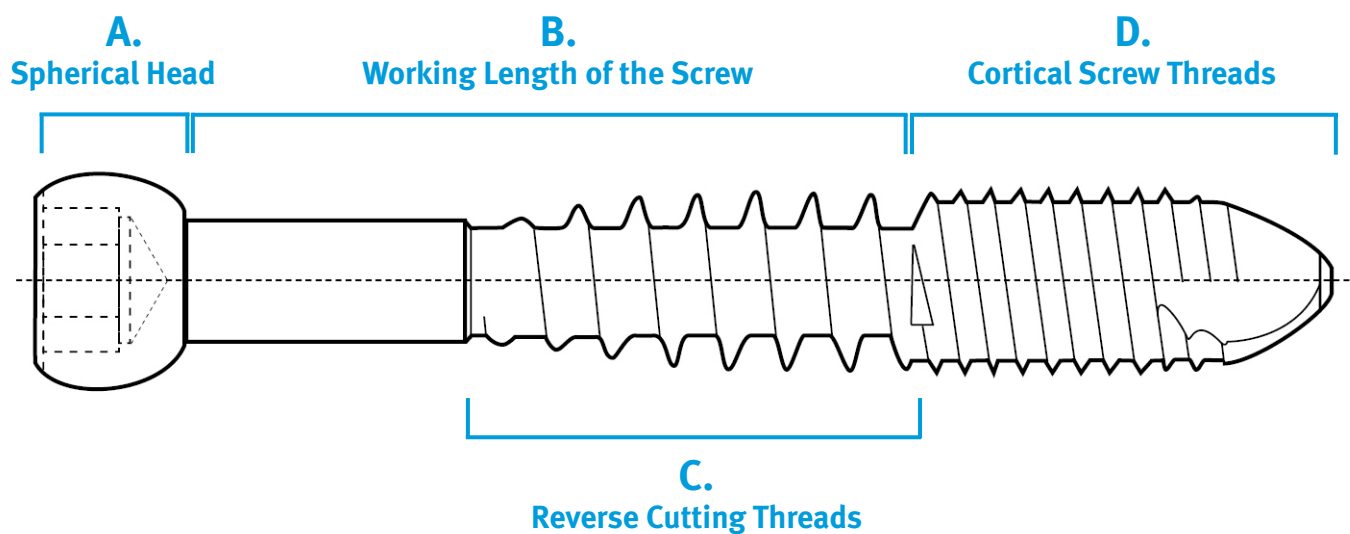


Fig. 1

## Citations

1. Boulton C, Chacko A, Appleton P, Rodriguez E: Factors for Increased failure rate of locked plating in the treatment of distal femoral fractures. Poster presented at the 78th Annual Meeting of the American Academy of Orthopaedic Surgeons, February 15-19, 2011, San Diego, CA.
2. Gross J, Serna F, Lybrand K, Qui X, Humphrey C, Gorczyca J: Surgical approach does not affect union of supracondylar femur fractures treated with plate fixation. Poster presented at the 78th Annual Meeting of the American Academy of Orthopaedic Surgeons, February 15-19, 2011, San Diego, CA.
3. Henderson CE, Lujan TJ, Kuhl LL, Bottlang M, Fitzpatrick DC, Marsh JL: Healing complications are common after locked plating for distal femur fractures. *Clin Orthop Relat Res* 2011;469(6):1757-1765.
4. Skirving AP, Day R, Macdonald W, McLaren R: Carbon fiber reinforced plastic (CFRP) plates versus stainless steel dynamic compression plates in the treatment of fractures of the tibiae in dogs. *Clin Orthop Relat Res* 1987; 224:117-124.
5. Bottlang M, Feist F: Biomechanics of far cortical locking. *J Orthop Trauma* 2011;25(suppl 1):S21-S28.

## A. Spherical Head

This part of the screw interfaces with the plate. Since the *MotionLoc* Screw was designed to work with the *NCB*® and *NCB* Periprosthetic plating systems, a spherical head is locked to the plate through the use of locking caps that are threaded into the plate holes. This design permits a range of 0° – 15° off-axis, or a 30° cone of polyaxiality (Fig. 2).

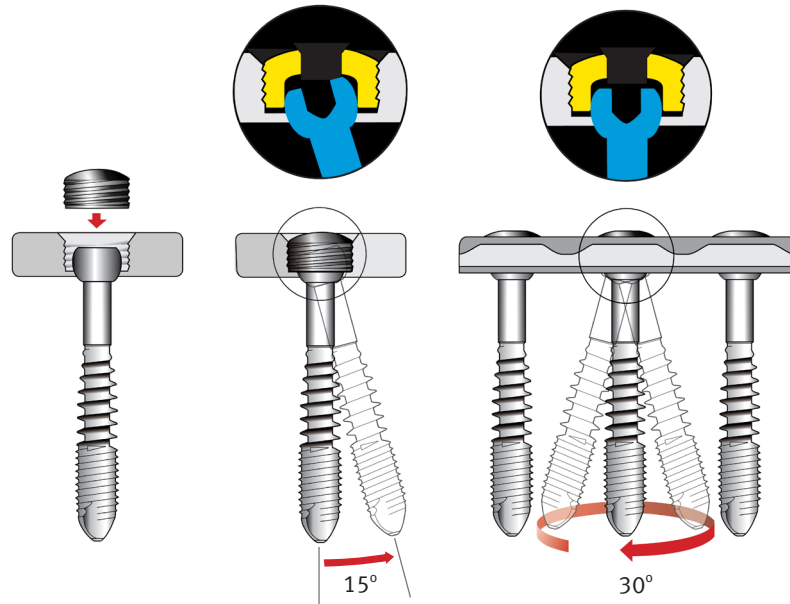


Fig. 2

This picture shows how much the screws can be angled with the *NCB* Plating System.

