Surgical Technique for Fixation of Intertrochanteric Fractures of the Femur
Introduction

Choosing the Angle of Fixation

The development of tube/plates has provided the surgeon with a wider range of options. For a simple intertrochanteric fracture which is stable and not displaced, the lower angle (135-degree) device is appropriate, as only minimal impaction and collapse of fracture fragments typically occur.

Higher-angle fixation, while more technically demanding, is helpful for treating comminuted fractures where fracture fragments need to impaction postoperatively in order to gain stability. Increasing the neck/shaft angle with high-angle fixation decreases mechanical stress on the implant and increases the tendency for sliding, thereby facilitating the impaction of fracture fragments.

In choosing the angle of fixation, keep in mind that it is desirable to achieve 70 to 80 percent of fracture impaction at the time of surgery. Another consideration, apart from the nature of the fracture itself, is the substantial anatomic variation encountered in the natural neck/shaft angle of the femur. This angle can vary from 135 degrees to as much as 160 degrees.

The Versa-Fx Femoral Fixation System provides maximum flexibility in angle of fixation with tube/plates of 130, 135, 140, 145 and 150 degrees. Supracondylar tube/plates are also available in 90- and 95-degree versions.

Rotational Stability

The Versa-Fx Femoral Fixation System for internal fixation of hip fractures is indicated for intracapsular and intertrochanteric fractures, osteotomies, arthrodeses and some subtrochanteric fractures (with restrictions).
Surgical Technique for Intertrochanteric Fractures

Patient Positioning and Radiographic Control

After anesthesia is administered, place the patient in the supine position on the fracture table (Figure 1). The sacrum and perineal post should be well padded. Pull the patient down onto the padded post and position both lower limbs in 30 to 40 degrees of abduction.

Strap or tape the feet directly to the foot plates of the traction device. Using manual traction, bring the injured limb to about 10 degrees of abduction and the uninjured limb to maximum abduction. Using mechanical traction, internally rotate both legs so that the feet rest in approximately 45 degrees internal rotation with the knees in slight internal rotation. Apply further traction to the limb to tighten the hip capsule. This will cause the externally rotated neck and shaft to be distracted distally and brought into internal rotation.

The A/P tube should be overhead. When available, image intensification may be used in a similar manner, positioning the machine between the patient's legs.

Reduction, Incision and Exposure

The incision should not be made until the best reduction possible is accomplished. Obtain A/P and lateral roentgenograms and make sure the entire femoral head and acetabulum are visible in the lateral film. Further manipulation of the fracture may be necessary to obtain the best possible reduction. An anatomic reduction or a slightly over corrected (valgus) reduction should be seen in the A/P film. Occasionally, a slight sag of the fracture may be seen on the lateral view.

Prepare the operative site in the usual manner. Begin the incision at the tip of the greater trochanter and extend it distally for about 15 cm in a longitudinal direction (Figure 2). Continue the incision down through the subcutaneous tissues and split the fascia lata to expose the underlying vastus lateralis.
Retract the muscle anteriorly and follow it posteriorly along the fascia toward the linea aspera. Incise the muscle just anterior to its insertion on the linea aspera, then elevate it subperiosteally from the femoral shaft. (In extremely obese patients, the insertion on the intertrochanteric line may be tenotomized as well.) Palpate the lesser trochanter on the interior posterior aspect of the proximal femur and use it as a reference point for the insertion of the guide pin.

**Guide Pin Placement**

The placement of the guide pin is the most critical step of the surgical procedure as the guide pin serves to establish the angle of fixation. Subsequent reaming, tapping and implant placement are performed with cannulated instrumentation which follows the path established by the guide pin.

Establish a drill track with an entry point on the lateral femoral cortex. If using a 135-degree tube/plate, establish the entry point at an area directly opposite the lesser trochanter and aim it proximally and medially at 135 degrees. Place a guide pin through this point directly into the center of the femoral neck and head (Figure 3). If using a 150-degree tube/plate, establish the drill track 2 cm below this point. A guide pin inserted at this point and aimed proximally and medially at 150 degrees will pass along the calcar femorale into the femoral head.

![Figure 3: Guide Pin Placement](image-url)
A guide pin passed along the anterior aspect of the femoral neck may be visualized on image intensification and serve as a further guide to pin placement along the lateral cortex as well as assisting in the determination of the angle of anteversion or retroversion of the femoral neck.

