EVOS MINI with IM Nailing
A series of studies
Intramedullary nailing has become the standard for many long bone fractures. Fracture reduction prior to nail insertion is of paramount importance. Multiple closed, percutaneous and open techniques have been described to achieve fracture reduction.

Traditional reduction techniques in IM Nailing still play a major role in fracture reduction when nailing. However, each technique has its weakness.

- Bumps and rolls provide support but do not secure the fracture site and can be unstable.

- Percutaneous clamps are less effective in the presence of fracture comminution and achieving the correct clamp vector to reduce the fracture is often times difficult. Placement of clamps in muscular or obese patients can be challenging and potentially place unnecessary pressure on the soft tissue envelope. Finally, applied clamps can loosen during the course of nailing.

- External fixators/distractors provide length and traction, but are less effective in controlling alignment and rotation. Pins must be kept out of the path of the nail and this technique is unfamiliar to some surgeons.
In some instances, limited open fracture reduction and stabilization with mini-fragment implants has a role in long bone intramedullary nailing. These implants can be especially beneficial in:

- Segmental fractures.
- Comminuted fractures.
- Proximal or distal fractures subject to deforming muscle forces.
- Open fractures providing direct access to fracture site.
- Closed fractures unable to be reduced by closed or percutaneous methods.

When using this technique:

- Soft tissue stripping should be minimized in order to achieve reduction and apply the plate. Only the necessary soft tissue is cleared from the cortical edges to obtain a reduction read.
- Screws (especially unicortical) are placed with sharp drills and under bulb saline irrigation in order to avoid thermal necrosis.
- In the setting of an open fracture, traumatic soft-tissue injury is used when possible for fracture visualization.
- The plate is almost always removed when an open wound is present at the fracture site but is left on at the surgeons discretion in closed injuries when a surgical incision is made through non-compromised skin/soft tissue.
- When a surgical procedure has time constraints (poly trauma/unstable patient/etc.) reliable and expeditious reduction via mini fragment plates prior to intramedullary fixation may assist the surgeon.

Mini fragment plates can be very beneficial in obtaining and maintaining reduction during IM Nailing. They can provide reduction of both simple and complex fractures.
Case 1: Femur

Patient information
• 50-year-old male
• Segmental femur fracture with comminuted proximal and simple transverse distal fracture.

Case information
This patient presented after he sustained multiple gunshot wounds to the right lower extremity and abdomen (Figures 1 – 2). An injury to the profunda femoris artery was initially identified. The patient was initially placed in a large JET-X™ spanning external fixator on the day of injury to allow for vascular intervention (Figure 3).

Challenges
The deforming muscles forces of the proximal femur presented a problem with the sub-trochanteric fracture. There was difficulty in obtaining a reliable cortical read with regard to length, alignment and rotation.

The transverse distal diaphyseal fracture was at the junction of femoral diaphysis and the wider metaphyseal region and required reduction prior to nail passage.

Figure 1  Figure 2  Figure 3
Solution
Performed ORIF of the distal femoral segmental fracture. Utilized a modified clamp to obtain fracture compression, and utilized a 2.7mm Strength Plate to maintain and reduce the distal fracture (Figure 4). Unicortical non-locking screws were used to avoid disrupting the path of the nail. This technique converted the segmental femur fracture into a subtrochanteric fracture.

The proximal ex-fix Schantz pin was left in place to help obtain correct starting point for nail (Figure 5). The guide wire was passed, the canal reamed and the nail placed with the plate still in place (Figures 6 – 7). Limb length and rotation was based on fluoroscopy of contralateral limb. The distal 2.7mm strength plate was modified in-situ to allow for two interlocks to be placed in the nail (Figure 8).
Case 2: Tibia

Patient information

• 45-year-old male
• Type IIIA open segmental tibia fracture

Case information

This patient was struck by a motor vehicle traveling at unknown speed. The patient was intubated and sedated in the trauma bay. He was found to have a 3mm open wound about the proximal tibia and a 5cm open wound about the distal tibia with exposed bone. The patient also sustained multiple blunt thoracoabdominal injuries.

Challenges

The segmental tibia fracture consisted of a simple oblique fracture proximally and an oblique fracture with butterfly segment distally. There was also an associated comminuted fibula fracture (Figure 9 – 10).
Solution
The proximal and distal fractures were anatomically reduced using two 2.4mm Strength Plates to obtain length, alignment and rotation (Figure 11). These plates also maintained reduction during nail placement.

The wounds were debrided and irrigated. A reamed and statically locked tibial nail was placed through the suprapatellar approach. The mini fragment plates were removed upon completion of the nail procedure. Meticulous layered soft tissue closure of both wounds (Figures 12 – 13).