## B. Working Length of the Screw

This is the portion of the *MotionLoc* Screw that makes it unique. The diameter of this portion has been reduced in comparison to the distal end of the screw. This allows the screw within the drilled hole to flex through elastic deformation without deforming the screw. This is called the working length of the screw because this is the area that essentially does all of the work and flexes a controlled amount to create micromotion at the fracture site (Fig. 3).

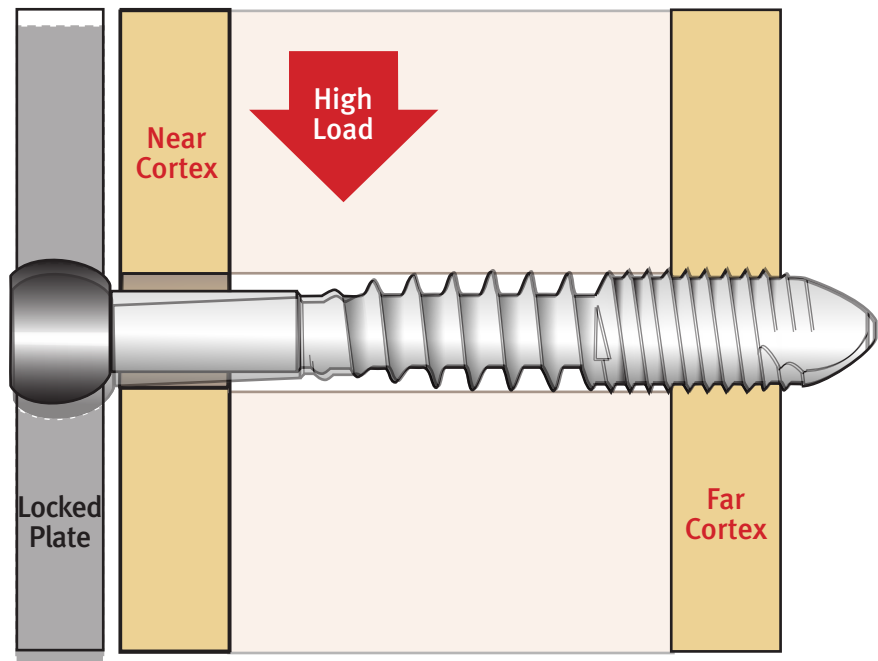


Fig. 3

This picture shows how the screw flexes as the load is applied.

It is important to maximize the working length of the screw, so centering the screw in the bone is key. The figure to the right will show how the screw is affected when placed off-center.

(Fig. 4) shows the working length when the *MotionLoc* Screw is centered in the bone. (Fig. 5) shows how the working length shrinks when the screw is placed off-center. This is the portion of the screw that does all of the work. As the working length increases, so does screw flexibility.

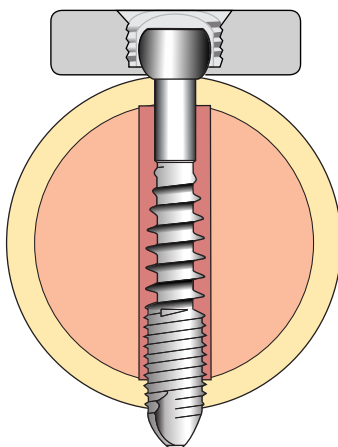


Fig. 4

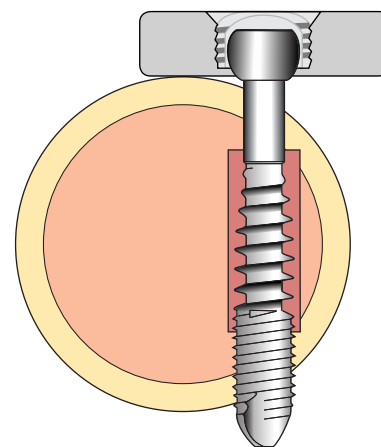
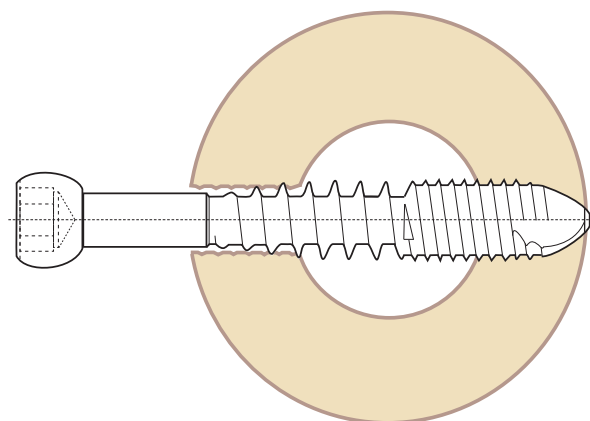


Fig. 5

### C. Reverse Cutting Threads

The reverse cutting threads on the working length of the screw are necessary for screw removal (Fig. 6). The reverse cutting threads are designed to engage with the near cortex before the threads on the tip of the screw disengage with the far cortex, so the screw can be backed out.



*This picture shows how the reverse cutting threads engage the near cortex as the cortical threads disengage from the far cortex when the screw is backed out.*

Fig. 6

## D. Cortical Screw Threads

This is what makes the *MotionLoc* Screw a standard screw with a standard surgical procedure. As this screw advances through the drilled hole, it carves out a flexibility envelope for the reduced shaft portion of the screw. This is also the portion that fixes into the cortical bone for hold. Since *MotionLoc* Screws are only fixed in the far cortex, radiographs must be inspected to confirm the screw tip has completely engaged that cortex (Fig. 7 and Fig. 8).

