Rapid treatment in complex, periarticular tibial fractures

Hybrid Ring Fixator

Surgical Technique
This description alone does not provide sufficient background for direct use of DePuy Synthes products. Instruction by a surgeon experienced in handling these products is highly recommended.

Processing, Reprocessing, Care and Maintenance
For general guidelines, function control and dismantling of multi-part instruments, as well as processing guidelines for implants, please contact your local sales representative or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance
For general information about reprocessing, care and maintenance of Synthes reusable devices, instrument trays and cases, as well as processing of Synthes non-sterile implants, please consult the Important Information leaflet (SE_023827) or refer to:
http://emea.depuysynthes.com/hcp/reprocessing-care-maintenance
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## MRI Information
Indications and Contraindications

**Indications**

- The hybrid ring fixator is designed for fixation of complex proximal and distal tibial fractures, especially those involving the joint.
- In soft tissue injuries which make open reduction and internal fixation impossible.
- In fracture patterns which do not allow placement of Schanz screws for construction of a standard external fixator frame.

**Contraindications**

No specific contraindications.
Examples of indications

**Proximal tibial fracture**
35-year-old woman involved in a MVA. Injuries include severe head and chest trauma and a complex fracture of the proximal tibia involving the articular surface.
Distal tibial fracture
Below left: 50-year-old man, impaction and compression of the right leg due to complete articular pilon fracture of the tibia, severe open crushing of soft tissues.

Below right: emergency stabilization of the fibula and use of a transarticular external fixator as a temporary measure.
Minimally invasive reconstruction and screw fixation of the tibial articular surface ten days after the accident with detumescent soft tissue showing no signs of irritation. Application of hybrid ring fixator to achieve neutralization and protection. Postoperative X-ray. Physiotherapy started immediately.

Removal of the hybrid ring fixator 12 weeks after the accident. Partial weight-bearing of 25–30 kg.
Preoperative planning

As with every surgical intervention, careful preoperative planning is essential.

**Note:** For a detailed handling description of the Schanz screws, refer to the surgical technique Schanz Screws and Steinmann Pins (DSEM/TRM/0516/0677)
Tibial plateau fracture

Restoring articular surface and stabilizing

Frame configuration is dictated by the fracture pattern and soft tissue injury, regardless of fracture location (proximal or distal tibia). This description of the surgical technique is limited to basic principles.

Notes regarding the surgical technique for distal tibial fractures may be found on pages 20 and 21.

If required, use the large distractor across the knee joint. This provides ligamentotaxis and aids fracture reduction.

As with any intra-articular injury, good reduction of the joint surface must be achieved. This may require open reduction and bone grafting using a minimally invasive approach.

If interfragmentary compression is required to reduce the articular surface lag screws may be used (e.g. 7.3 mm or 7.0 mm cannulated screws).

Precautions:

• Instruments and screws may have sharp edges or moving joints that may pinch or tear user’s glove or skin.
• Handle devices with care and dispose worn bone cutting instruments in an approved sharps container.
Determining wire position

• You should insert at least two wires so that they form an X when viewed axially. They should be inserted at the greatest possible angle to each other. You may choose between reduction wires with olive and/or Kirschner Wires.
• Wires should be placed within the anatomically safe zones (note the location of the peroneal nerve).
• The two typical positions are:
  • lateral to medial tibia (possibly through the head of the fibula)
  • anterolateral to posteromedial tibia

If cannulated screws are already in position in the proximal fragment, position wires distally to the capsular attachment of the knee joint.
Inserting wires

Make a stab incision and insert a slotted protection sleeve through the soft tissue to the bone. Insert the first wire through the sleeve until it contacts the bone. Using the COMPACT™ AIR DRIVE, insert the wire into the bone, monitoring the procedure with an image intensifier.

When using a reduction wire with olive, insert the wire until the olive contacts the bone surface. Washers can be used in osteoporotic bone.

Once the wire has penetrated the opposite cortex, remove the air drive and advance the wire through the soft tissue using either gentle blows with a hammer or manually, until equal amounts of wire protrude from both sides of the bone.

Reduction wires with olives may be used instead of Kirschner Wires to:

• prevent vertical shearing
• achieve secondary interfragmentary compression (possibly in connection with cannulated screws)
• reduce small fragments.
Applying ring

Choose a ring size which allows for soft tissue clearance. Position it parallel to the articular surface and centred over the tibia. A 3/4 ring allows sufficient room for knee flexion.

Loosen the wire-locking nuts (a) and ring-locking nuts (b) on two adjustable wire/pin clamps.

Next, slide an adjustable clamp over each end of the wire, inserting the wire into the hole marked “wire”. The larger hole accommodates Schanz screws.