**EVOS® MINI Implants**

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<tr>
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<th><img src="image1" alt="Image" /></th>
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<tbody>
<tr>
<td>2 x EVOS MINI 6 hole 2.4mm Strength Plate</td>
<td><img src="image2" alt="Image" /></td>
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<tr>
<td>8 x 2.4mm Unicortical Non-Locking Screws</td>
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**Other implants used:** TRIGEN® META-NAIL® Tibial Nail

![Image](image4)
Case 3: Tibia

Patient information
- 43-year-old male
- Closed segmental right tibia and fibula fracture

Case information
This patient sustained a 9 foot fall from a ladder. The patient had immediate pain and deformity in the right leg with inability to bear weight (Figures 14 – 15).

Challenges
The proximal third tibia fracture presented a potential valgus and procurvatum deformity during nail placement. The proximal fracture was a closed oblique fracture with posterior extension while the distal fracture was a closed diaphyseal fracture with a butterfly fragment.
Solution

The proximal fracture was anatomically reduced with a 2.7mm Strength Plate. This aided in maintaining anatomic fracture reduction during nail placement.

A small surgical incision was made along the posterior medial proximal tibia. The fracture edges were exposed, and a clamp was applied to obtain an anatomic reduction of the fracture. A 2.7mm Strength Plate with Unicortical Non-Locking Screws was applied along the posterior medial surface of tibia to maintain reduction during reaming and subsequent nail passage.

A reamed and statically locked tibial nail was placed through the suprapatellar approach. The plate was left in to support fixation (Figures 16 – 17).

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<th>EVOS® MINI Implants</th>
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<tr>
<td>EVOS MINI 5 hole 2.7mm Strength Plate</td>
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<tr>
<td>4 x 2.7mm Unicortical Non-Locking Screws</td>
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Other implants used: TRIGEN® META-NAIL® Tibial Nail
Case 4: Tibia

Patient information
• 44-year-old female
• Closed segmental tibia fracture with distal intra-articular extension

Case information
This patient presented with an isolated closed fracture of the right lower extremity after being struck by a car at high speeds. The patient was found to have a segmental tibial fracture. A CT scan was obtained to evaluate the distal tibial plafond due to findings on the plain radiographs.

Challenges
The patient sustained a comminuted segmental tibia fracture with a closed transverse fracture proximally and a closed comminuted diaphyseal fracture distally (Figures 18 – 19). A CT scan also demonstrated intra-articular extension with a simple minimally displaced coronal plane fracture and sagittal plane medial malleolus fracture (Figures 20 – 22). An ipsilateral comminuted fibula fracture was also present.
Solution

The distal tibia joint surface was addressed first. Percutaneous clamps were used to reduce the fracture. Three 2.7mm Non-locking Screws were placed using lag technique to secure the fragments.

A small posterior medial incision was made to access to the proximal tibia fracture. The fracture was initially reduced using a clamp and a 2.7mm Flex Plate with 4 posteriorly directed bicortical screws was subsequently placed to aid in maintaining length, alignment and rotation.

A reamed, statically locked tibial nail was placed through the suprapatellar approach (Figures 23 – 24).

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**EVOS® MINI Implants**

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<tr>
<th>Procedure</th>
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<tr>
<td>3 x 2.7mm Non-Locking Screws with Washers (placed using lag technique after percutaneous clamp reduction)</td>
<td><img src="image1.png" alt="Image" /></td>
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<tr>
<td>EVOS MINI 6 hole 2.7mm Flex Plate with Non-Locking Screws</td>
<td><img src="image2.png" alt="Image" /></td>
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**Other implants used:** TRIGEN® META-NAIL® Tibial Nail

![Image](image3.png)
**Case study author**

**What specific details about the EVOS® MINI Plating System do you like?**

- Option of Strength or Flex Plate
- Pre-contoured specialty plates (e.g. hook)
- Multiple plate options at 2.0, 2.4 and 2.7mm sizes
- Long mini fragment screw sizes, especially in 2.4mm and 2.7mm sizes

**Surgeon quote**

“The EVOS minifragment set provides the surgeon with multiple fixation options to manage both simple and complex fractures; it can be a valuable tool in gaining and maintaining reduction while treating long bone fractures with intramedullary nails.”

**John A. Scolaro, MD**

Dr. Scolaro is an Assistant Professor of Orthopaedic Surgery at the University of California, Irvine Medical Center in Orange, California. Dr. Scolaro is a fellowship trained orthopaedic traumatologist who specializes in acute orthopaedic trauma as well as the post traumatic reconstruction of fracture malunions and nonunions.