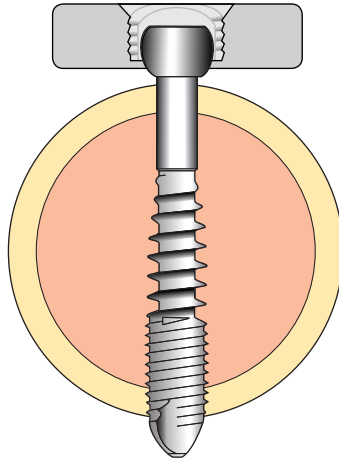


Fig. 7

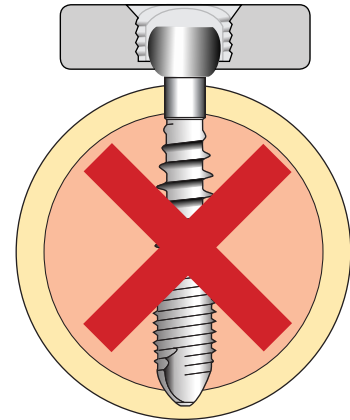


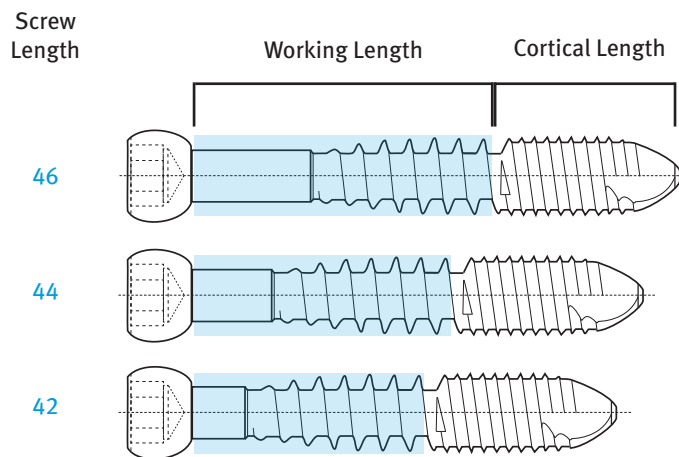
Fig. 8

### Screw Length

Increased flexibility of the screw is directly proportional to the length of the screw (Fig. 9). Mechanically, *MotionLoc* Screws behave in a manner similar to a cantilever beam. As the length of the beam/screw increases so does the beam/screw flexibility. This makes it very important to keep the *MotionLoc* Screw completely perpendicular to the bone to maximize the working length of the screw.

### Reducing Stiffness of Locked Plating Constructs

*MotionLoc* Screws reduce the locked plating construct stiffness by more than 64% while retaining construct strength. This stiffness reduction through the screws creates nearly-parallel micromotion at the fracture site. Due to precise engineering, these screws have been designed to flex 0.4mm reducing the construct stiffness to create the necessary controlled micromotion.



*This picture shows as the screw length increases, the working length increases, and so does the screw flexibility.*

Fig. 9



NCB Polyaxial Locking Plate

## Concept

- *MotionLoc* Screws reduce the stiffness of a locked plating construct.
- *MotionLoc* Screws reduce construct stiffness by elastic flexion of the *MotionLoc* Screw shaft within a controlled motion envelope in the near cortex
- To enable elastic flexion of the *MotionLoc* Screws, the plate segment containing the *MotionLoc* Screws should not be compressed onto the bone surface.

## Technique

**WARNING:** The *MotionLoc* Screws are only intended for use in the diaphyseal side of a fracture where screw purchase in the far cortex opposite the plate can be obtained. Do not use them in the metaphysis or epiphysis of the bone.

**WARNING:** The *MotionLoc* Screws should not be used with *NCB* Plates in a condition where the gap between the plate and the bone is greater than 3mm as this may place undue stress on the screw and cause failure.

**WARNING:** Do not use standard *NCB* Screws in the same fracture segment as the *MotionLoc* Screws since this may lead to a stress riser and potential failure.

**WARNING:** Do not use 4.0mm *MotionLoc* Screws for femur fractures. 5.0mm *MotionLoc* Screws must be used.

**NOTE:** To maximize the effectiveness of the *MotionLoc* Screw, the plate should not be compressed to the bone. Use *NCB* Spacers in the diaphysis to elevate the plate off the bone surface. *NCB* Spacers are available in 1mm, 2mm, and 3mm sizes. Two spacers may be inserted into the plate before plate application. Insert the *NCB* Plate and temporarily fix it to the bone with a 2.0mm K-wire at each

end of the plate (Fig. 10).

Fix the epiphyseal and metaphyseal segments of the fracture as described in the surgical techniques for the *NCB* Distal Femoral, Proximal Tibial, Proximal Humeral, Large Fragment or *NCB* Periprosthetic Femur plates (Fig. 11).

Fig. 10

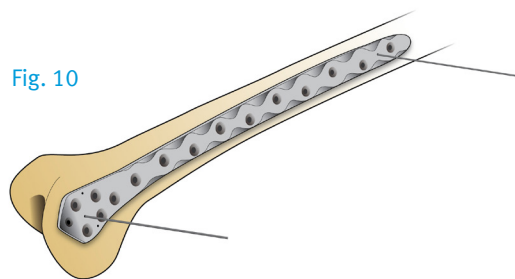
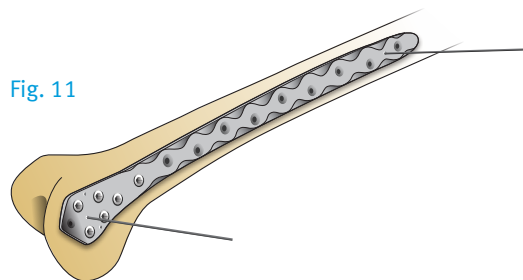