Use a countersink or drill bit to make a pilot hole approximately 6.4 mm in diameter through the appropriate reference point. Then use one of five angle settings on the Adjustable Angle Guide (130, 135, 140, 145 or 150 degrees) to insert the guide pin at the desired angle (Figure 4). Use anteroposterior and lateral roentgenograms or image intensification to verify correct placement of the guide pin. If using image intensification, verify pin position during insertion. The guide pin should be inserted until well purchased in the subchondral bone of the femoral head, extending to within 3 to 6 mm of the joint space. Do not drill the guide pin into the joint space or acetabular cortex as this may damage the joint.

**Determining Guide Pin Depth**

Use the Guide Pin Depth Gauge to obtain a direct reading of the guide pin “pilot length” (Figure 5). Select the length of tap and ream depth from this measurement.

If the guide pin perforated the femoral head cortex, the amount of the overshoot of the guide pin must be considered in determining ream and tap depth.
Reaming the Lag Screw Channel

To prepare the lag screw channel, assemble the Lag Screw Reamer with either the short or long tube reamer head (Figure 6). The reamer shaft is calibrated for direct measurement of the distance from the tip of the reamer shaft to the countersink portion of the reamer head. Set the reamer with the calibrations at the rear of the reamer head as shown. Ream to the point where you countersink as shown in figure 6.

If working with good, healthy bone stock, set the reamer to ream to the true pilot length of the lag screw to be used. This will make it easier to tap and drive the lag screw. In elderly osteoporotic patients, ream the channel shorter than the selected length of the lag screw, as this may enhance screw purchase in the bone.

If the guide pin is inadvertently removed with the reamer, place the Pin Relocator into the reamed channel. Reinsert the guide pin through the cannulation and tap it into place (Figure 7).

Use of Provisionals (Optional)

Check the angle of fixation and the exact fit of the tube/plate with the metal tube/plate provisionals (Figure 8). Because all Versa-Fx Femoral Fixation implants are packaged presterile, use of the provisionals is preferable to opening multiple implant packages if an adjustment in size or angle is required.

Note: If the surgeon chooses not to assemble the tube/plate on the lag screw inserter, as in figures 11 and 12, use of the provisional should be done after the lag screw has been inserted.
Tapping the Lag Screw Channel (Optional)

After reaming, in dense bone, pass the Cannulated Bone Tap with centering collar over the guide pin to pre-tap a channel for the lag screw threads (Figure 9). Place the centering collar into the center of the reamed tube channel to maintain an on-center tap position. The calibrations (Figure 10) on the bone tap are true measurements of the distance from the tip of the tap to the rear of the locking assembly. Tap in a clockwise motion until the locking assembly comes in contact with the centering collar.

FIGURE 8 PLACEMENT OF PROVISIONAL

FIGURE 9 TAPPING

CENTERING COLLAR

FIGURE 10 CALIBRATIONS ON BONE TAP
Determining the Lag Screw Length

For a typical case in which a standard tube/plate is used and the distance reamed and tapped is the same as the pilot length, the lag screw length may be 10 mm less than the pilot length for low-angle plates (130, 135, 140 degrees). Higher-angle plates (145, 150 degrees) may use a lag screw equal to 5 mm less than the pilot length. Short tube/plates require a lag screw 5 mm longer than the pilot length for low-angle plates (130, 135, 140 degrees). High-angle short tube/plates require a lag screw 10 mm longer than the pilot length. (Refer to Guidelines in Determining Lag Screw Length.)

Note: Under all circumstances, a minimum of 22 mm of overlap must be maintained between the tube/plate and lag screw to ensure that binding between the two components is minimized.

### Guidelines in Determining Lag Screw Length

<table>
<thead>
<tr>
<th>Tube Style</th>
<th>Angle</th>
<th>130°</th>
<th>135°</th>
<th>140°</th>
<th>145°</th>
<th>150°</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Short</td>
<td></td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

1. Typical case, use same lag screw length as pilot length.
2. May use lag screw 10 mm less than pilot length.
3. May use lag screw 5 mm less than pilot length.
4. Should use lag screw 5 mm more than pilot length.
5. Should use lag screw 10 mm more than pilot length.

When pilot length is between the available incremental values, go to the next highest reading. This will be the correct pilot length.

