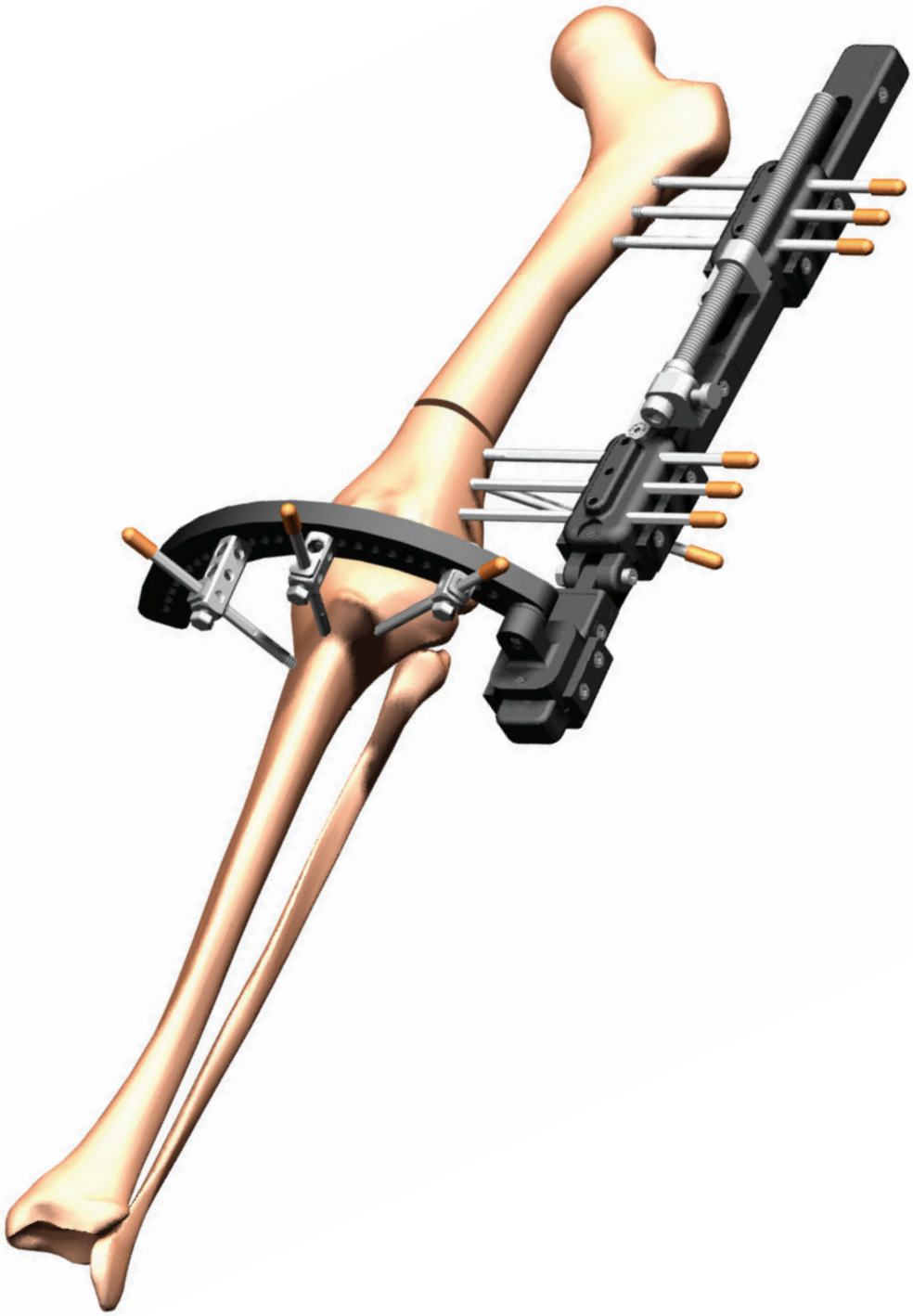
Surgical Technique

smith&nephew

MODULAR RAIL SYSTEM◇

External Fixator



Surgical Technique for the MODULAR RAIL SYSTEM (MRS)

Contents

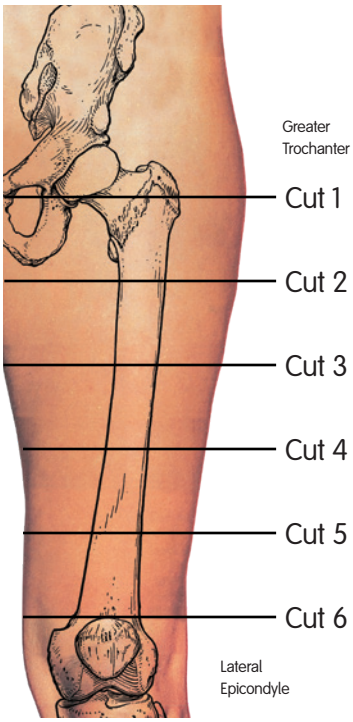
Smith & Nephew is grateful to Dr. Dror Paley for his expertise and guidance in authoring this Surgical Technique

Nota Bene
The technique description herein is made available to the healthcare professional to illustrate the author's suggested treatment for the uncomplicated procedure. In the final analysis, the preferred treatment is that which addresses the needs of the patient. For more information on the products shown in this surgical technique, including indications for use, contraindications, effects, precautions and warnings, please consult the Instructions for Use (IFU) for the product.

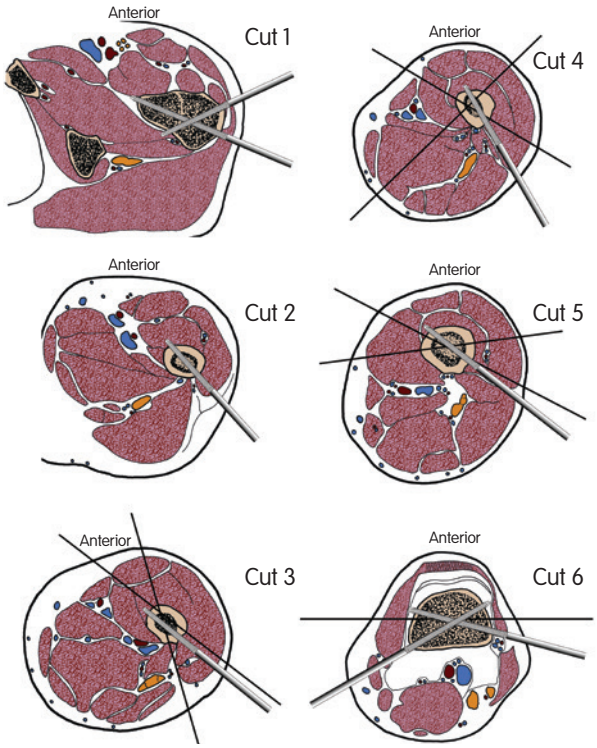
Safe zones of the femur, tibia and pelvis

Care must be taken to avoid neurovascular structures and intra-articular penetration. The following images[1] are excerpts from Catagni MD, Maurizio. Atlas for the Insertion of Transosseous Wires and Half-Pins Ilizarov Method. Ed. Antonio Bianchi Maiocchi, MD. Milan: Medicalplastic srl, 2003. These images show suggested safe pin and wire pathways that allow for minimal transfixion of muscle compartments and avoidance of neurovascular structures of the femur, tibia and pelvis.

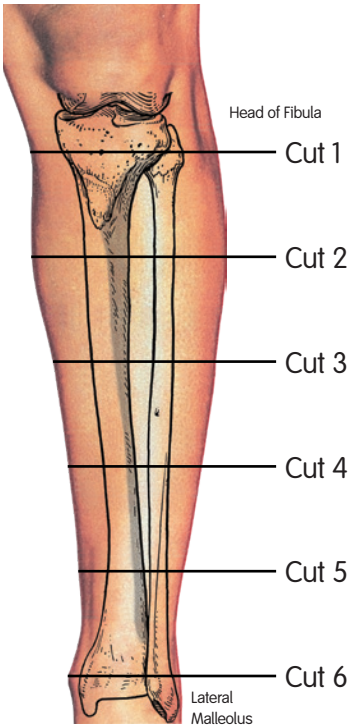
Femur - left



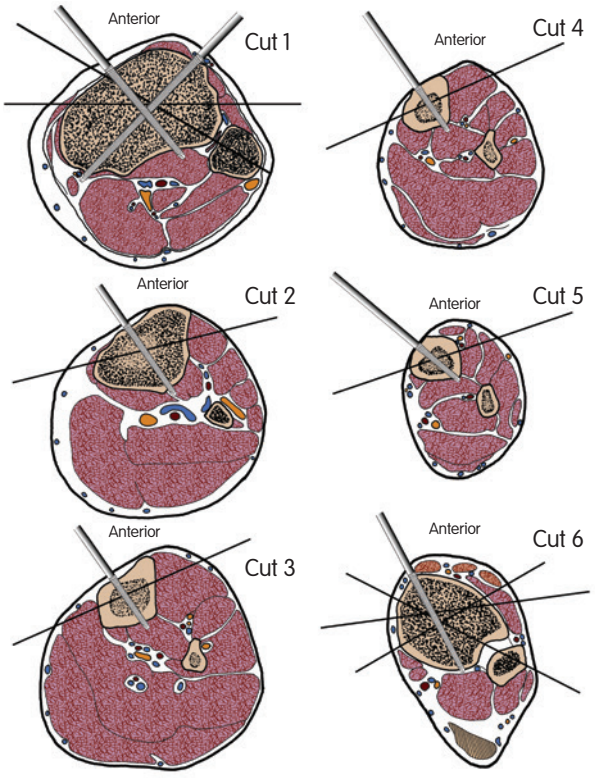
Insertion wires and half-pins - left



Tibia and Fibula - left

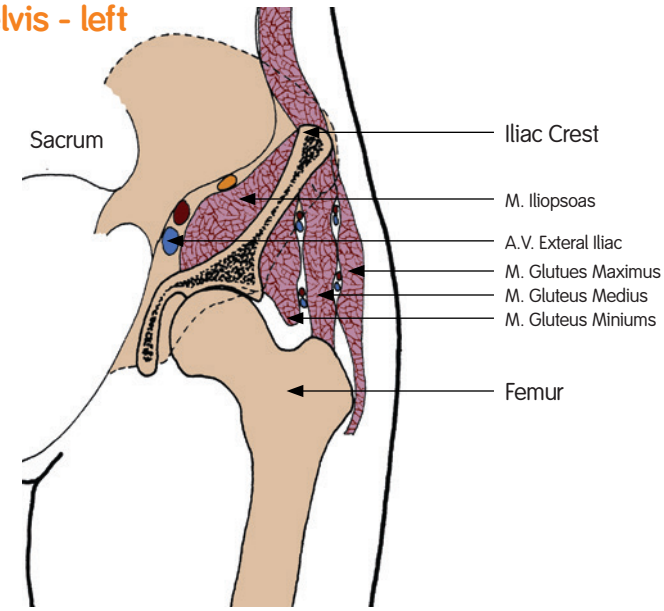


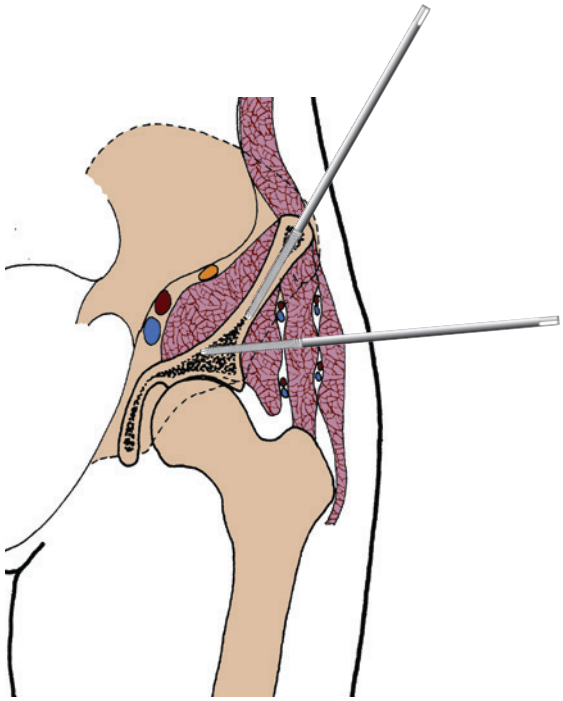
Insertion wires and half-pins - left



Coronal section

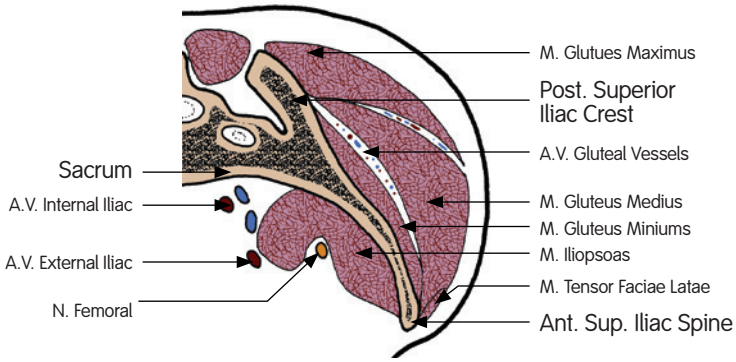
Pelvis - left

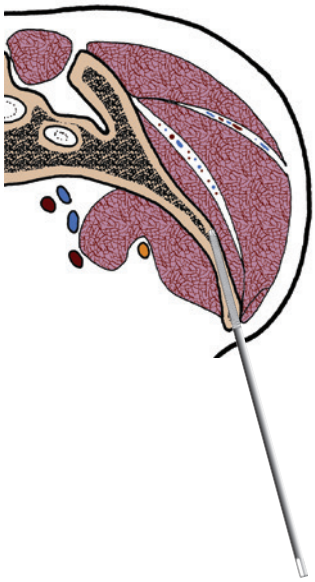




Transverse section Iliac crest

Pelvis - left



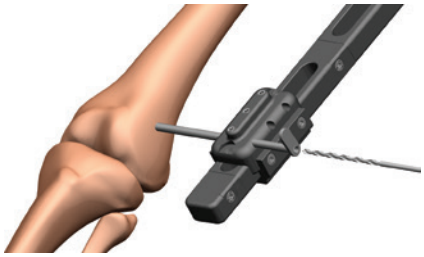


Common techniques

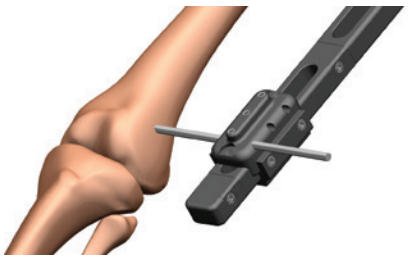
There are several techniques that are the same, regardless of the indication treated or construct built using the MODULAR RAIL SYSTEM®. These include Half Pin insertion, preassembly of the Rail, Clamp assembly, and application of the Distraction/Compression Device. Each of these will be briefly discussed.