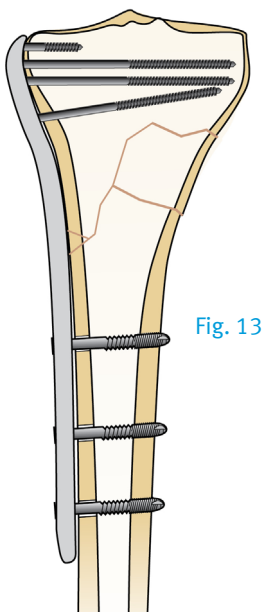
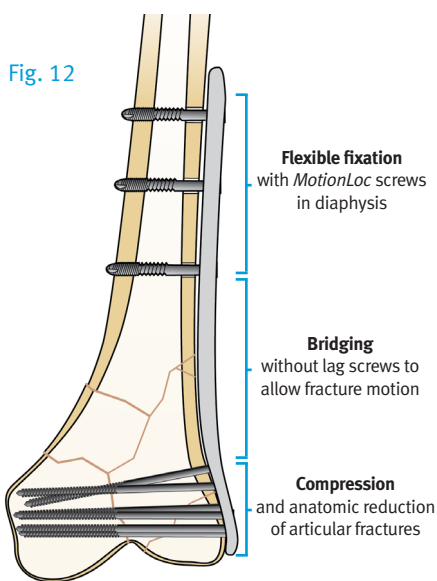
Fig. 11



### For NCB Femoral and Tibial Plate Fixation with 5.0mm Screws

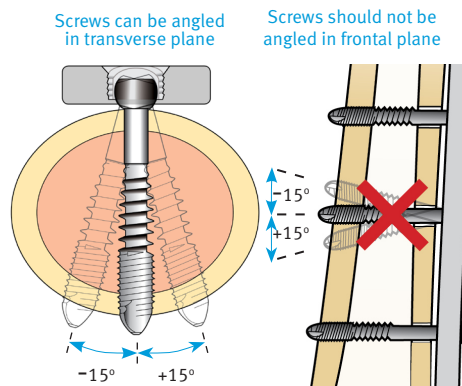
**WARNING:** A MINIMUM of three (3) *MotionLoc* Screws are required to be placed in the shaft of the bone: 1) distal to the fracture in proximal tibial fractures; and 2) proximal to the fracture for distal femur fractures (Fig. 12 and 13).

**WARNING:** Do not use 4.0mm *MotionLoc* Screws for femur fractures. 5.0mm *MotionLoc* Screws must be used.



To insert the 5.0mm *MotionLoc* Screws use the 4.3mm Drill Guide. Fully seat the Drill Guide into the plate hole perpendicular to the plate surface, and then tilt it as necessary to achieve the desired screw angle.

For maximum stiffness reduction, screws should be placed as perpendicular to the plate as possible. Avoid angling the drill in the axial direction to ensure perpendicular screw placement in the plate (Fig. 14).



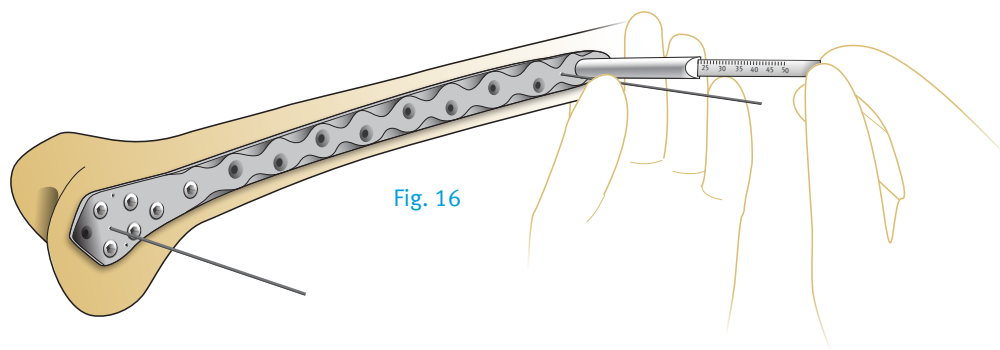
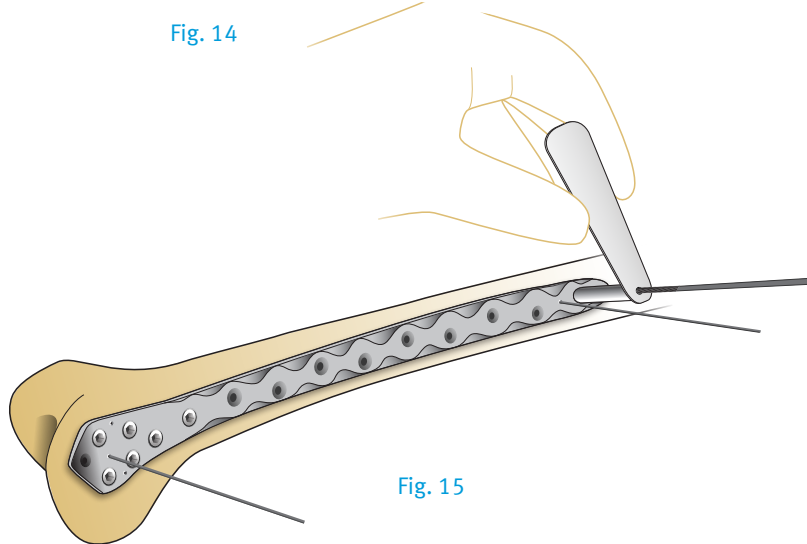
**NOTE:** The Drill Guide must remain fully seated in the plate hole to limit the amount of angulation to within the 30° cone allowed by the NCB System (Fig. 15).

Drill using the 4.3mm drill bit. If drilling in hard cortical bone, remove the Drill Guide and tap the far cortex with the 5.0mm Tap.