**Target minimum overlap of lag screw and tube/plate is 22 mm.**

Note: Any differences in ream or tap depth, or large degrees of anticipated impaction should be taken into account.
Insertion of the Implant

Assemble the T-handle onto the Lag Screw Inserter and place the selected tube/plate onto the recessed diameter of the inserter. Place the appropriate length lag screw into the driving tip of the instrument. Then place the entire assembly over the guide pin and into the channel prepared in the lateral cortex (Figure 11).

The Lag Screw Inserter engages a slot on the base of the screw. The design of the inserter prevents side-to-side migration within the lag screw slot (Figure 12). Turn the screw first in a counterclockwise direction until a click is felt indicating that the screw threads match the tapped hole. Then turn the inserter clockwise to advance the lag screw to the desired depth. The T-handle of the Lag Screw Inserter should be parallel to the shaft of the femur when the screw is completely inserted. After insertion of the lag screw, move the tube/plate into position over the lag screw with the barrel resting in the reamed channel. If desired, clamp the tube/plate to the shaft of the femur.

Attaching the Side Plate

Attach the tube/plate to the shaft of the femur using 4.5 mm diameter cortical bone screws with bicortical fixation. The proximal hole on the tube/plate has been enlarged to accept either 4.5 mm cortical, 6.5 mm cancellous, or 7.0 mm cannulated screws. The larger 6.5 and 7.0 mm screws are helpful in capturing medial fragments. The Neutral and Load Drill Guide assures proper screw placement with the side plate hole (Figure 13). The Screw Depth Gauge determines the proper bone screw length (Figure 14). The Bone Tap assures proper interface between the bone screws and the bone.

Please refer to pages 14 and 15 to review the use of the Magna-Fx Cannulated Bone Screw in the proximal hole of the tube/plate for better fixation in specific fracture indications.
Impaction (Optional)

Use the Impactor* to impact the fracture. This instrument features the Impactor Guide which screws into the back of the lag screw (Figure 15). When the Impactor is inserted over the impactor guide, calibration can be documented in 5 mm increments, allowing measurement of the amount of impaction (Figure 16).

Use of a compression screw is recommended in all cases to ensure adequate overlap of the screw in the tube as well as to achieve further impaction (Figure 17). **However, it is important to avoid excessive force with compression or impaction because the lag screw may strip the threads in soft femoral head bone.**

After compression is achieved, the compression screw should be removed.

Final radiographs should be obtained before closing to make certain that the fracture is completely compressed and there is no gap or abnormal angulation at the fracture site.

* Developed in cooperation with William M. Deyerle, M.D.
Close the wound using widely separated and superimposed sutures in muscle, fascia, subcutaneous tissue and skin to allow adequate drainage. Dress the wound with a pressure dressing.

Dependent of fracture type and surgeon discretion, patients should be encouraged to get out of bed the day following surgery. The standing position helps prevent thromboembolism. Institute a program of partial weight bearing to provide additional compression of the fracture fragments. Patients should be allowed to ambulate with crutches or walkers. Full weight bearing is usually possible by the eighth week, but many patients begin full weight bearing at once because they would be unable to ambulate otherwise.

Because most of these patient are elderly, they are frequently given broad spectrum antibiotics prophylactically during or just before surgery; and the antibiotic regimen is continued for three days postoperatively. To help prevent thromboembolism, aspirin therapy (if not contraindicated) can be instituted and the patient fitted with anti–embolism stockings.
Inserting the *Magna-Fx* Cannulated Bone Screw

**Step 1 – Guide Pin Placement**

Following fracture reduction under image intensification control, insert a 3.2 mm, 9-inch long guide pin across the fracture site, either freehand or using the 3.2 mm Pin Guide, engaging the subchondral bone.

**Step 2 – Measuring**

Place the Cannulated Depth Gauge over the guide pin and read the actual depth of the pin in the bone. The surgeon may elect to use a screw 5 to 10 mm less than the Depth Gauge reading.

**Step 3 – Drilling† (Optional)**

Using the Cannulated Reamer, drill to a depth 10 mm less than the actual depth of the pin.

**Step 4 – Tapping‡ (Optional)**

The self-cutting threads of the *Magna-Fx* Screw allow tapping to be optional. Place the Cannulated Tap over the guide pin and tap the proximal cortex. In young patients with hard bone, it may be necessary to tap the entire reamed length.