General Half Pin application

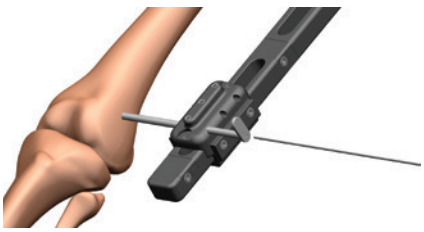
Using the MRS Pin Clamp as a guide, insert the appropriate Drill Sleeve into a Half Pin hole on the Clamp. Where the Drill Sleeve touches the skin, make an incision and push the Drill Sleeve down to bone.

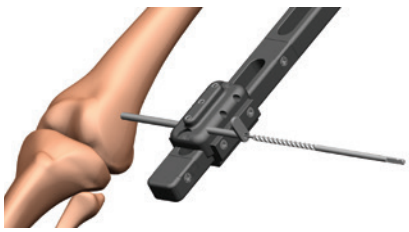


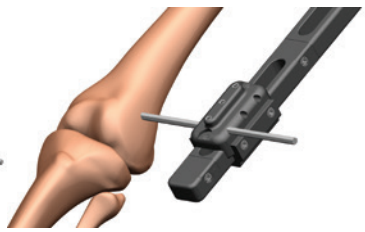
Drill the bone through the Drill Sleeve taking frequent pauses to allow for heat dissipation. Once the second cortex is perforated, read the calibrated drill off of the back of the Drill Sleeve to choose the proper thread length for the Half Pin. Take care to avoid plunging the drill bit through the second cortex. Remove the Drill Sleeve and insert the Half Pin until bicortical purchase is obtained.



Alternatively, a 1.8mm Drill Tip Wire (7193-3244) may be inserted through a 1.8mm Drill Sleeve (7193-4024 and 7193-4023 Long). When proper positioning of the Drill Tip Wire is confirmed, a Cannulated Drill Bit and Drill Sleeve is used over the Drill Tip Wire. Remove the Drill Tip Wire, Cannulated Drill, and Drill Sleeve and insert the Half Pin until bicortical purchase is obtained.

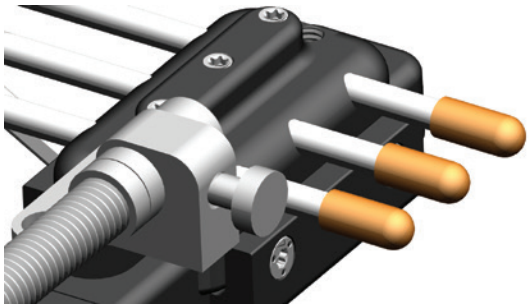






Half Pin	Drill and Drill Sleeve	Drill Sleeve	Drill	Cannulated Drill
6mm HA-Coated Half Pin	4.8mm Drill/Drill Sleeve	7193-3699 7193-4018 Long	7193-4029 7193-3346 Long	7193-4032 7193-3348 Long
4.5mm HA-Coated Half Pin	3.8mm Drill/Drill Sleeve	7193-4021 7193-4019 Long	7193-4030 7193-4025 Long	7193-4033 7193-4027 Long

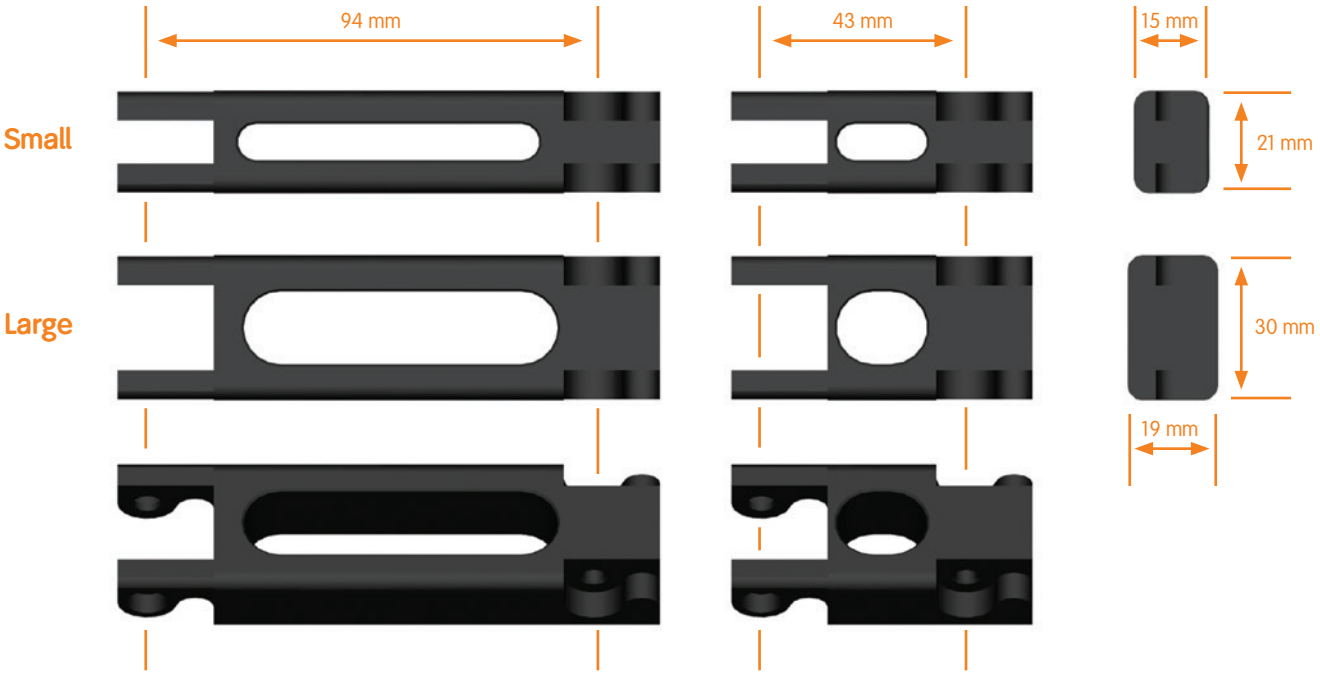
Following the completion of frame construction, cut Half Pins with a Rod Cutter and place Pin Caps (7107-0290) on the ends. Check and retighten all set screws and bolts on the frame to ensure stability.



Apply sterile dressings over surgical incisions. Apply ACTICOAT◇ EXFIX Sponges (6680-0637) or ILIZAROV™ Sponges (10-2140) with Disc Clips (7107-0291) around the pin sites. Alternatively, wrap each pin cluster with a Kerlix™ bandage until there is pressure applied between the Kerlix™ bandage and the skin.

Preassembly of the MRS Rail

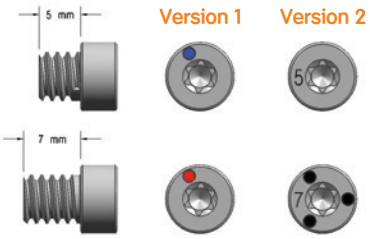
The MODULAR RAIL SYSTEM® (MRS) is available in two sizes; large and small. Henceforth, items that are specific to the Small MODULAR RAIL SYSTEM will be denoted with a "Small:" prefix. Both large and small MRS have standard size Rail Segments (7193-3325 for the Large MRS and Small: 7193-3931 for the Small MRS) and short Rail Segments (7193-4653 for the Large MRS and Small: 7193-4043 for the Small MRS). Measurements for each of these segments can be found in the following image.



Pre-assemble the Rail Segments taking into consideration the distance between the planned location of the Pin Clamps and the amount of lengthening desired. Place the Rail Segments on a flat surface and connect the Rail Segments together using 7mm Rail Bolts (71933600) for the Large MRS and 5mm Rail Bolts (71933599) for the Small MRS. Tighten all bolts after assembly to ensure construct integrity, paying close attention to the bolts that will be on the inside of the rail and facing the patient. *Once the rail is in place, these bolts can be difficult to access*.

Note: Be sure the segments are properly lined up by preassembling the segments on a flat surface.

Rail Bolts are available in two configurations. The 5mm Rail Bolts (7193-3599) have either a **blue** dot on the face or the number “5” laser marked on the face. The 7mm Rail Bolts (7193-3600) have either a **red** dot on the face or the number “7” with three black dots laser-marked on the face. Regardless of the bolt version, the associated thread length is the same.

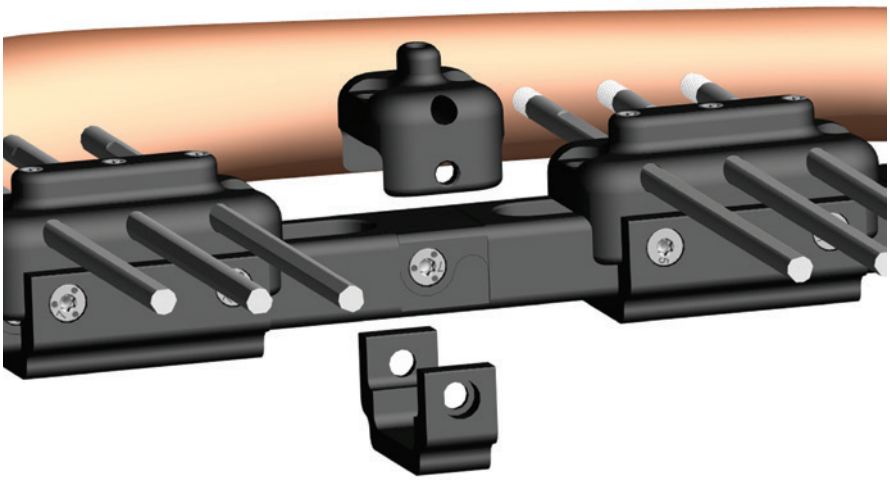


Male End Caps (7193-3638 and Small: 7193-3950) and Female End Caps (7193-3639 and Small: 7193-3951) are placed on the exposed proximal and distal ends of any Rail Segment.

Clamp assembly

Pin Clamps are assembled to the rail in their planned locations. Moving Clamps should be assembled using four 5mm Rail Bolts (7193-3599). For the static, Non-Moving Clamp two 5mm Rail Bolts (7193-3599) should be used on the interior, patient-facing side of the Pin Clamp and two 7mm Rail Bolts (7193-3600) on the side of the Pin Clamp facing away from the patient. The 7mm Rail bolts will lock the Pin Clamp to the Rail.

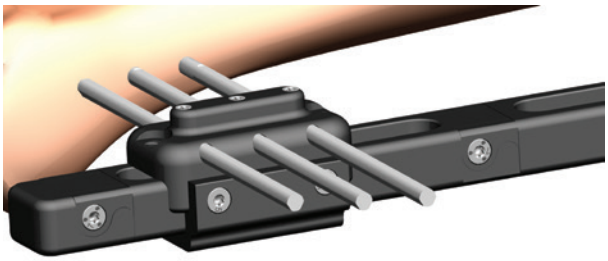
The clamshell design of the Pin Clamps enables the assembly of additional Pin Clamps at any point during the procedure.



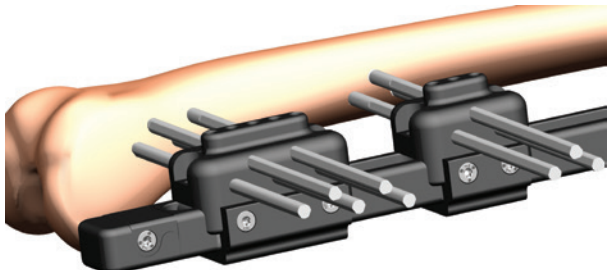
Clamp assembly (continued)

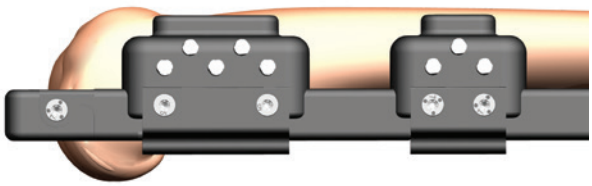
Clamp options

3-hole Pin Clamps are the standard preassembled Pin Clamp (7193-4150 and Small: 7193-4153), with three pin holes in the same plane of fixation, 17.3 mm from the center of the rail.