Use the NCB Depth Gauge to determine the appropriate screw length (Fig. 16). Be sure the drill has completely cut through the far cortex without damaging soft tissue because *MotionLoc* Screws should fully engage the far cortex.

Select the appropriate *MotionLoc* Screw from the *MotionLoc* Screw Caddy. Insert the screw until it is gently seated in the plate hole.

**WARNING:** To prevent screw stripping in poor quality bone, do not over-tighten the screw.





**NOTE:** The plate may be gently lagged to the bone, but **do not compress** plate to bone.

**NOTE:** If NCB Spacers are not used, and the plate is directly adjacent to the bone, the *MotionLoc* Screws should be backed out  $\frac{1}{2}$  turn to provide a 1mm gap between the plate and the bone (Fig. 17).

**WARNING:** After insertion, the reverse cutting threads (for screw removal) of the *MotionLoc* Screw should not be engaged in the near cortex as this will reduce the effectiveness of the construct and may cause failure of the screw. Verify using x-ray that the threads of the *MotionLoc* Screw are not engaged in the near cortex.

To lock the screw to the plate, insert a Locking Cap and tighten it using the NCB 6Nm Torque-Limiting Screwdriver until a **CLICK** is heard from the handle of the Screwdriver. The **CLICK** indicates that enough torque has been applied to effectively lock the Cap (Fig. 18).

**CAUTION:** All *MotionLoc* Screws must be locked into the plate.

Repeat this procedure as necessary to insert a **MINIMUM of three (3)** *MotionLoc* Screws and Locking Caps into the shaft of the bone (Fig. 19).

NCB Spacers may be removed after all screws have been locked with Locking Caps.

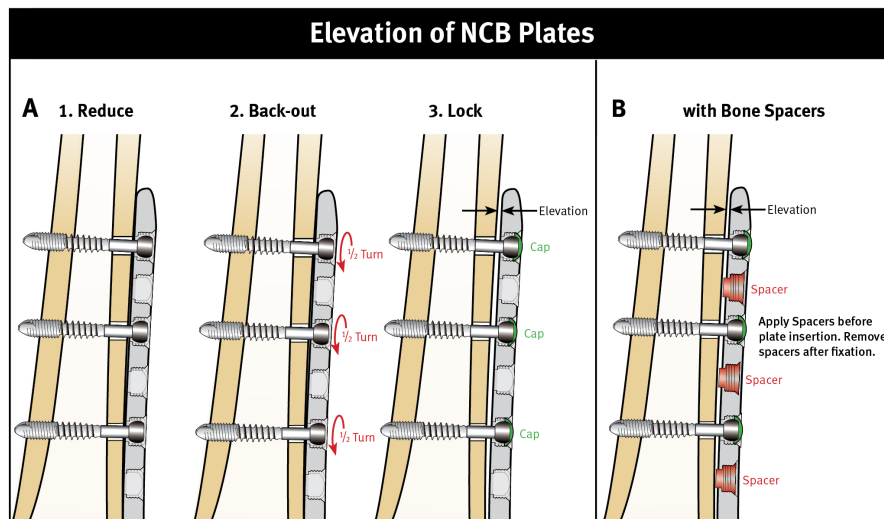


Fig. 17

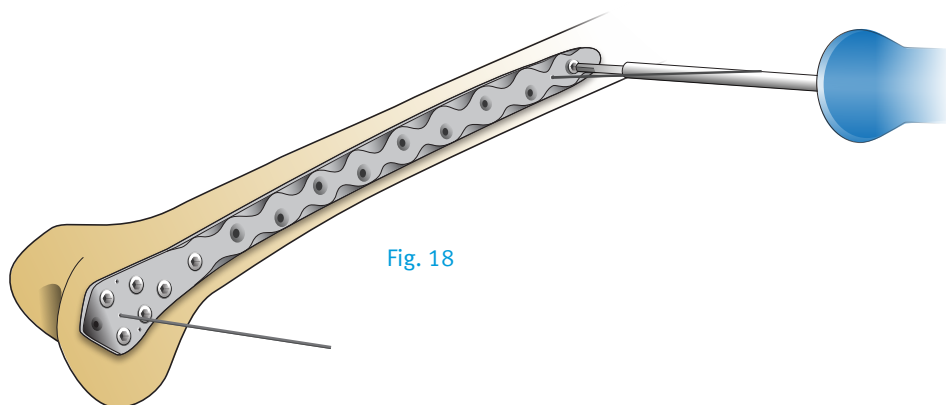


Fig. 18

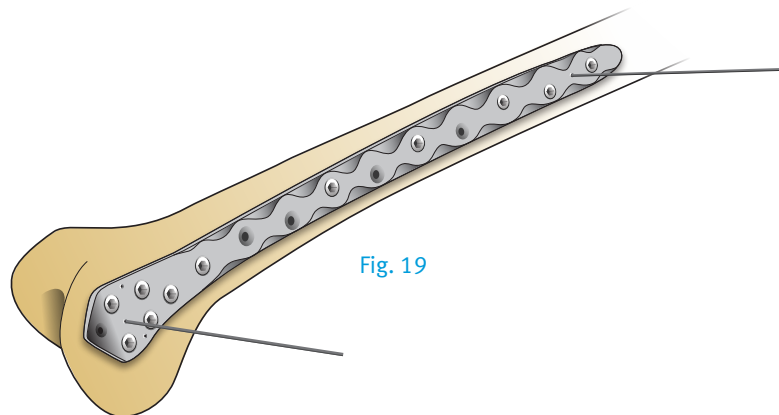


Fig. 19

## For NCB Periprosthetic Femur Fixation with 5.0mm Screws

**WARNING:** A MINIMUM of three (3) *MotionLoc* Screws are required to be placed in the shaft of the bone: 1) Distal to the fracture around a prosthesis in a proximal femur (Fig. 20) and 2) Proximal to the fracture around a prosthesis for a distal femur fracture (Fig. 21).