**Step 5 – Screw Insertion‡**

A. Using a power handpiece with the Cannulated Screwdriver Bit, insert the proper length *Magna-Fx* Fixation Screw over the guide pin. When the screw is one inch from the side plate, remove powered handpiece and screwdriver.

B. Using the manual Cannulated Driver and T-handle, finish seating the screw and check fracture impaction with x-ray. Threads must not extend across the fracture site. Remove the guide pin.

*Warning: During placement of the guide pins, reaming, tapping and screw insertion, image intensifier control is required. This will assure proper guide pin placement and also assure that the guide pins do not advance during the reaming, tapping or screw insertion procedure.*
DESCRIPTION
The compression tube/plates of this system are used with 8 Compression Hip Fixation System lag screws (Cat. No. 1181 series) for the internal fixation of proximal femoral fractures and of supracondylar fractures. This insert encompasses both applications, with section headings and clauses specifying Hip and Supracondylar, respectively.

Hip
The Versa-Fx compression tube/plate is a keyed device.

The compression tube/plates have an outside tube diameter of 12.2 mm; an inside diameter of 8.7 mm; short (25.4 mm) and standard (38.1 mm) tube lengths; tube/plate angles of 130°, 135°, 140°, 145°, and 150°. Plates are available with 2, 3, 4, 5, 6, 8, 10, 12, and 14 holes in regular tube length, and 4, 5, and 6 holes in short tube length. All screw holes accept ECT Internal Fracture Fixation bone screws with hexagonal socket heads (Cat. No. 2306) or self-tapping screws (Cat. No. 2319). The most proximal hole accepts the Magna-Fx Cannulated Screw (Cat. No. 1146 series), a 4.5 mm cortical screw, or a 6.5 mm cancellous screw. Each plate has a distal compression hole for the ECT compression device (Cat. Nos. 2365-10 or 2365-13). Self-Compression Plate (SCP) holes are used on all standard and short barreled tube/plates.

Supracondylar
Tube/plates with angles of 90° and 95° are used in supracondylar applications. A surgeon may also elect to use the 150° tube/plate when conditions warrant (see INDICATIONS AND USAGE). The 90° and 95° tube/plates are available with 6, 9, or 12 cortical screw holes; two cancellous screw holes are found in all supracondylar compression tube/plates. The 2332 and 2333 cancellous screws are recommended for supracondylar applications.

Lag Screws
Free-Lock compression lag screws (Cat. No. 1181 series) are self-impacting and cannulated to accommodate 3.2 mm guide wires. The screw threads are gently tapered for easy insertion and removal. Lag screws range in length from 55 to 150 mm; lag screw diameter is 12.7 mm and 15.8 mm; the shaft diameter is 8.7 mm; and thread lengths are 25.4 mm or 17.2 mm. A complete line of instrumentation to facilitate implantation and removal is available.

Material:
Tube/plate: 22-13-5 stainless steel
Provisionals: 22-13-5 stainless steel

INDICATIONS AND USAGE
Hip
The Versa-Fx Femoral Fixation System may be used for internal fixation of hip fractures, with application to intracapsular and intertrochanteric fractures, osteotomies, and arthrodeses.

Supracondylar
The Versa-Fx Femoral Fixation System may be used for the internal fixation of supracondylar fractures with displaced intra-articular fragments, with vertical intra-articular extension, and in the patient with multiple lower extremity fractures.

The reverse 150° tube/plate is indicated in both intra-articular and extra-articular supracondylar femur fractures.

WARNINGS
Note: The compression tube/plate component of the Versa-Fx System was not designed to be mated with corresponding components from the Key-Free Compression Hip Fixation System. Also, since close tolerances are important for proper functionality of this device, the tube/plate component may not be compatible with corresponding or allegedly interchangeable variations of lag screw components made by other manufacturers. Combining tube/plates from the Versa-Fx System with lag screws from other systems may lead to device failure or surgical complications.

(Note: Free-Lock Lag Screws [Cat. No. 1181 series] are used with this system.)

Preoperative procedures, knowledge of applicable surgical techniques, good reduction, proper selection, and correct placement of the implant are equally important for the successful use of all temporary internal fixation devices.

To prevent damaging the lag screw during insertion, the appropriate lag screw inserter (Cat. No. 1199-01) must be used. A damaged lag screw may no longer slide freely in the tube/plate. Misalignment of the lag screw and inserter can cause damage to the lag screw making subsequent placement of the tube/plate difficult or impossible.