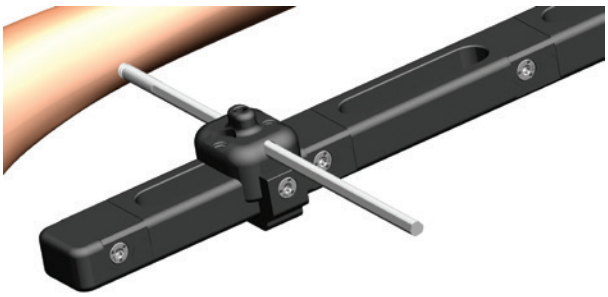


Stacked Upper Pin Clamps are available in both 5-hole and 3-hole options. The 5-hole Pin Clamp (7193-3324 and Small: 7193-3930) is assembled with a 2-hole Long Lower clamp (71933329 and Small: 71933935) and provides two planes of fixation, with three pin holes in the lower level and two pin holes in the upper level. The 3-hole Pin Clamp (7193-3330 and Small: 7193-3936) provides two planes of fixation, with two pin holes in the lower level and one pin hole in the upper level. These Stacked Clamps take the place of having a T-clamp and are useful in larger anatomy, when dealing with the bow of the proximal femur, and when using the knee hinge to span the knee.

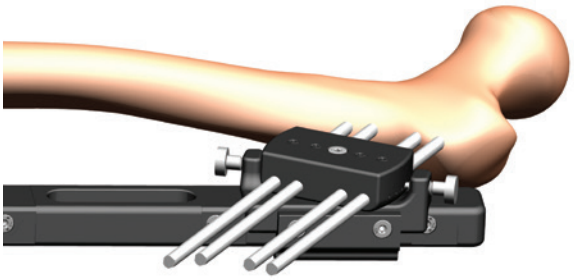


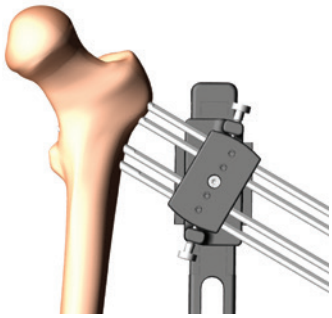


One-hole Upper Pin Clamps (7193-3340 and Small: 7193-3945) offer a single half pin hole and are useful when space is limited and additional fixation is required. These clamps are assembled with 1-hole Lower Clamps (7193-3337 and Small: 7193-3942).

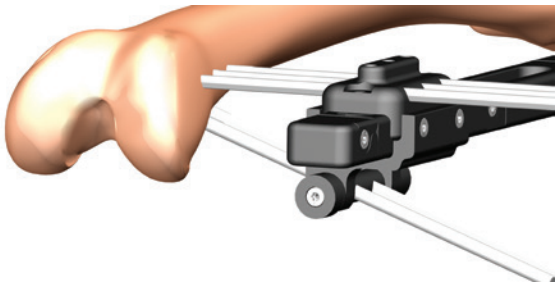


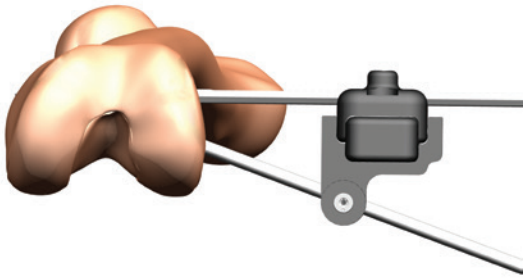
Angular Correction Clamps allow Half Pins to be placed at angles varying between 90° and 130° to the Rail. These Upper Clamps are offered in 4-hole configurations (7193-3333 and 7193-3341) for the large MRS and are assembled with a 2-hole Long Lower clamp (7193-3329). For the small MRS, they are offered in 2-hole configurations (Small: 7193-4050 and Small: 7193-4051) and are assembled with a Lower 2-hole Clamp (Small: 7193-3947). These clamps are useful when acute angular deformity correction is indicated and when placing a Half Pin into the femoral neck.



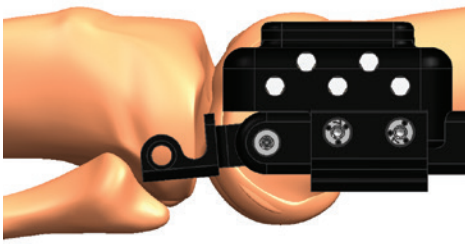


Anterior/Posterior Angle Clamps (7193-3332 and Small: 7193-3938) are lower clamps and allow Half Pins to be placed at varying angles to the rail in the transverse plane. These lower clamps should be used as **static**, **non-moving** clamps and can be assembled with a variety of upper clamps including the standard 3-hole Upper Clamp and the 5-hole stacked Upper Clamp. To avoid impingement with the rail, place the barrel on the inside of the rail facing the patient. These clamps are useful in obtaining out of plane fixation to create a delta configuration.





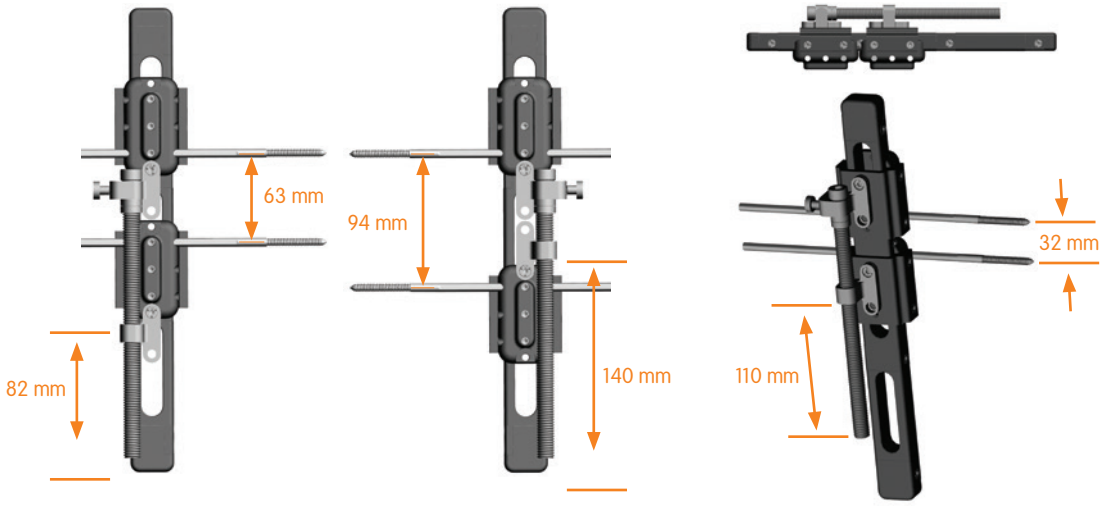
When spanning the knee, Overhang Clamps (7193-4622 or Small: 7193-4623) can be assembled with a Lower 2-Hole Clamp (7193-3342 and Small: 7193-3947) and can be used to place a Half Pin very close to the hinge.



Distraction/Compression Device

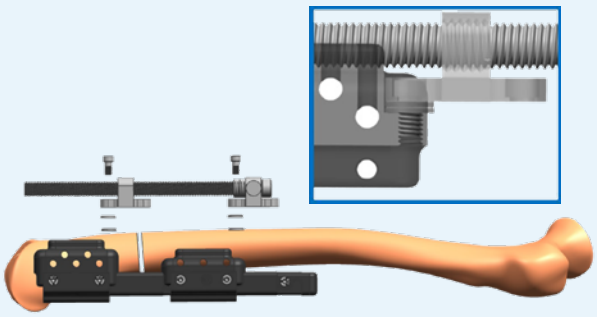
The Low Profile Rail Distractor (right 7193-4681, left 7193-4682) is attached to the Pin Clamps using two 7mm Rail Bolts (7193-3600) (*see note re: Stacked Clamps below). Depending on the resulting distance between Half Pins, the Distractor can be attached to the Pin Clamps in a number of different ways utilizing various holes in the Pin Clamps. A few examples are depicted, including minimum pin spread between the two clamps along with the remaining thread available for lengthening. Note that the device should be placed such that the knob can be easily accessed by the patient or caregiver.

Plan the rail length and Pin Clamp positions to best accommodate the desired distraction or compression goal.

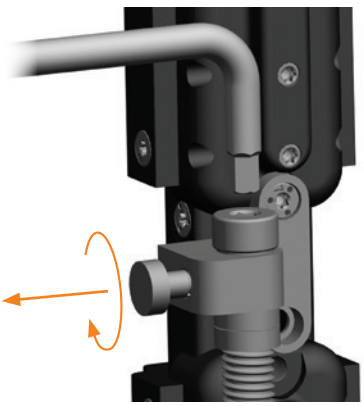


*Distraction/Compression Device with Stacked Clamps or Overhang Clamps

The Low Profile Rail Distractor (right 7193-4681, left 7193-4682) is attached to the Pin Clamps using two 11mm Rail Bolts (7193-4047) with 2 Washers (71101690S). Use the bolt-washer configuration on each end of the Distractor, in any scenario where a Stacked or Overhang Clamp is used. This will elevate the Distractor to clear the Clamp during distraction.

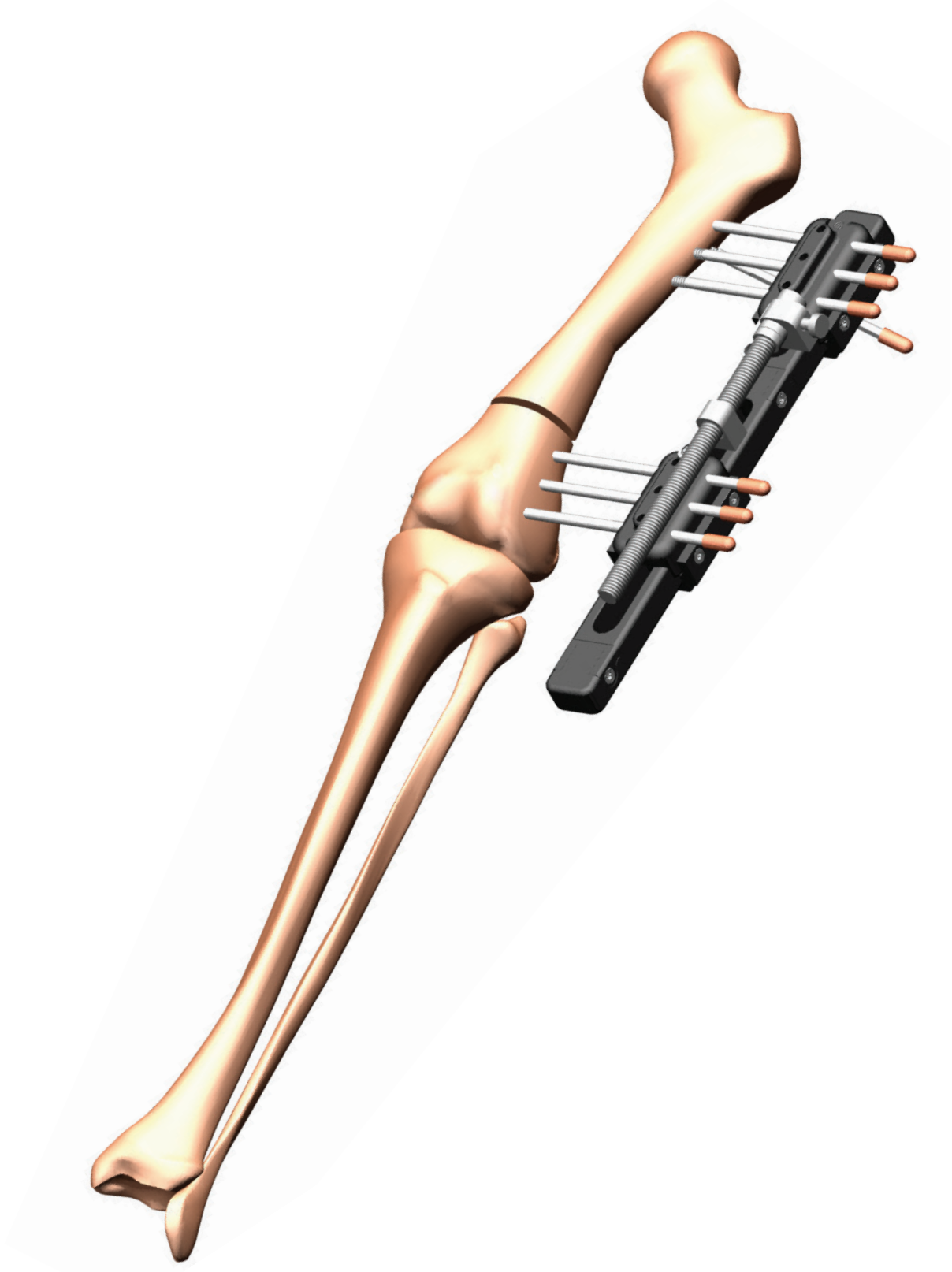


The Distraction/Compression Device is actuated using the 6mm Allen Wrench (7105-3006). The central bolt is turned in the counterclockwise direction to distract. A complete revolution (360°) corresponds to 1mm of distraction. Each ¼ turn (90°) is laser marked with the numbers 1, 2, 3 or 4 and corresponds to 0.25mm of distraction.



Gross adjustments can be made by pulling the spring loaded plunger and turning 90° prior to releasing. Rotate an additional 90° to re-engage the plunger, allowing for 0.25mm adjustments.

Femoral lengthening technique



Choose the level of the osteotomy

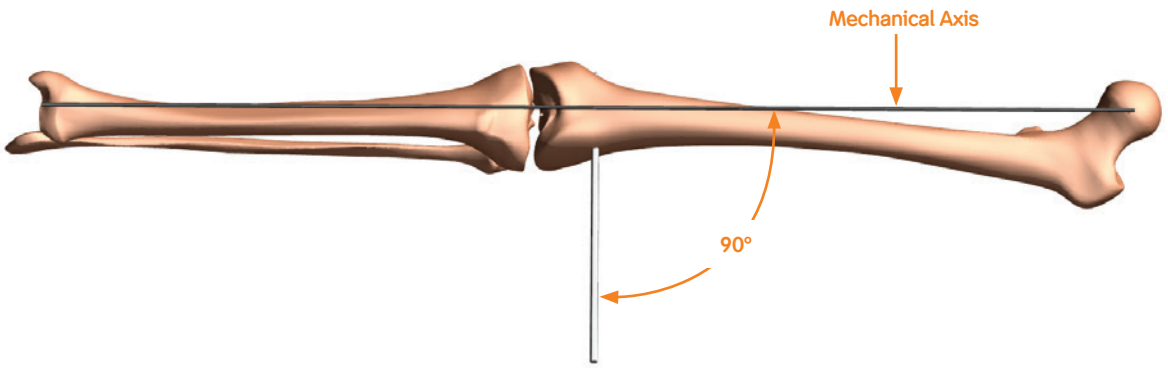
Choose the level of the osteotomy, position of the static and moving clamps, and overall length of rail based on the desired amount of lengthening.