**WARNING:** Do not use 4.0mm *MotionLoc* Screws for femur fractures. 5.0mm *MotionLoc* Screw must be used.

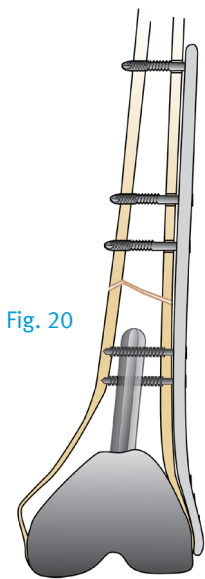


Fig. 20

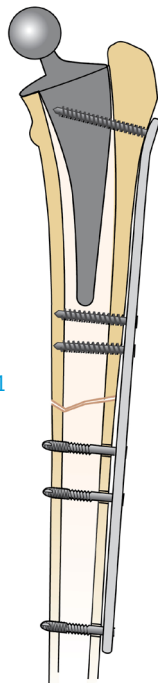


Fig. 21

To insert the 5.0mm *MotionLoc* Screws use the 4.3mm Drill Guide. Fully seat the Drill Guide into the plate hole perpendicular to the plate surface, and then tilt as necessary to achieve the desired screw angle.

For maximum stiffness reduction, screws should be placed as perpendicular to the plate as possible. Avoid angling the drill in the axial direction to ensure true perpendicular screw placement in the plate (Fig 22).

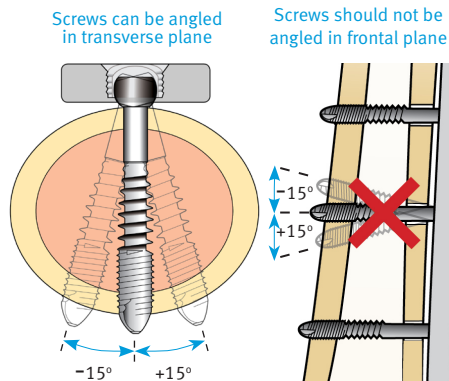


Fig. 22

**NOTE:** The Drill Guide must remain fully seated in the plate hole to limit the amount of angulation to within the 30° cone allowed by the NCB Periprosthetic System.

Drill using the 4.3mm drill bit. If drilling in hard cortical bone, remove the Drill Guide and tap the far cortex with the 5.0mm Tap.

Use the NCB Depth Gauge to determine the appropriate screw length. *MotionLoc* Screws should fully engage the far cortex. Select the appropriate *MotionLoc* Screw from the *MotionLoc* Screw Caddy. Insert the screw until it is gently seated in the plate hole. Be sure the drill has completely cut

through the far cortex without damaging soft tissue because *MotionLoc* Screws should fully engage the far cortex.

**WARNING:** To prevent screw stripping in poor quality bone, do not over-tighten the screw.

**NOTE:** The plate may be gently lagged to the bone, but do not compress plate to bone.

**NOTE:** If NCB Spacers are not used, and the plate is directly adjacent to the bone, the *MotionLoc* Screws should be backed out ½ turn to provide a 1mm gap between the plate and the bone (Fig 23).

**WARNING:** After insertion, the reverse cutting threads (for screw removal) of the *MotionLoc* Screw should not be engaged in the near cortex as this will reduce the effectiveness of the construct and may cause failure of the screw. Verify using x-ray that the threads of the *MotionLoc* Screw are not engaged in the near cortex.

To lock the screw to the plate, insert a Locking Cap and tighten it using the NCB 6Nm Torque-Limiting Screwdriver until a **CLICK** is heard from the handle of the screwdriver. The **CLICK** indicates that enough torque has been applied to effectively lock the Cap.

**CAUTION:** All *MotionLoc* Screws must be locked into the plate.

Repeat this procedure as necessary to insert a **MINIMUM of three (3)** *MotionLoc* Screws and Locking Caps into the shaft of the bone.

NCB Spacers may be removed after all screws have been locked with Locking Caps.

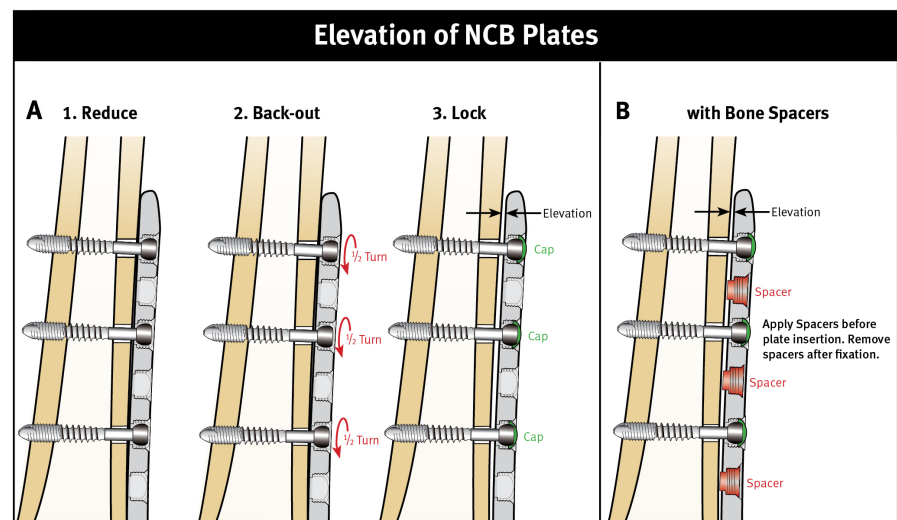


Fig. 23

## For NCB Tibial and Humeral Plate shaft fixation with 4.0mm Screws

**WARNING:** A MINIMUM of three (3) *MotionLoc* Screws on the diaphyseal side of the fracture are required to be placed in the shaft of the bone distal to the fracture in proximal humerus and proximal tibial fractures (Fig. 24).