Mount clamp onto the ring. Hook the upper jaw of the clamp on the ring, pull on the lower jaw to separate the jaws and snap it onto the ring. Repeat this step on the opposite end of the wire.

Additional wires may be inserted easily by using a clamp as an aiming device. Mount another adjustable clamp onto the ring and insert the wire through the clamp and the slotted protection sleeve and advance it through the bone.

This wire should be positioned at the greatest possible angle to the first wire. Alternative technique: First insert both wires, then apply the ring and the clamps.
All wires should be inserted before tensioning. If you require additional stabilization of the proximal fragment, insert a Schanz screw in the proximal fragment before tensioning the wires.

Slide another adjustable clamp over the other end of the wire and snap it onto the ring.

It is important to eliminate any bowing in the wires as this could cause soft tissue irritation. Adjust wire position within the clamp and finger-tighten wire-locking nuts.

Adjust the position of the clamps on the ring to straighten the wire and then tighten the ring-locking nuts using the 11 mm ratchet wrench.
Tightening and tensioning wires

For the first wire, tighten the wire-locking nut on one side using the 11 mm ratchet wrench, tension the wire and then finger-tighten the wire-locking nut on the other side.

For reduction wires, tighten the wire-locking nut on the “olive end” of the wire using the 11 mm ratchet wrench.

Twist the fluted knob of the wire tensioner counterclockwise until the wire passes freely through the cannulation.

Advance the tensioner over the finger-tightened end of the wire until its concave end seats against the wire/pin vice.
Turn the knob of the tensioner clockwise by hand until the desired tension is reached. If necessary, use the 11 mm ratchet wrench to achieve the desired tension.

The amount of tension being applied to the wires is indicated by the position of the knob relative to the numbered lines etched on the tensioner body. The lines correspond to 50, 100 and 130 kg tension. Wires are usually tensioned to 100–130 kg.

**Take care to avoid pulling the olive through the cortex when tensioning reduction wires.**

**It is important to eliminate any bowing in the wires as this could cause soft tissue irritation.**

Once the desired tension has been reached, tighten the wire-locking nut using the 11 mm ratchet wrench.

Remove the tensioner by turning the knob counterclockwise. Tension all other wires in the same manner.
Tibial plateau fracture
Tightening and tensioning wires

Trim excess wire with the bending/cutting pliers, leaving at least 3–4 cm of wire so that wires can be retensioned if desired.

Bend wires out of the way with the bending/cutting pliers.
Place protective caps on the wire ends.

**Alternative option: Use of the Back-up Wire Tightener**

Twist the hexagonal nut counterclockwise. Slide the Back-up Wire Tightener over the wire until its concave end seats against the wire/pin vice. Tighten the wing nut to secure the wire. Turn the hexagonal nut clockwise using the 11 mm ratchet wrench until the desired tension has been achieved. To remove the wire tensioner, turn the wing nut which secures the wire counterclockwise.
Completing frame

Anterior frame
Insert Schanz screws (SELDRIIL™ or standard) into the tibial shaft as determined during preoperative planning. Using the AO/ASIF technique, slide the open adjustable clamps onto a carbon fibre rod and join this assembly to the Schanz screws to form a unilateral anterior frame. Afterwards, connect this frame to the ring.

The carbon fibre rod should extend proximally for connection to the ring. More stability can be achieved by spacing the Schanz screws in the distal fragment as far away from each other as possible and keeping the rod as close to the bone as possible.

Finger-tighten the open adjustable clamps on the carbon fibre rod and reduce the distal fragment to the reconstructed proximal fragment.
Attach ring to anterior frame

Remove the ring-locking nut (a) from the ring to rod clamp and loosen the rod-locking nut (b). Slide the clamp onto the rod, ensuring that the rod-locking nut is accessible and positioned externally.

Insert the threaded post (c) into a hole on the ring.

Replace ring-locking nut on the threaded post and finger-tighten.
Fracture reduction

Use the ring and rod as “handles” to manipulate the fragments and reduce the fracture.

Maintain the reduction manually while an assistant tightens both nuts on the ring to rod clamp with the 11 mm ratchet wrench.
Additional stabilization options

Stability may be increased using the following frames:

- Delta frame

- Triangular frame

- Additional Schanz screw $\phi$ 4.0 or 5.0 mm (avoids procurvatum by counteracting the pull of the patellar tendon).

**Implant Removal**

Implants can be removed by using general surgical instruments.
Distal fractures of the tibia

Distracting
If necessary, the large distractor may be placed across the ankle joint to provide ligamentotaxis and aid fracture reduction.

In the case of an associated distal fibular fracture, first fix this fracture by plating to restore correct length, rotation and alignment.