Insert first Half Pin

The level of the Half Pins depends on the level of the planned osteotomy. The following steps describe distal femoral lengthening. For distal femoral lengthening the first pin is placed in the supracondylar region just proximal to the growth plate in a child or at the level of the adductor tuberoisty in an adult. The proximal pin is placed at the level of the lesser trochanter.

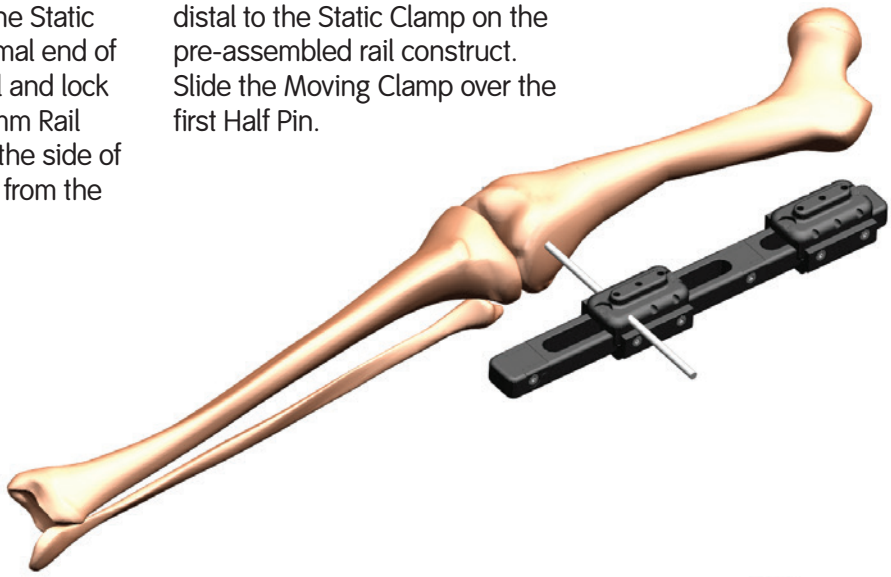
If proximal femoral lengthening is indicated, place the proximal pin first at the level of the base of the greater trochanter. The distal pin is placed in the infraisthmal portion of the femur.

Pre-drill the first Half Pin hole perpendicular to the mechanical axis of the femur (7° to the shaft or approximately parallel to the knee joint line) using the previously described Half Pin technique. Insert the first half pin into this hole. This step is critical in ensuring that the Rail is parallel to the mechanical axis such that lengthening can occur along the mechanical axis.

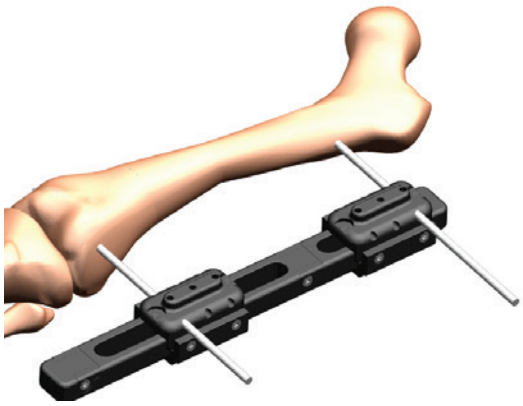


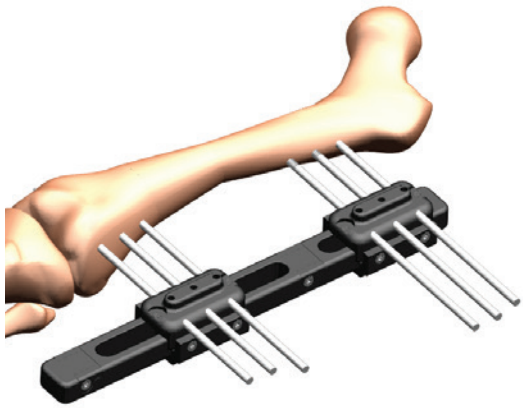
Apply Rail with Clamps

Using an Anterior-Posterior Lower Clamp, place the Static Clamp onto the proximal end of the preassembled rail and lock it in place with two 7mm Rail Bolts (7193-3600) on the side of the MRS facing ***away*** from the patient. Place the Moving Clamp distal to the Static Clamp on the pre-assembled rail construct. Slide the Moving Clamp over the first Half Pin.

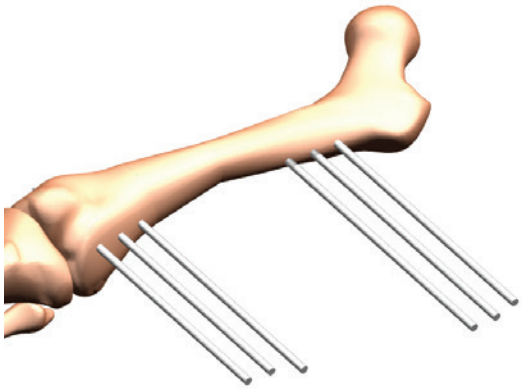


Use the Rail and Pin Clamps as a guide for inserting the remaining Half Pins. The second Half Pin should be inserted in the proximal, Static Clamp in a symmetrical position to the first Half Pin. For example, if the first Half Pin was placed in the most distal hole of the Moving Clamp, the second Half Pin should be placed in the most proximal hole in the Static Clamp and vice versa. This technique will secure the fixator in a parallel line to the mechanical axis of the bone. Use the remaining Pin Clamp holes as guides for Half Pin placement.



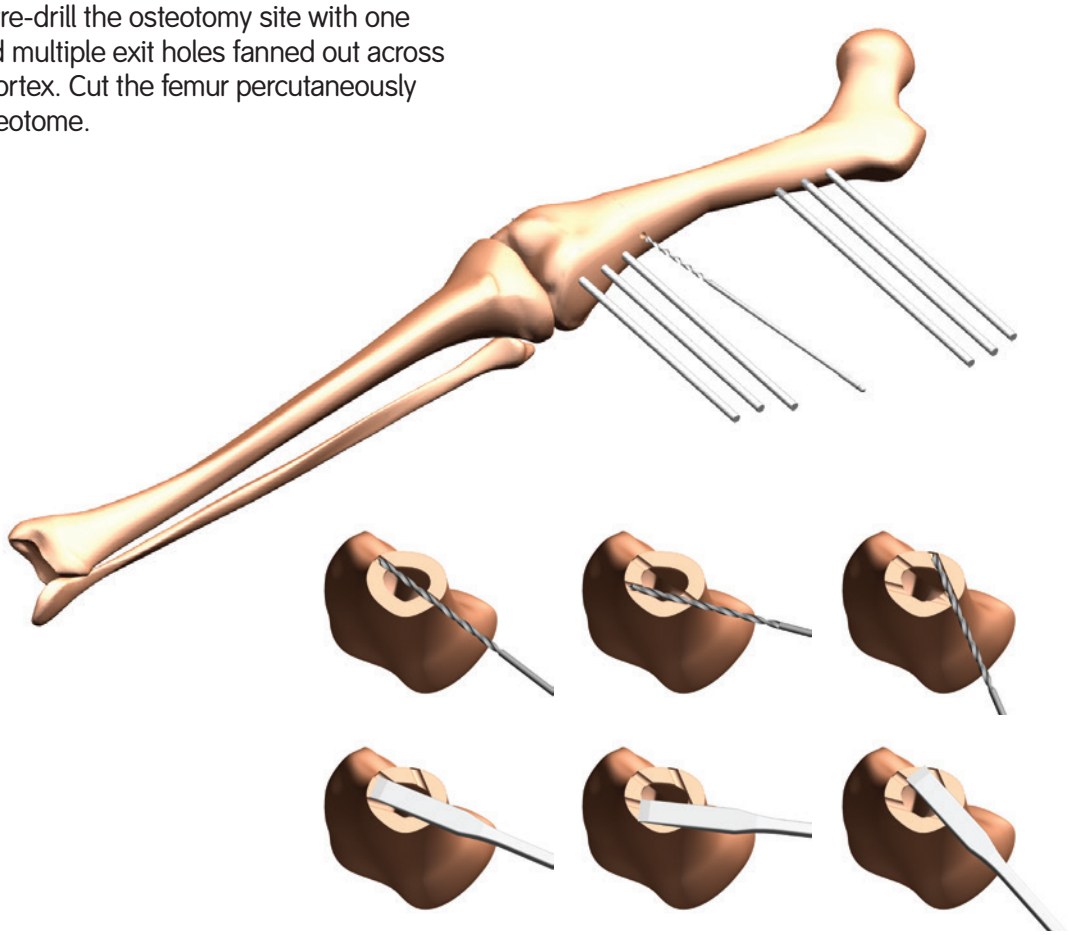


The rail can now be removed and the femur osteotomized between the upper and lower Half Pins.



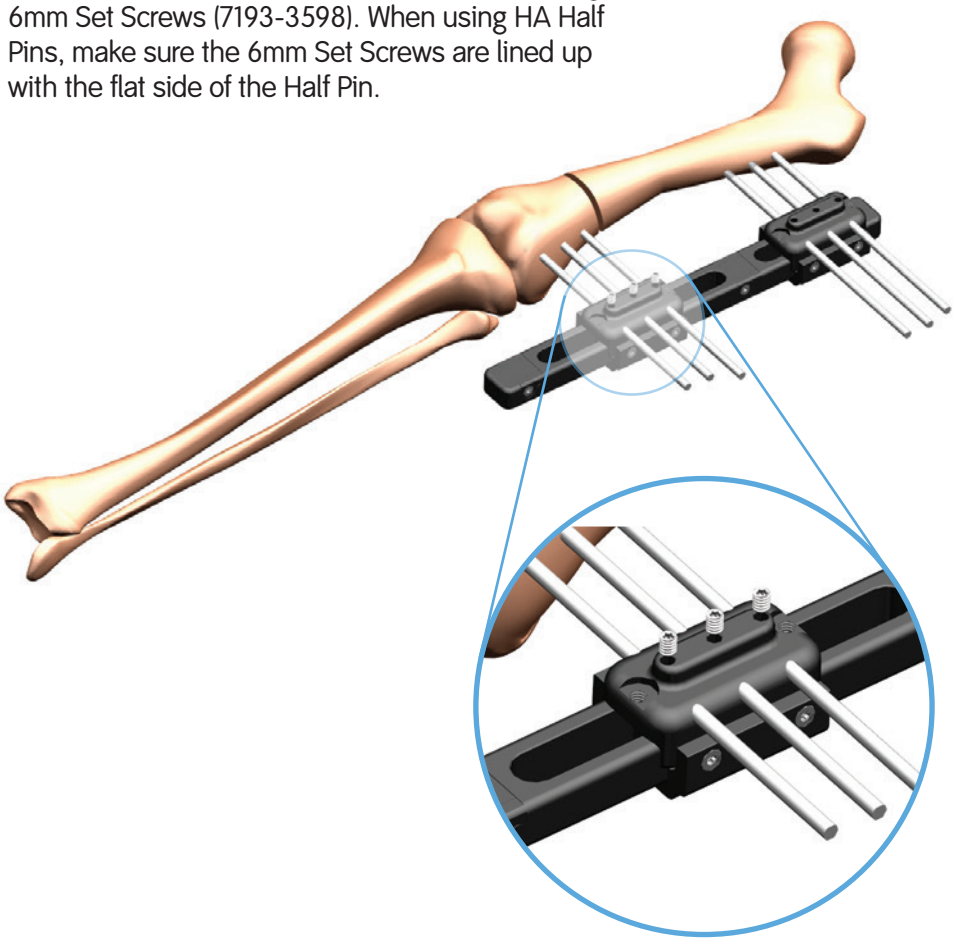
Osteotomize the femur

Make a small incision at the planned level of the osteotomy. Pre-drill the osteotomy site with one entrance and multiple exit holes fanned out across the medial cortex. Cut the femur percutaneously using an osteotome.



Reapply the Rail with Set Screws

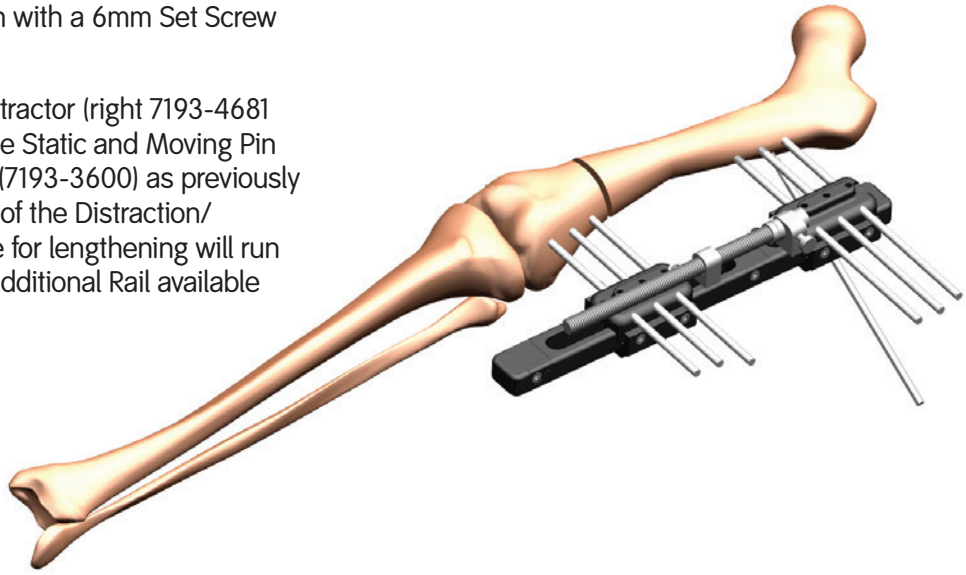
Following the osteotomy, reapply the rail to the Half Pins. Secure the clamps to the Half Pins using 6mm Set Screws (7193-3598). When using HA Half Pins, make sure the 6mm Set Screws are lined up with the flat side of the Half Pin.