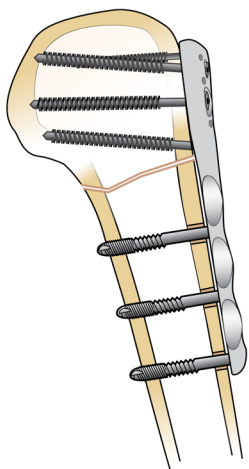


Fig. 24

To insert the 4.0mm *MotionLoc* Screws use the 3.3mm Drill Guide. Fully Seat the Drill Guide into the plate hole perpendicular to the plate surface, and then tilt it as necessary to achieve the desired screw angle.

For maximum stiffness reduction, screws should be placed as perpendicular to the plate as possible. Avoid angling the drill in the axial direction to ensure perpendicular screw placement in the plate (Fig. 25).

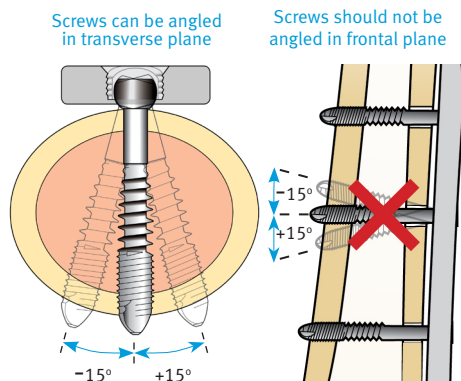


Fig. 25

**NOTE:** The Drill Guide must remain fully seated in the plate hole to limit the amount of angulation to within the 30° cone allowed by the *NCB* system.

Drill using the 3.3mm drill bit. If drilling in hard cortical bone, remove the Drill Guide and tap the far cortex with the 4.0mm Tap.

Use the *NCB* Depth Gauge to determine the appropriate screw length. *MotionLoc* Screws should fully engage the far cortex. Be sure the drill has completely cut through the far cortex without damaging soft tissue because *MotionLoc* Screws should fully engage the far cortex.

Select the appropriate *MotionLoc* Screw from the *MotionLoc* Screw Caddy. Insert the screw until it is gently seated in the plate hole.

**WARNING:** To prevent screw stripping in poor quality bone, do not over-tighten the screw.

**NOTE:** The plate may be gently lagged to the bone, but do not compress plate to bone.

**NOTE:** If *NCB* Spacers are not used, and the plate is directly adjacent to the bone, the *MotionLoc* Screws should be backed out ½ turn to provide a 1mm gap between the plate and the bone (Fig. 26).

**WARNING:** After insertion, the reverse cutting threads (for screw removal) of the *MotionLoc* Screw should not be engaged in the near cortex as this will reduce the effectiveness of the construct and may cause failure of the screw. Verify using x-ray that the threads of the *MotionLoc* Screw are not engaged in the near cortex.

To lock the screw to the plate, insert a Locking Cap and tighten it using the *NCB* 6Nm Torque-Limiting Screwdriver until a **CLICK** is heard from the handle of the Screwdriver. The **CLICK** indicates that enough torque has been applied to effectively lock the Cap.

**NOTE:** If using the *NCB* Proximal Humeral Plate, the use of the *NCB* 4Nm Torque Limiting Screwdriver is also acceptable.

**CAUTION:** All *MotionLoc* Screws must be locked into the plate.

Repeat this procedure as necessary to insert a **MINIMUM of three (3)** *MotionLoc* Screws and Locking Caps into the shaft of the bone.

*NCB* Spacers may be removed after all screws have been locked with Locking Caps.

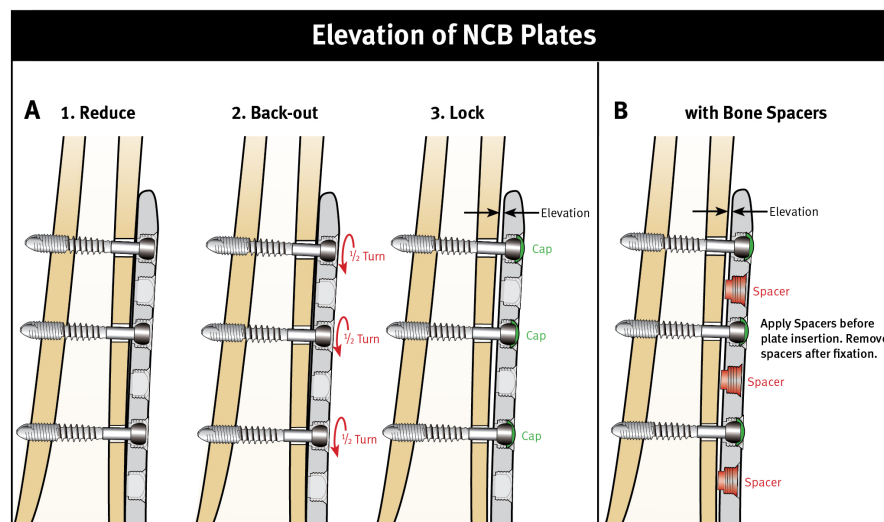


Fig. 26

## For Fixation Using the NCB Straight Narrow Shaft Plate

**WARNING:** A **MINIMUM of three (3)** MotionLoc Screws are required to be placed in the shaft of the bone (Fig. 27).

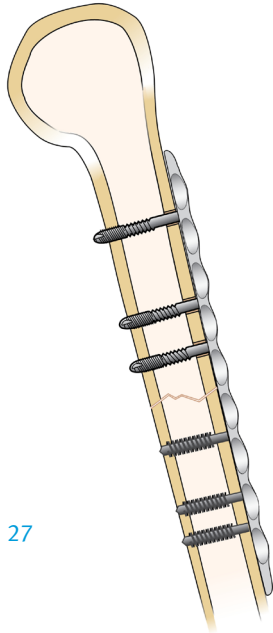


Fig. 27

To insert the **4.0mm** MotionLoc Screws use the **3.3mm** Drill Guide. Fully seat the Drill Guide into the plate hole perpendicular to the plate surface, and then tilt as necessary to achieve the desired screw angle.