Restoring articular surface
Fixation of the articular surface using cannulated screws (interfragmentary compression) is highly recommended.

Use bone graft as needed in severe articular defects.

Determining wire position
You should insert at least two wires so that they form an X when viewed axially. They should be inserted at the greatest possible angle to each other and in anatomically safe zones.

If cannulated screws are already in position in the distal fragment, position the wires proximally to these screws within the distal fragment.

Typical wire positions in the distal tibia are:
• lateral to medial tibia
• anterolateral to posteromedial tibia

Implant Removal
Implants can be removed by using general surgical instruments.
Completing frame
Construct a frame as explained in the section describing proximal tibial fractures (see pages 16–19).

Use delta frame to increase stability, if necessary.
Summary of basic steps

Basic construction principles apply for all hybrid fixator frames.

1. Insert first wire

2. Attach first wire to ring and insert further wires

3. Tension wires

4. Trim wires, bend out of the way and place protective caps on the wire ends
5. Construct anterior frame and attach to ring construction. Reduce fracture.

Precautions:

• Implant sites should be meticulously cared to avoid pintract infection. Schanz screws may be surrounded with antiseptic coated foam sponges in an effort to avoid infection. An implant-site care procedure should be reviewed with the patient.

• To minimize the risk of pin track infection the following points should be observed:
  a. Placement of Schanz screws taking anatomy into consideration (ligaments, nerves, arteries).
  b. Slow insertion and/or cooling, particularly in dense, hard bone to avoid heat necrosis.
  c. Release of skin tension at soft tissue entry point of implant.
# Product Information

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<th>Code</th>
<th>Description</th>
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<tr>
<td>219.980</td>
<td>Washer Ø 7.0/3.6 mm, for Screws Ø 2.7 to 4.0 mm, Stainless Steel</td>
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<td>292.380</td>
<td>Kirschner Wire Ø 1.8 mm with spade point tip, length 350 mm, Stainless Steel</td>
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<td>Kirschner Wire Ø 1.8 mm with spade point tip, length 350 mm, Stainless Steel, sterile</td>
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<td>294.785</td>
<td>SELDRILL Schanz Screw Ø 5.0 mm, length 175/60 mm, Stainless Steel</td>
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<td>310.370</td>
<td>Drill Bit Ø 3.5 mm, length 195/170 mm, 2-flute, for Quick Coupling</td>
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**Note:** For a detailed product information of the Schanz screws, refer to the surgical technique Schanz Screws and Steinmann Pins (DSEM/TRM/0516/0677)
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<tr>
<td>321.200</td>
<td>Ratchet Wrench for Nut, hexagonal, 11.0 mm</td>
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<td>390.008</td>
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<tr>
<td>391.962</td>
<td>Bending/Cutting Pliers</td>
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<td>392.180</td>
<td>Protective Cap for Wires Ø 1.8 and 2.0 mm</td>
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<tr>
<td>393.100</td>
<td>Universal Chuck with T-Handle</td>
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<td>393.420</td>
<td>Protective Cap, for Schanz Screws and Steinmann Pins Ø 5.0 mm</td>
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<td>393.436</td>
<td>Ring-to-Rod Clamp, for Hybrid Ring Fixator</td>
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<td>393.464</td>
<td>Wire/Pin-to-Ring Clamp</td>
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<td>394.970</td>
<td>Cap for Rods and Tubes</td>
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<tr>
<td>03.311.008</td>
<td>Back-up Wire Tightener</td>
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Maintenance of wire tensioners

Cleaning
For general guidelines, function control and dismantling of multi-part instruments, please contact your local sales representative or refer to: www.synthes.com/reprocessing
For general information about Reprocessing, Care & Maintenance of Synthes Instruments, please consult the Important Information SE_023827.

General Maintenance
1. Insert 4–6 drops of sterilizable SYNTHES® Special Oil (519.970) into:
   - every lateral opening
   - the cannulation at the end of the fluted knob and the opening on the concave end while maintaining the wire tensioner in a vertical position.

2. Distribute the oil by twisting the hexagonal nut or fluted knob five times fully in a clockwise direction and then counterclockwise. Repeat this two or three times.

3. The instrument can then be sterilized in the usual manner.

Back-up Wire Tightener (03.311.008)

Wire Tensioner (393.742)
Inadequate cleaning or oiling after every use may lead to impaired performance or a shorter instrument life.

Subject to modification.


The DePuy Synthes “Hybrid Ring Fixator” has not been evaluated for safety and compatibility in the MR environment. It has not been tested for heating, migration or image artifact in the MR environment. The safety of the “Hybrid Ring Fixator” in the MR environment is unknown. Scanning a patient who has this device may result in patient injury.