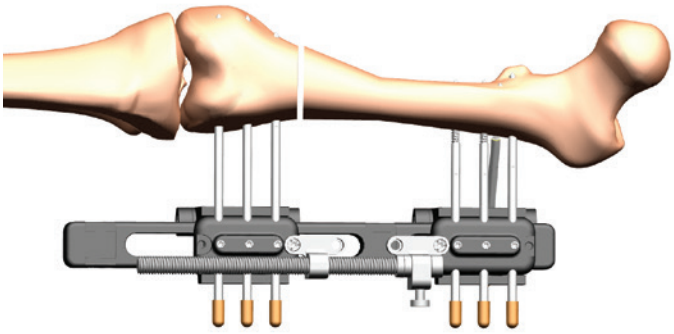
Apply Distraction/Compression Device

Add one Anterior-Posterior Half Pin to the AP Clamp proximally. Secure the Half Pin with a 6mm Set Screw (7193-3598).

Attach the Low Profile Rail Distractor (right 7193-4681 or left 7193-4682) between the Static and Moving Pin Clamps using 7mm Rail Bolts (7193-3600) as previously described. Ideally, the thread of the Distraction/ Compression Device available for lengthening will run in the same direction as the additional Rail available for lengthening.

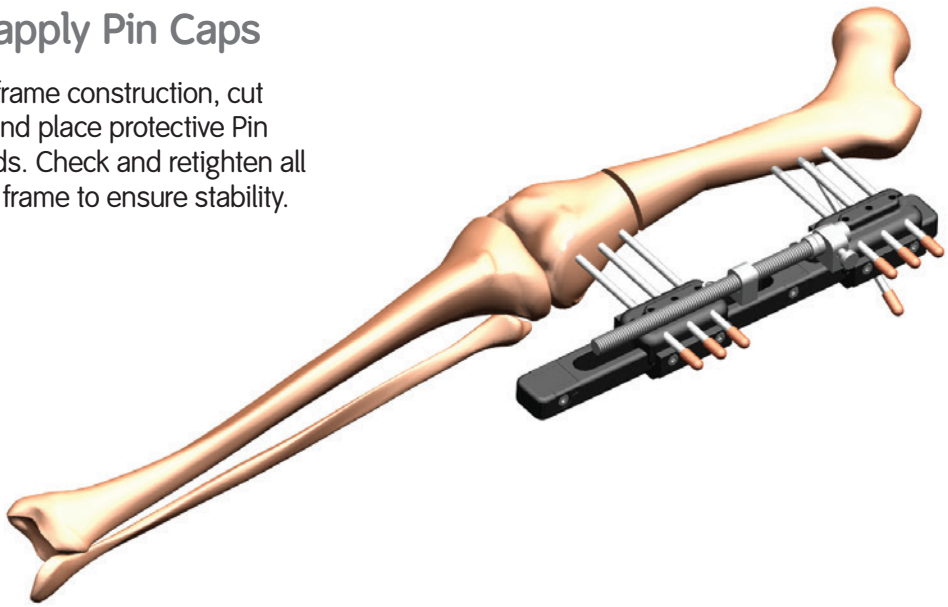


Note that for the construct shown, the Distraction/ Compression device is placed inside the two Pin Clamps.

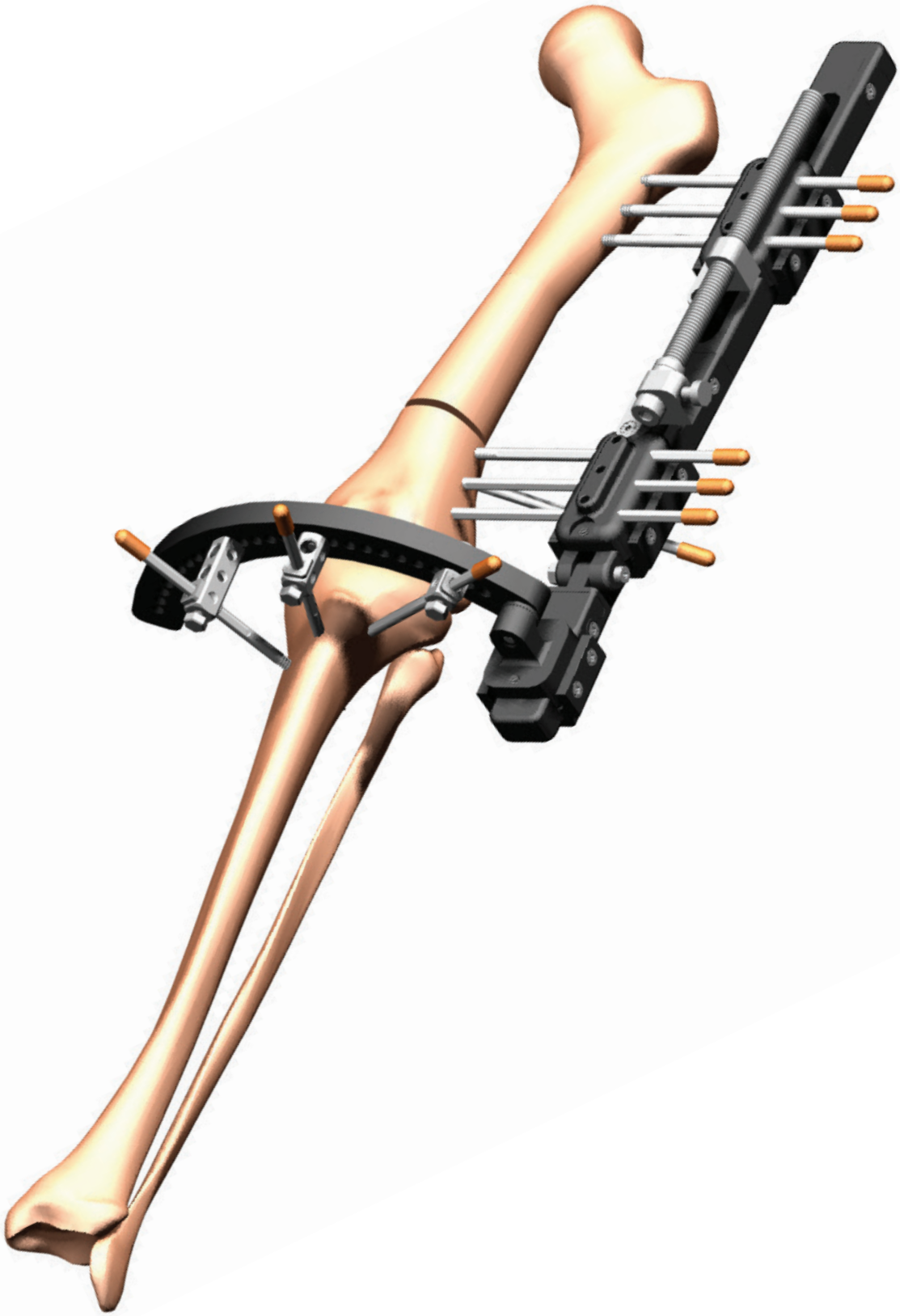


Cut Half Pins and apply Pin Caps

Following the completion of frame construction, cut Half Pins with a Rod Cutter and place protective Pin Caps (7107-0290) on the ends. Check and retighten all Set Screws and bolts on the frame to ensure stability.



Femoral lengthening with articulated knee spanning fixation

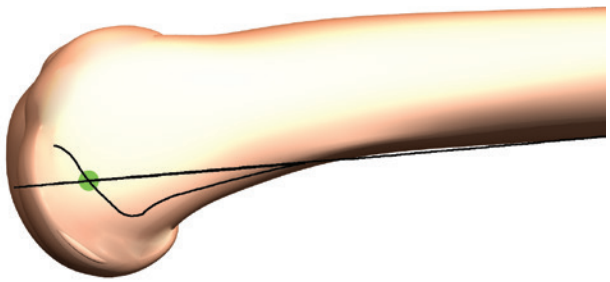


Identify center of rotation of the knee (CORK)

Using an image intensifier, internally and externally rotate the knee until the posterior aspects of the medial and lateral femoral condyles are overlapping.

This is the plane of the center of rotation of the knee (CORK).

In this plane, the CORK is located at the intersection point of Blumensaat's line and the posterior cortex of the femur.

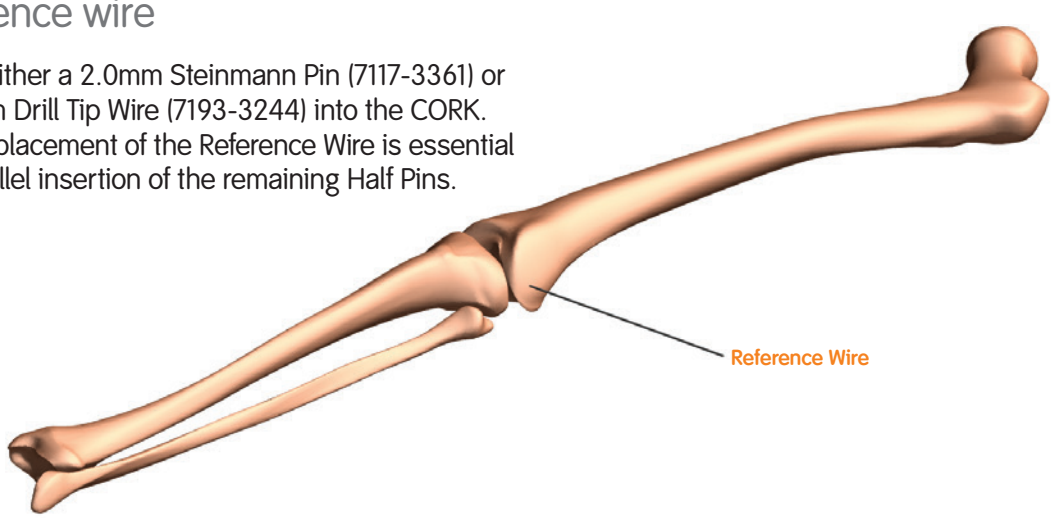


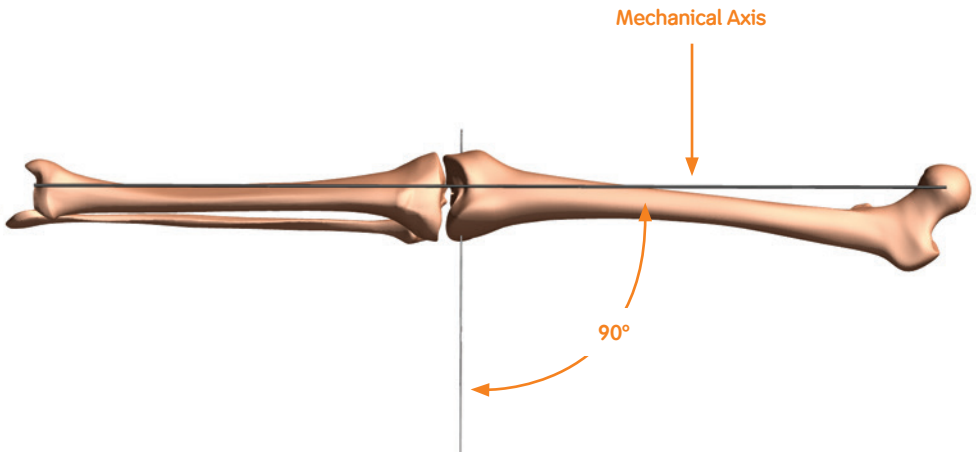
On the AP view, the CORK is perpendicular to the mechanical axis (usually 3° varus to the knee joint line).

In children it is difficult to visualize the posterior aspect of the femoral condyles because they are not ossified. Therefore, you must perform an arthrogram to outline the posterior condyles. In children, the center of rotation of the knee is at the level of the growth plate, at the intersection of the growth plate and a line extended from the posterior cortex of the femur.

Insert center of rotation of the knee reference wire

Insert either a 2.0mm Steinmann Pin (7117-3361) or a 1.8mm Drill Tip Wire (7193-3244) into the CORK. Proper placement of the Reference Wire is essential for parallel insertion of the remaining Half Pins.



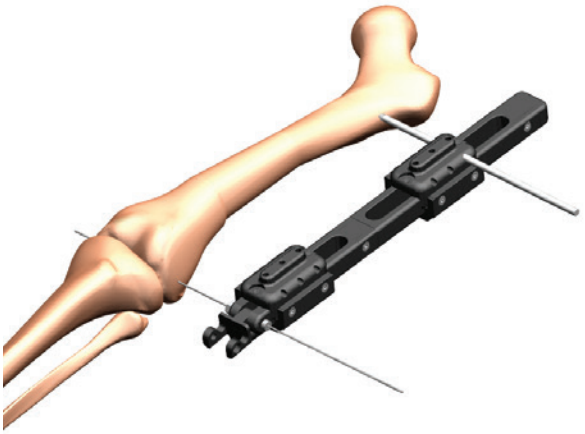


Apply Femoral Rail with Clamps and Hinge

Attach a Preassembled Knee Hinge (7193-4151 and Small: 7193-4154), instead of an End Cap, to the distal end of the preassembled rail.