For maximum stiffness reduction, screws should be placed as perpendicular to the plate as possible. Avoid angling the drill in the axial direction to ensure perpendicular screw placement in the plate (Fig. 28).

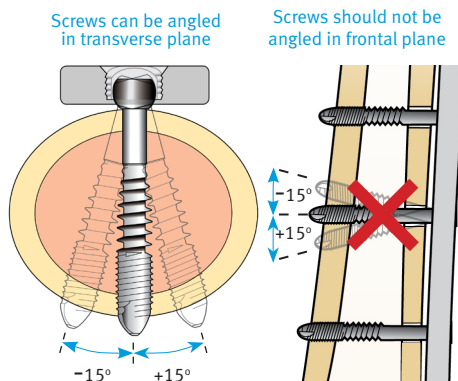


Fig. 28

**NOTE:** The Drill Guide must remain fully seated in the plate hole to limit the amount of angulation to within the 30° cone allowed by the NCB System.

Drill using the **3.3mm** drill bit. If drilling in hard cortical bone, remove the Drill Guide and tap the far cortex with the 4.0mm Tap.

Use the NCB Depth Gauge to determine the appropriate screw length. MotionLoc Screws should fully engage the far cortex. Be sure the drill has completely cut through the far cortex without damaging soft tissue because MotionLoc Screws should fully engage the far cortex.

Select the appropriate MotionLoc Screw from the MotionLoc Screw Caddy. Insert the screw until it is gently seated in the plate hole.

**WARNING:** To prevent screw stripping in poor quality bone, do **not over-tighten** the screw.

**NOTE:** The plate may be gently lagged to the bone, but **do not compress** plate to bone.

**NOTE:** If NCB Spacers are not used, and the plate is directly adjacent to the bone, the MotionLoc Screws should be backed out ½ turn to provide a 1mm gap between the plate and the bone (Fig. 29).

**WARNING:** After insertion, the reverse cutting threads (for screw removal) of the MotionLoc Screw should not be engaged in the near cortex as this will reduce the effectiveness of the construct and may cause failure of the screw. Verify using x-ray that the threads of the MotionLoc Screw are not engaged in the near cortex.

To lock the screw to the plate, insert a Locking Cap and tighten it using the NCB 6Nm Torque-Limiting Screwdriver until a **CLICK** is heard from the handle of the Screwdriver. The **CLICK** indicates that enough torque has been applied to effectively lock the Cap.

**NOTE:** If using the NCB Straight Narrow Shaft Plate for humerus fractures the use of the NCB 4Nm Torque Limiting Screwdriver is also acceptable.

**CAUTION:** All MotionLoc Screws must be locked into the plate.

Repeat this procedure as necessary to insert a **MINIMUM of three (3)** MotionLoc Screws and Locking Caps into the shaft of the bone.

NCB Spacers may be removed after all screws have been locked with Locking Caps.

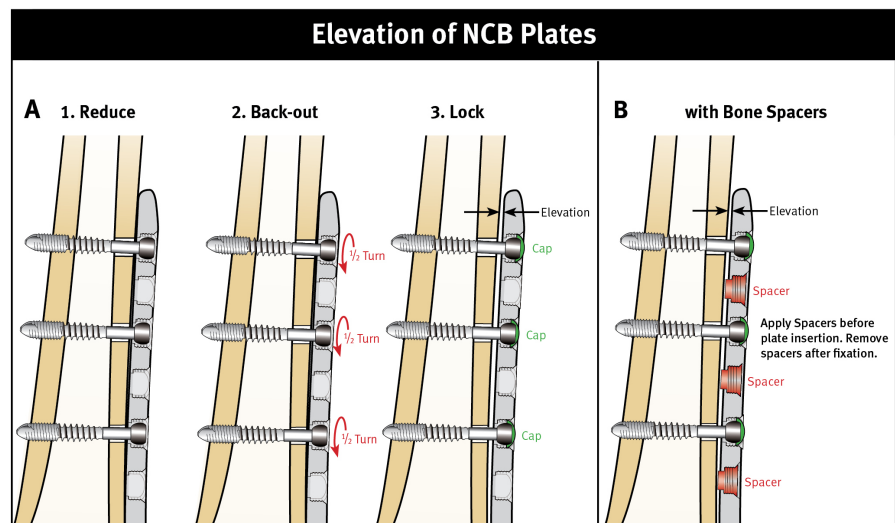


Fig. 29

## Implant Removal

To remove the *NCB* Plate, first remove all the Locking Caps. Then loosen all the bone screws without completely removing them (this prevents rotation of the bone plate when removing the last screw). Then completely remove all bone screws.

**NOTE:** Make sure that the tip of the *NCB* Screwdriver is correctly placed in the hex drive of the Locking Caps and/or *MotionLoc* Screws. Failure to do so could damage the hex drive and complicate the extraction of the implant.

**NOTE:** In case of difficulties in loosening the *MotionLoc* Screws, tighten the screws slightly before loosening them.

## Technical Pearls

### Minimizing stress in the fixation construct:

- Elevation of the plate over the bone surface is defined by the first two locked screws.
- **Additional screws should be gently seated into plate holes** before application of Locking Caps. If an additional screw is not fully seated, application of the Locking Cap may induce stress by forcing the screw into the bone. Conversely, if an additional screw is excessively tightened against an elevated plate, the plate may be bent.







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