Neither the lag screw threads nor the tube/plate barrel should bridge a fracture line. If either occurs, compression of the fracture fragments will be compromised.

When this device is used in the management of unstable intertrochanteric or subtrochanteric fractures, it is important that no less than six ECT-type bone screws be placed through both cortices of the intact shaft of the femur distal to the fracture site. Use of bone grafts on the medial side opposite the plate may be required for secure fixation of subtrochanteric and supracondylar fractures. Unstable intertrochanteric fractures may need a medial displacement osteotomy in conjunction with fixation by the Versa-Fx Femoral Fixation System. External support should be required and crutches used by the patient as the device is not intended to withstand full weight bearing.

The patient treated with this device must have careful postoperative supervision until firm bony union is achieved, including detailed written instructions on the use and limitations of this device. If protected or partial weight bearing is recommended or required prior to firm union, the patient must be warned that breakage or bending of the device are complications which could occur as a result of weight bearing or muscular activity. These complications may necessitate surgical revision. An active patient or a debilitated patient who cannot properly utilize supportive devices (such as crutches) must be particularly warned about these dangers.

Internal fixation devices are designed to stabilize the fracture site during the normal healing process. After healing occurs, these devices serve no functional purpose and therefore should be removed. In most cases, removal is indicated because these implants are not intended to transfer or support forces developed during normal activities. If the device is not removed, any of the following complications may occur: corrosion, with localized tissue reaction or pain; migration, resulting in injury to soft tissue, visceral organs, or joints; risk of additional injury from postoperative trauma; breakage, which could make removal impractical or difficult; pain, discomfort, or abnormal sensations which may occur due to presence of the device; possible increased risk of infection; and bone loss due to stress shielding.

The physician must advise patient of these considerations and of the potential of subsequent surgical intervention.

Any decision to remove the device should take into consideration the potential risk to the patient of a second surgical procedure. Implant removal must be followed by adequate postoperative management to avoid refracture.
PRECAUTIONS

If metal screws, wire, bands, or other metallic devices are to be used together with the temporary internal device selected for this treatment, all such devices must be manufactured from a stainless steel alloy that will not cause galvanic corrosion or other metallic reaction. Laboratory tests have shown that screw fabricated from Zimmer Certified Stainless Steel can be used with the Versa-Fx Compression Tube-/Plate.

A temporary internal fixation device must never be reused.

Because of the increased strength of 22-13-5 stainless steel, an Anvil Assembly (Cat. No. 1180-95) and an Anvil Base (Cat. No. 1180-96) must be used with an ECT Bending Press (Cat. No. 2371-30) to contour Versa-Fx tube-/plates. Such contouring must be gradual. Under no circumstances should the tube-/plate be sharply bent, reverse bent, bent at a screw hole, notched, or scratched because such treatment can critically weaken the device.

ADVERSE EFFECTS

Loosening, breakage, or bending of the device can occur. Loss of fixation, malunion, nonunion, and infection have been reported with use of sliding compression screw-plate combinations. Screw cut-out through the femoral head can occur, although this adverse effect is usually associated with osteoporotic bone.

Cancer, allergic reactions, metallosis, osteolysis, and other adverse tissue responses can be caused by the utilization of orthopaedic implants and prostheses. There are a variety of metals, polymers, chemicals, and other materials utilized with orthopaedic implants which have been known to cause cancer and other adverse bodily tissue reactions. Cancer can metastasize from the soft tissue sites (lung, breast, digestive system, and others) to bone, including areas adjacent to implants, or it can be seeded to these locations during operative and diagnostic procedures (such as biopsies). Paget's disease has been reported to progress to cancer; patients suffering from this disease who are candidates for implantation procedures in the affected areas should be warned accordingly.

In addition, any factor that causes chronic damage to tissues may be oncogenic. These risks and possible complications must be discussed with and explained to the patient in addition to the obvious risk that all orthopaedic implants may fail.

STERILITY

The tube-/plates are provided sterile by prior exposure to a minimum of 2.5 Mrad gamma irradiation. Opened but unused fixation components can be resterilized using accepted procedures for steam autoclaving or ethylene oxide. No aeration is needed for solid metal items.

Custom products of the type may be provided nonsterile. They can be sterilized using either of the above methods.