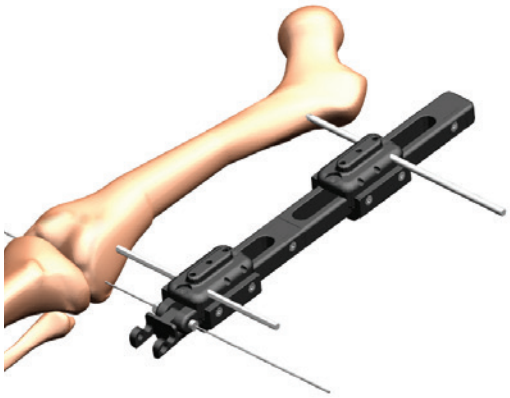
Insert Half Pins

Pre-drill a hole in the proximal femur parallel to the Reference Wire. Make sure this hole is located in the mid-coronal plane of the bone and that the pin is parallel in all planes to the Reference Wire. Insert a Half Pin with the appropriate thread length into the pre-drilled hole.

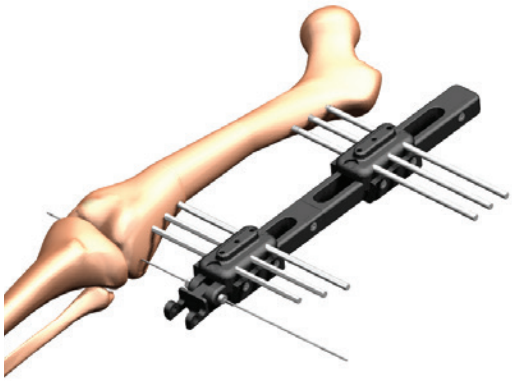


Place the static clamp onto the end of the preassembled rail and lock it in place with two 7mm Rail Bolts (7193-3600) on the side of the MRS facing ***away*** from the patient. Use an Overhang Clamp to get the distal Half Pins as close to the hinge as possible. Alternatively use a standard Upper Clamp with an Anterior/Posterior Angle Clamp attached if there is more room. Place the moving clamp proximal to the static clamp, on the pre-assembled rail construct. Mount the rail onto the proximal Half Pin through the most proximal hole of the proximal moving clamp. Slide the Cannulated Rail Bolt (7193-3603 or Small: 7193-4044) of the Knee Hinge Assembly over the CORK Reference Wire. Support the weight of the rail so it does not sag and deflect the CORK Reference Wire.

The second Half Pin should be inserted in the distal most hole of the distal clamp.



Use the remaining pin clamp holes as guides for Half Pin placement.



Osteotomize the femur

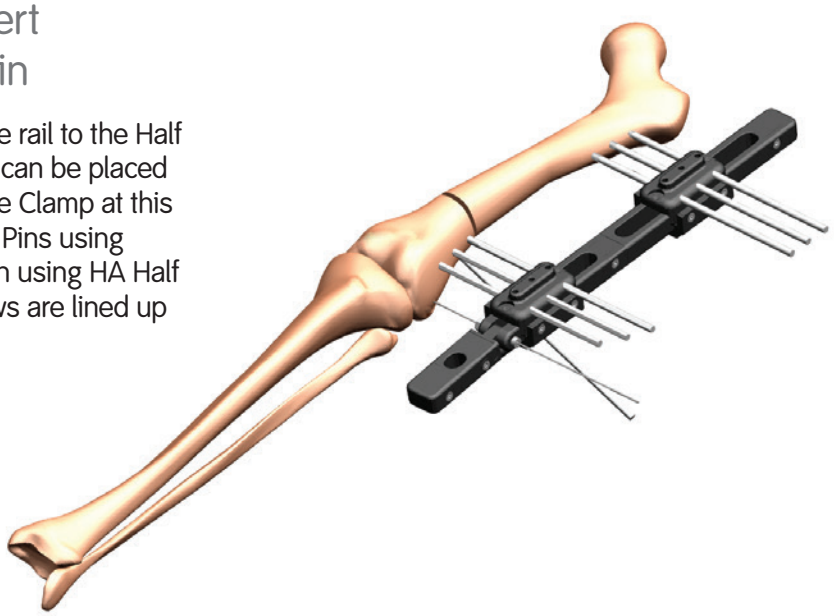
The rail can now be removed and the femur osteotomized just proximal to the distal Half Pins.

Apply Distal Rail Segment

Attach either a standard size Rail Segment (7193-3325 and Small: 7193-3931) or a Short Rail Segment (7193-4653 and Small: 7193-4043) and associated end cap to the distal side of the knee hinge. Standard size Rail Segments (7193-3325 and Small: 7193-3931) can also be used here in order to obtain more distal fixation on the tibia.

Reapply the Rail and insert Anterior-Posterior Half Pin

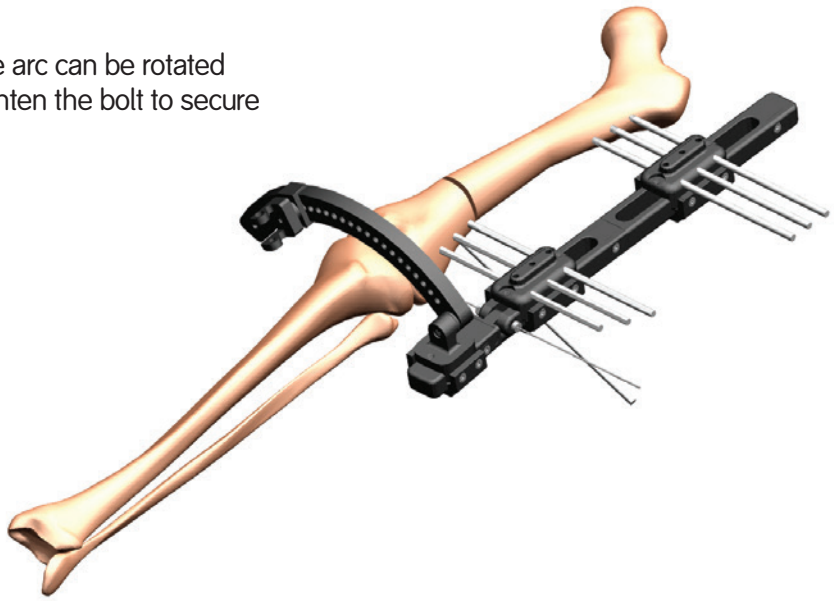
Following the osteotomy, reapply the rail to the Half Pins. An Anterior-Posterior Half Pin can be placed in the distal Anterior-Posterior Angle Clamp at this time. Secure the clamps to the Half Pins using 6mm Set Screws (7193-3598). When using HA Half Pins, make sure the 6mm Set Screws are lined up with the flat side of the Half Pin.



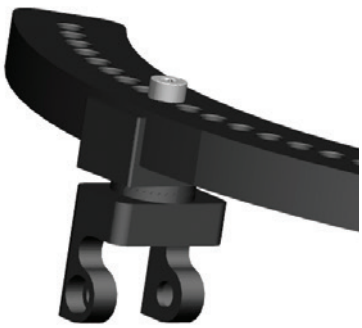
Apply Arc to the Distal Rail

Select a Preassembled Arc Assembly (7193-4152 and Small: 7193-4155 or Small: 7193-4820 Short) and ensure that the 2-hole Lower Pin Clamp (7193-3342 and Small: 7193-3947) of the arc assembly is secured with two 5mm Rail Bolts (7193-3599) on the interior, patient-facing side of the construct and two 5mm Rail Bolts (7193-3599) on the exterior side of the construct. The use of 5mm bolts allows the assembly to slide with knee motion and decreases pressure on the knee joint. Slide this assembly over the end cap and distal rail segment towards the knee hinge.

Loosen the bolt such that the arc can be rotated into the desired position. Tighten the bolt to secure the position of the Arc.



Note that in order to obtain optimal fixation in the tibia, the Rail to Arc connection (7193-3338 or Small: 7193-3943) and Arc Rotation End (7193-3339 or Small: 7193-3944) of the Arc Assembly can be moved to any open hole on the arc. It can also be removed altogether.



Apply tibial fixation

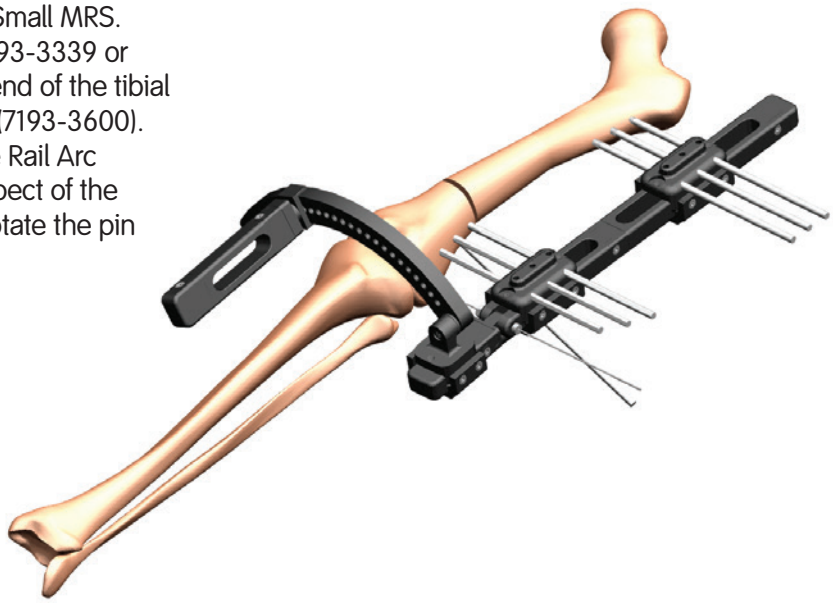
Tibial Fixation may be obtained using one of two methods. Option 1 is using another Rail Segment and pin clamps on the antero-medial tibial face. Option 2 is using TAYLOR SPATIAL FRAME® Rancho cubes and Angled Pin Connectors.

Option 1: MRS tibial fixation

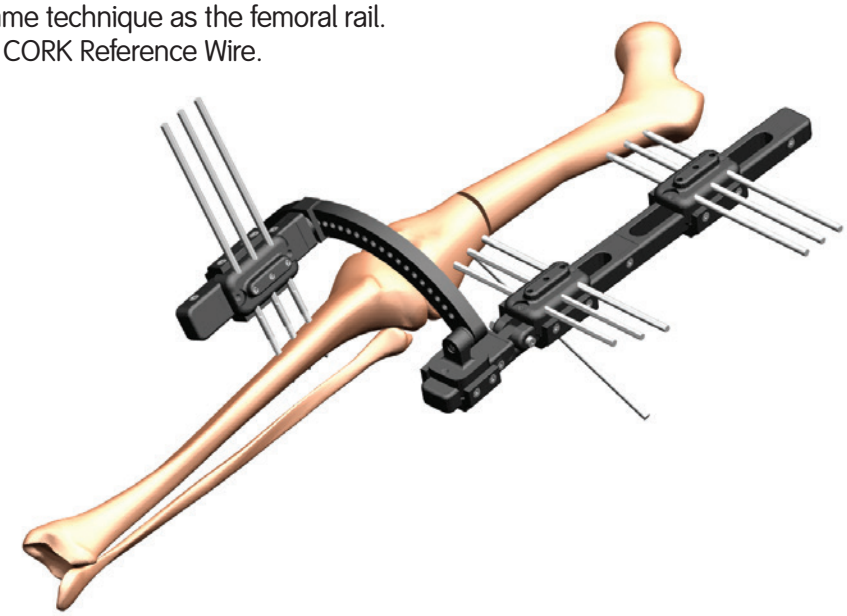
Preassemble the Rail Segments using 7mm Rail Bolts (7193-3600) for the Large MRS and 5mm Rail Bolts (7193-3599) for the small MRS. Tighten all bolts after assembly to ensure construct integrity, paying close to attention to the bolts that will be on the inside of the rail and facing the patient. *Once the rail is in place, these bolts can be difficult to access.*

Note: Be sure the segments are properly lined up by preassembling the segments on a flat surface.

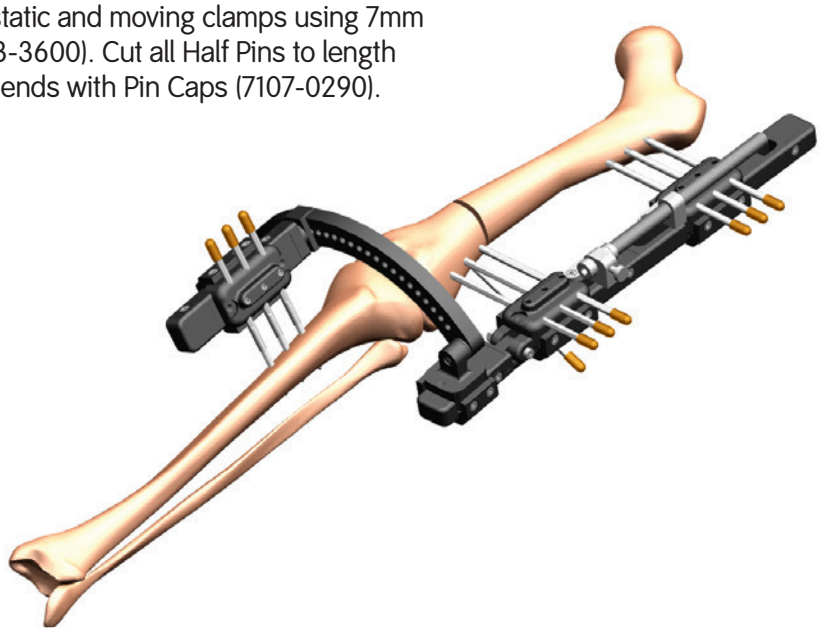
Connect the Rail Arc Rotation Connection (7193-3338 or Small: 7193-3943) and Rotation End (7193-3339 or Small: 7193-3944) to the Rail Arc adjacent to the anterior or antero-medial face of the tibia using a 6mm x 30mm Rail Bolt (7193-3602) for the Large MRS or a 6mm x 27mm Small Rail Bolt (7193-4045) for the Small MRS. Attach the Rail Arc Rotation End (7193-3339 or Small: 7193-3944) to the proximal end of the tibial rail construct using 7mm Rail Bolts (7193-3600). Align the “poker chip” aspect of the Rail Arc Rotation End to the “poker chip” aspect of the Rail Arc Rotation Connection and rotate the pin clamp to the desired position.



