Zimmer® MotionLoc® Screw for the NCB® Polyaxial Locking Plate System
Periprosthetic Surgical Technique
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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%.1,2,3 While it is true that a plating construct needs to be strong enough to support the damaged bone while the fracture heals, it is also true that too much stiffness forces the body to heal through osteonal or primary/direct healing (Fig. 1). Primary healing requires nearly-perfect anatomic reduction and rigid compression for absolute stability, and can be a very complex and unforgiving procedure.4 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.5 The idea of Far Cortical Locking Technology motivated Zimmer to create Zimmer® MotionLoc™ Screws.

Asymmetric Gap Closure

Fig. 1
Conventional locked plating constructs bend to create motion and callus formation on the far cortex, while stress shielding the near cortex. This can lead to delayed union or non-union issues if the fracture does not heal before the plate breaks.
**Concept**

*MotionLoc* uses far cortical locking technology as a strategy to reduce the stiffness of a locked plating construct without losing construct strength.

*MotionLoc* screws lock in the plate and the far cortex of diaphyseal bone. *MotionLoc* screws have a reduced diameter mid-shaft to bypass the near cortex (Fig. 2). Under load the screw will elastically flex to create interfragmentary motion at the fracture site until the shaft of the screw contacts the near cortex for added support and load sharing.

The elastic deformation of the *MotionLoc* screws translates to nearly parallel micromotion at the fracture site (Fig. 3). With a standard locking construct in a bridging technique, micromotion is only created at the far cortex.
**MotionLoc Screw Design**

MotionLoc Screws look different than most cortical screws. Fig. 4 outlines the different design aspects. Each labeled part (A–D) of the screw has a specific function.

**Design Specification**

**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. 5).

**B. Working Length**

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. 6).

It is important to maximize the working length of the screw, so centering the screw in the bone is key. Fig. 7 shows how the working length shrinks when the screw is placed off-center. As the working length increases, so does screw flexibility.
C. Reverse Cutting Threads

The reverse cutting threads on the working length of the screw are necessary for screw removal (Fig. 8). 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.

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. 9).

Screw Length

Increased flexibility of the screw is directly proportional to the length of the screw (Fig. 10). 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.

As the screw length increases, the working length increases, and so does the screw flexibility.
Compatibility

MotionLoc Screws for use with NCB and NCB Periprosthetic System are offered in a 4.0mm and 5.0mm version.

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See the package insert for specific indications for each plate.
5.0mm *MotionLoc* Screw Surgical Technique

For NCB Distal Femur, NCB Proximal Tibia, NCB Curved Femur Shaft, and NCB Periprosthetic Proximal and Distal Femur Plates

**Preoperative Preparation**

After assessing the fracture radiographically and preparing a preoperative plan, position the patient on the appropriate table. Ensure that the fluoroscope can be positioned to visualize the appropriate bone in both the lateral and anterior/posterior views. For specific preoperative positioning, refer to the surgical technique for the appropriate Zimmer NCB Plate being used.

**Plate Selection**

Two factors to consider when choosing plate length: (1) Location of the fracture and (2) the number and distribution of the screws around the fracture site.

**WARNING:** *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. A minimum of 3 (three) *MotionLoc* screws are required to be placed in the shaft of the bone:

1. Proximal to the fracture for distal femur fractures. (Fig. 11)
2. Distal to the fracture in proximal tibia fractures (Fig. 12)
3. Proximal to the fracture around a prosthesis for a distal femur fracture (Fig. 13).
4. Distal to the fracture around a prosthesis in a proximal femur (Fig. 14)

**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.
Plate Insertion

Insert the NCB Plate and temporarily fix it to the bone with a 2.0mm K-wire at each end of the plate (Fig. 15).

Fix the epiphyseal and metaphyseal segments of the fracture as described in the surgical techniques for the NCB Distal Femoral, Proximal Tibial, or NCB Periprosthetic Femur plates (Fig. 16).

WARNING: 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.

WARNING: 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. 17).

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.
Screw Fixation

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.

**WARNING:** For maximum stiffness reduction, screws should be placed as perpendicular to the plate as possible and should fully engage the far cortex.

Avoid angling the drill in the axial direction to ensure perpendicular screw placement in the plate (Fig. 18).

**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. 19).

Drill using the 4.3mm drill bit.

**WARNING:** 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. 20). 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.

**WARNING:** Do not use 4.0mm MotionLoc Screws for femur fractures. 5.0mm MotionLoc Screws must be used.
**NOTE:** The plate may be gently lagged to the bone, but do not compress plate to bone.

**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. 21).

**WARNING:** Locking Caps must be used with all *MotionLoc* Screws.

Repeat this procedure as necessary to insert a MINIMUM of three (3) *MotionLoc* Screws and Locking Caps into the shaft of the bone (Fig. 22).

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

**WARNING:** 5.0mm *MotionLoc* Screws may be used in the Proximal Femur plate holes of a long (245-401mm) *NCB* Periprosthetic Proximal Femur/Trochanter plate construct. They cannot be used with the Periprosthetic Trochanter Plate or with a short (115mm) *NCB* Periprosthetic Proximal Femur/Trochanter plate construct (neither has the required three holes for secure fixation).
4.0mm *MotionLoc* Screw Surgical Technique

For NCB Proximal Tibia, NCB Proximal Humerus, NCB Straight Narrow Shaft Plates

Preoperative Preparation

After assessing the fracture radiographically and preparing a preoperative plan, position the patient on the appropriate table. Ensure that the fluoroscope can be positioned to visualize the appropriate bone in both the lateral and anterior/posterior views. For specific preoperative positioning, refer to the surgical technique for the appropriate *NCB* Plate being used.

Plate Selection

Two factors to consider when choosing plate length: (1) Location of the fracture and (2) the number and distribution of the screws around the fracture site.

**WARNING:** *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. A minimum of 3 (three) *MotionLoc* screws are required to be placed in the shaft of the bone:

1. Distal to the fracture in proximal tibial fracture (Fig. 23)
2. Distal to the fracture in proximal humerus fractures (Fig. 24)

**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.
Plate Insertion

Insert the NCB Plate and temporarily fix it to the bone with a 2.0mm K-wire at each end of the plate.

Fix the epiphyseal and metaphyseal segments of the fracture as described in the surgical techniques for the NCB Proximal Tibia, Proximal Humerus, or NCB Straight and Narrow Shaft plates.

**WARNING:** 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.

**WARNING:** 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:** 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.
**Screw Fixation**

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.

**WARNING:** For maximum stiffness reduction, screws should be placed as perpendicular to the plate as possible and should fully engage the far cortex.

Avoid angling the drill in the axial direction to ensure perpendicular screw placement in the plate (Fig. 27).

**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.

**WARNING:** 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. 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.

**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* or the *NCB Straight Narrow Shaft Plate in the humerus*, the use of the *NCB 4Nm Torque Limiting Screwdriver* is also acceptable.

**WARNING:** Locking Caps must be used with all *MotionLoc Screws*.

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.
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.
References:


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