Using the proximal hole of the Pin Clamp construct, insert a Half Pin. Support the weight of the rail and test the flexion and extension of the knee joint. Perform the drop test to determine if the knee bends without friction. Complete the tibial fixation using the same technique as the femoral rail. Remove the CORK Reference Wire.



Apply the Distraction/Compression Device between the static and moving clamps using 7mm Rail Bolts (7193-3600). Cut all Half Pins to length and cover the ends with Pin Caps (7107-0290).

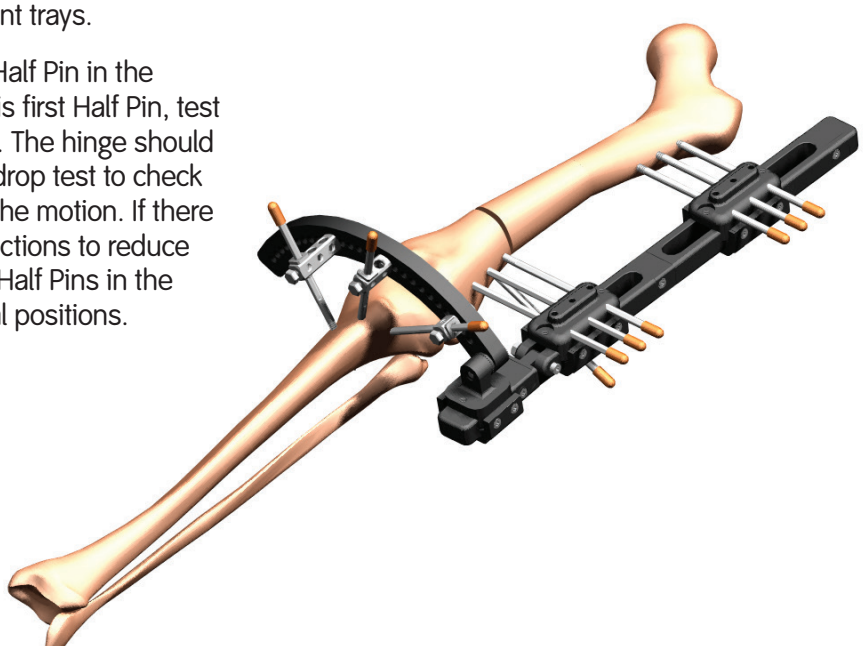


Apply tibial fixation (continued)

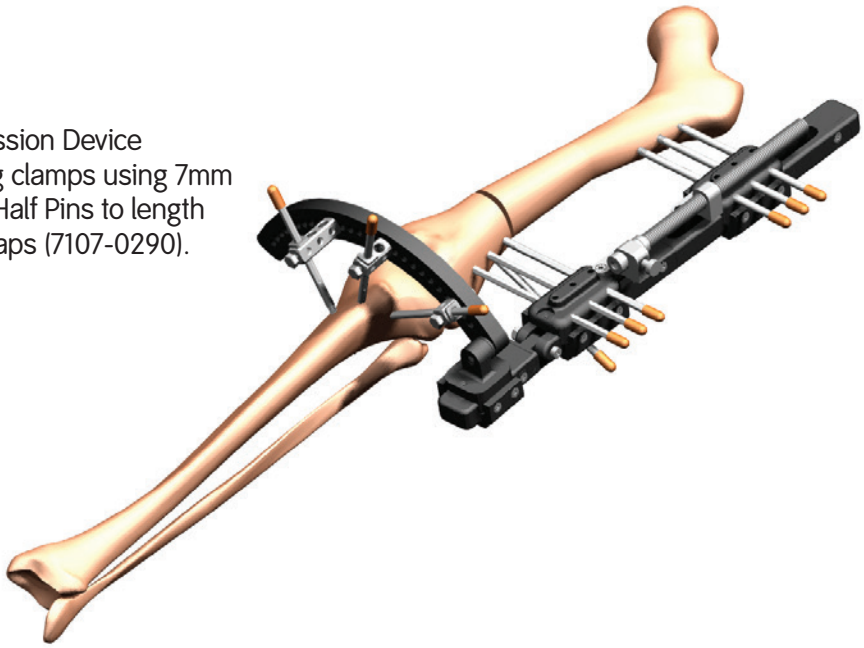
Option 2: Rancho Cube/Angled Pin Connector tibial fixation

While respecting the safe zones described earlier, gain firm fixation of the tibia with a minimum of 3 Half Pins using Rancho Cubes. Angled Pin Connectors can be used with the Small Arc Assembly. Rancho Cubes and the appropriate instruments are available in the TAYLOR SPATIAL FRAME® Hardware and Instrument trays.

Start with the antero-posterior Half Pin in the sagittal plane. After inserting this first Half Pin, test the range of motion of the knee. The hinge should allow 90° of motion. Perform a drop test to check that there is no friction limiting the motion. If there is friction then adjust the connections to reduce the friction. Add two additional Half Pins in the antero-medial and antero-lateral positions.



Apply the Distraction/Compression Device between the static and moving clamps using 7mm Rail Bolts (7193-3600). Cut all Half Pins to length and cover the ends with Pin Caps (7107-0290).



Optional elective constraint around the knee

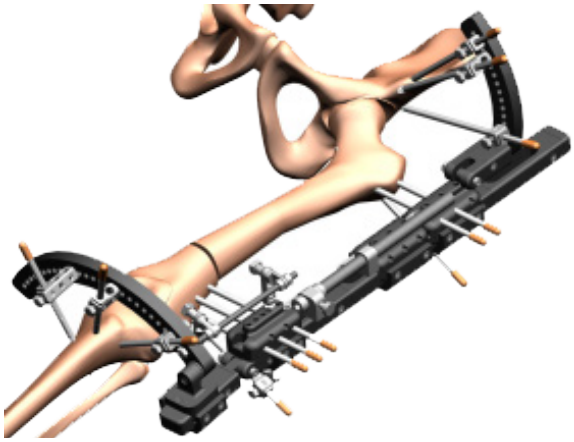
In order to lock a knee hinge in extension during the night, a removable out-rigger can be constructed and used to prevent flexion across the Femoral Rail and Tibial Arc. This technique is accomplished using standard Ilizarov components.

First a male Post is mounted on the distal femoral Clamp:

Attach a Nut to the Post

Insert into one of the ventral holes of the distal femoral Clamp.

Once correct orientation of the Post is attained, tighten the Nut



Next, attach a similar construct on the Tibial Arc:

Attach a Standard 90° Hinge (102501) to the proximal side of the Tibial Arc

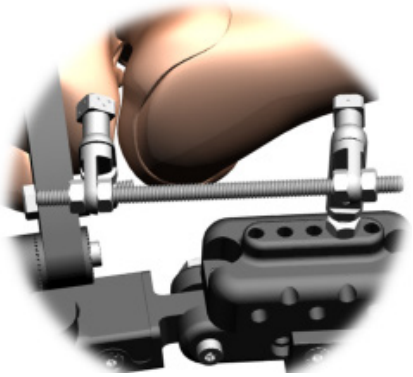
Use a 30mm Bolt (103202) and 4mm Washer (102707 or 102600) to secure the 90° Hinge

Finally, assemble the removable out-rigger:

Attach two Standard Male Hinges (101600) to a threaded rod.

Adjust the thread length to allow amount of flexion/extension permitted

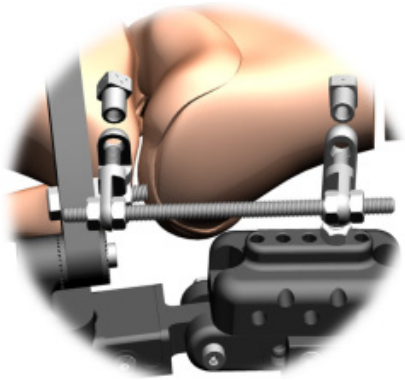
Lock the Hinges on the Threaded Rod with 10mm Nuts



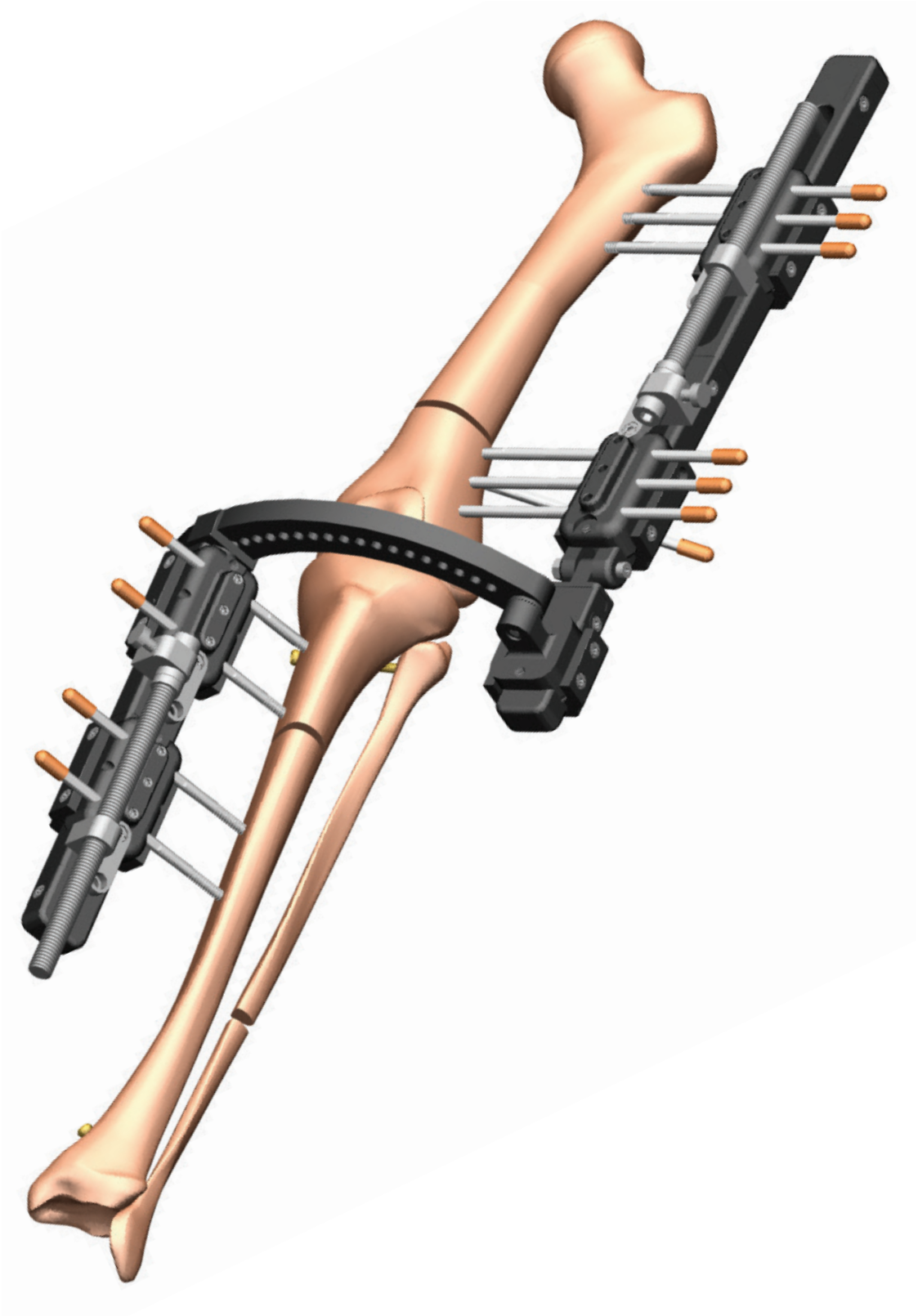
The construct is inserted in the Post on the Femoral Rail and the 90° Hinge on the Tibial Arc

Square Nuts (103302) are used to secure the out-rigger in place

The Caregiver is instructed on appropriate removal and re-application of the out-rigger

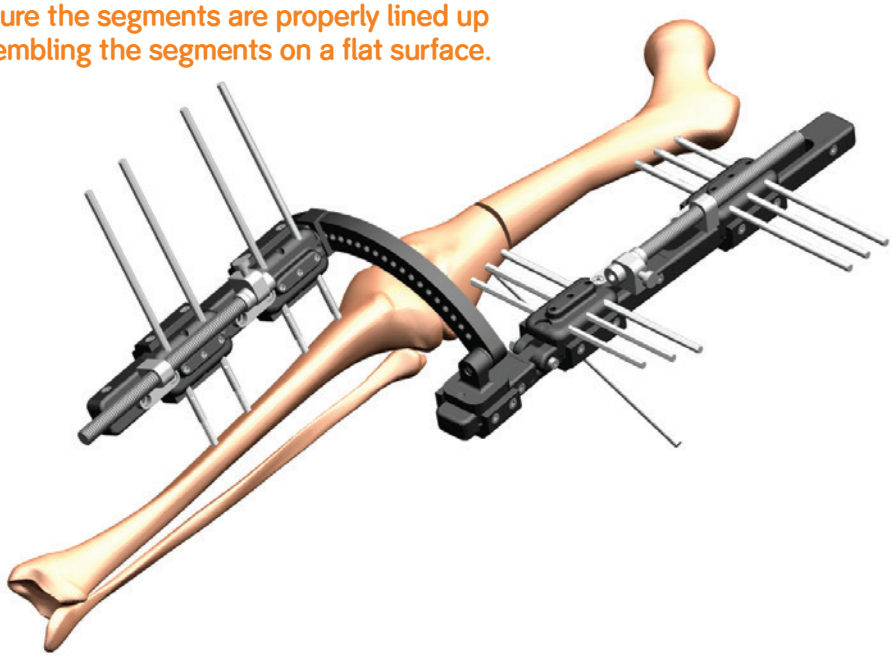


Combined femoral and tibial lengthening with articulated knee spanning fixation



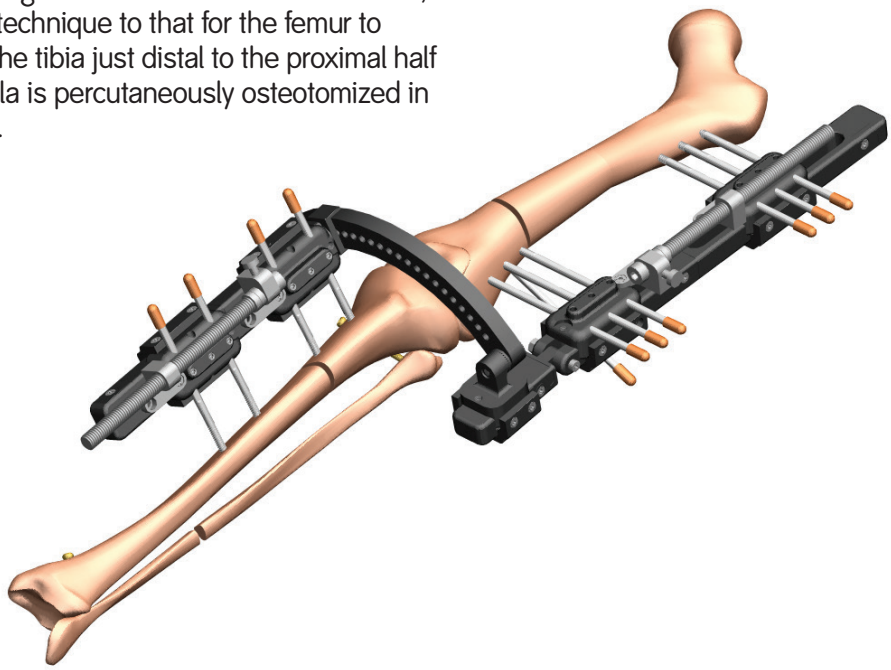
If lengthening of the tibia is indicated in addition to lengthening of the femur, then follow the MRS Tibia fixation (Option 1) previously discussed. Ensure that the number of Rail Segments assembled for the tibia will be sufficient to support two pin clamps and achieve the desired lengthening.

Note: Be sure the segments are properly lined up by preassembling the segments on a flat surface.

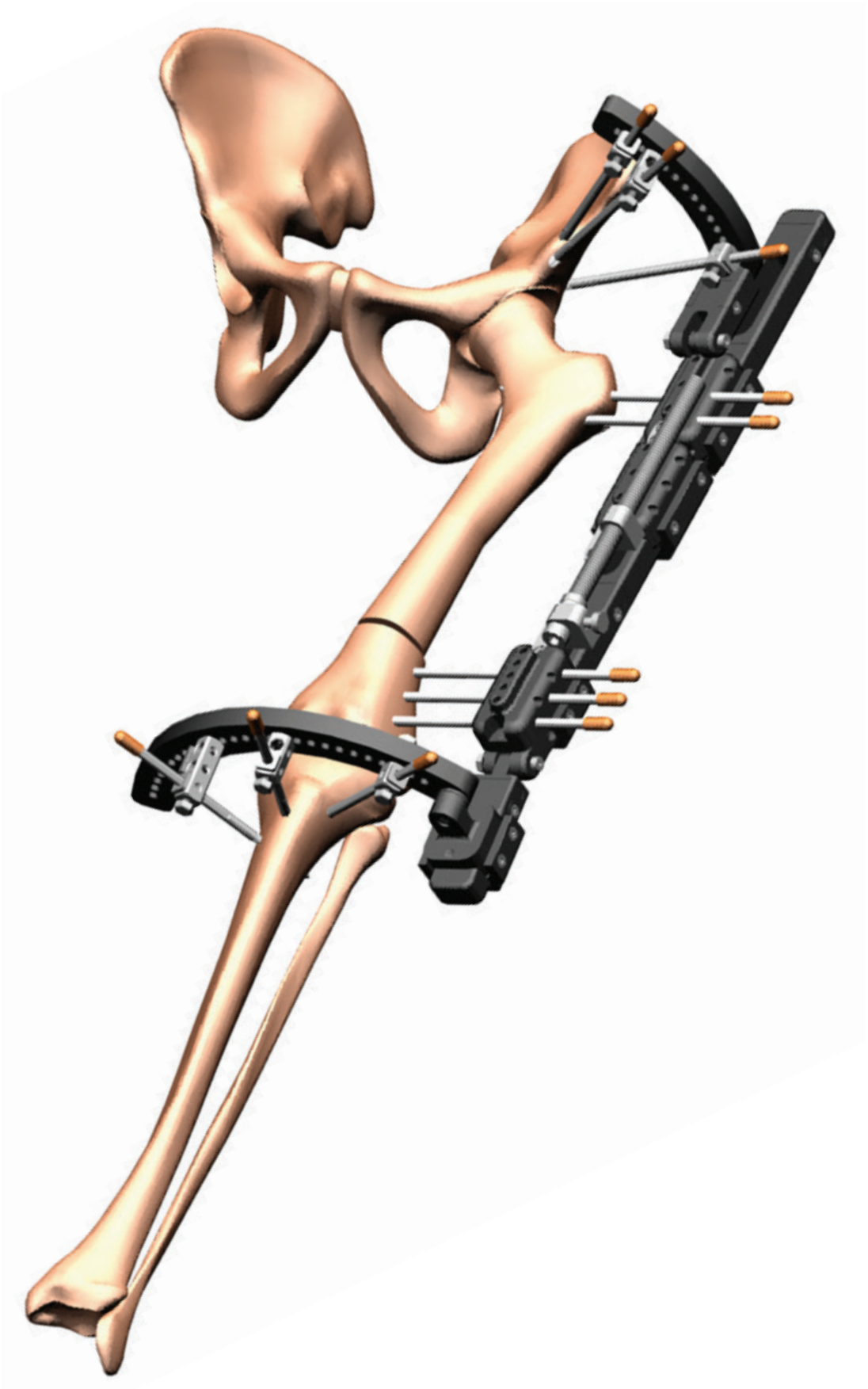


Osteotomize the tibia and fibula

While respecting the safe zones described earlier, use a similar technique to that for the femur to osteotomize the tibia just distal to the proximal half pins. The fibula is percutaneously osteotomized in the distal half.



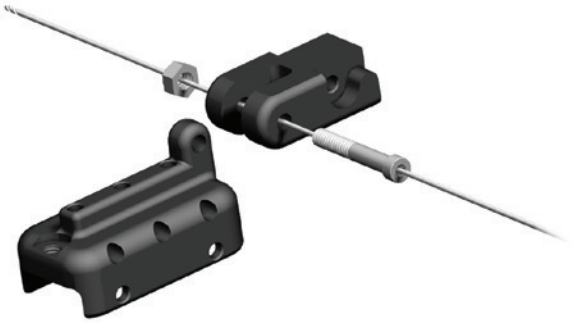
Femoral lengthening with articulated knee and hip spanning fixation



Identify center of rotation of the hip (CORH)

Identify the CORH as described in the articulated knee spanning fixation section and place a 1.8mm Drill Tip Reference Wire (7193-3244).

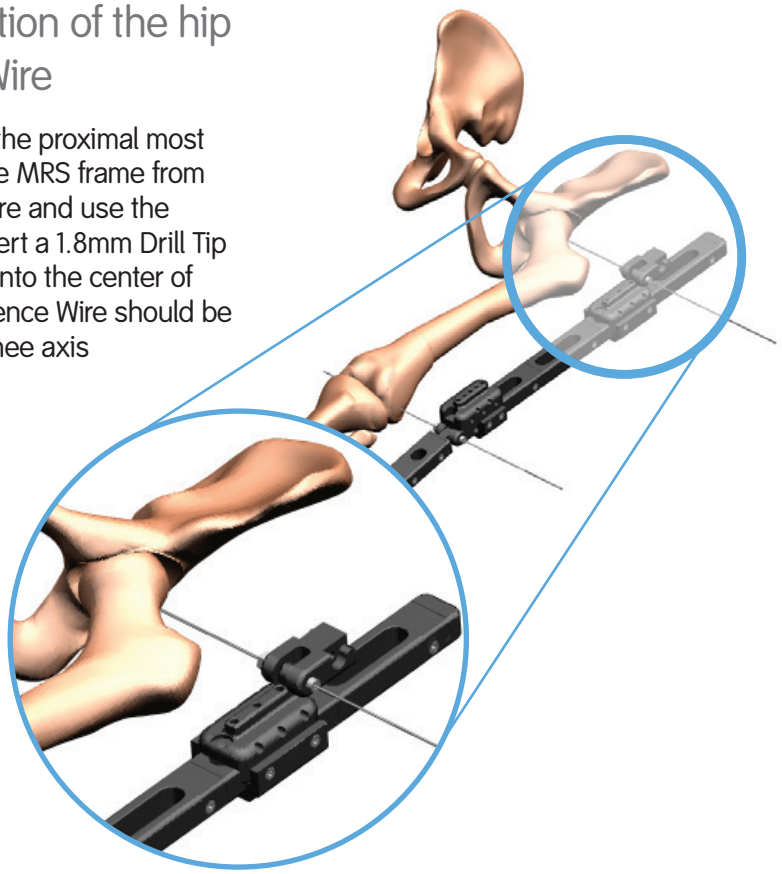
Preassemble the Rail of desired length and attach the Knee Hinge to the distal end. In order to get the Half Pins closer to the knee hinge, an Overhang Clamp (7193-4622 or Small: 7193-4623) can be used for the distal Static Clamp. For the proximal most Moving Clamp, use either a High Profile Upper Hip Hinge (7193-4039 or Small:7193-4041) or a Low Profile Upper Hip Hinge (7193-4040 or Small:7193-4042) as the upper portion of the Pin Clamp. Choose either the high or low profile Upper Hip Hinge Clamp based on whether the center of rotation of the hip (CORH) in the coronal plane is near or far from the plane of the Hip Hinge Half Pins holes.



Use a Cannulated Rail Bolt (7193-3603 or Small: 7193-4044) and a 6mm Lock Nut (7193-3703) to assemble a Female Rail Hinge (7193-3328 or Small: 7193-3934) to the Upper Hip Hinge.

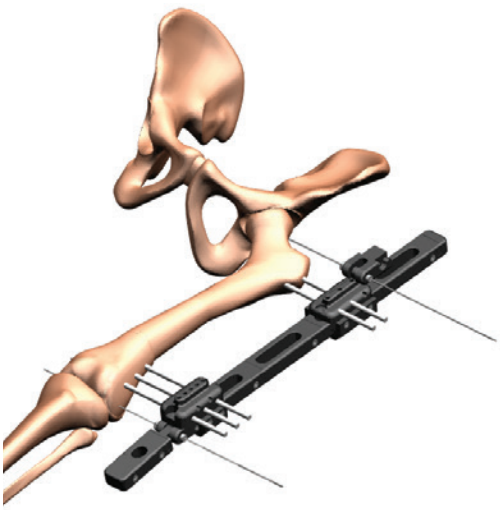
Insert center of rotation of the hip (CORH) Reference Wire

Before choosing the level of the proximal most femoral Half Pin, suspend the MRS frame from the knee hinge Reference Wire and use the cannulation in the bolt to insert a 1.8mm Drill Tip Reference Wire (7193-3244) into the center of the femoral head. This Reference Wire should be parallel in all planes to the knee axis Reference Wire.



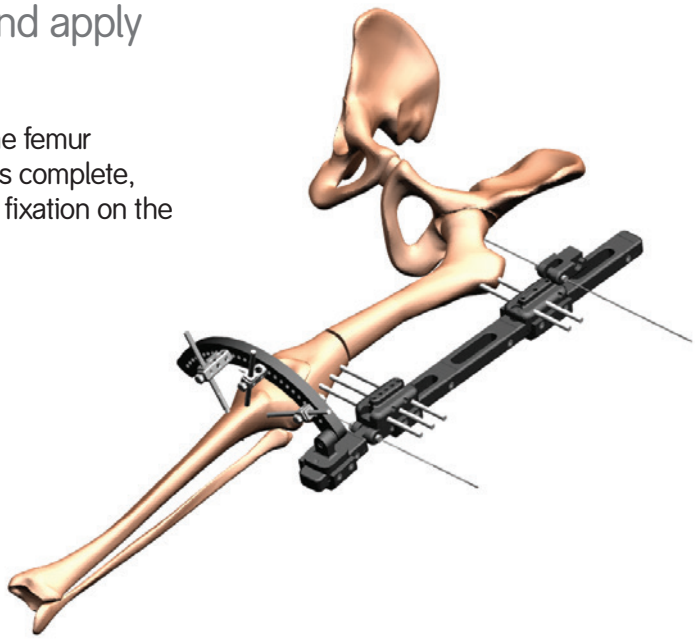
Insert Half Pins

Pre-drill holes for the proximal and distal femoral Half Pins using the Pin Clamps and Drill Sleeves. Insert Half Pins.



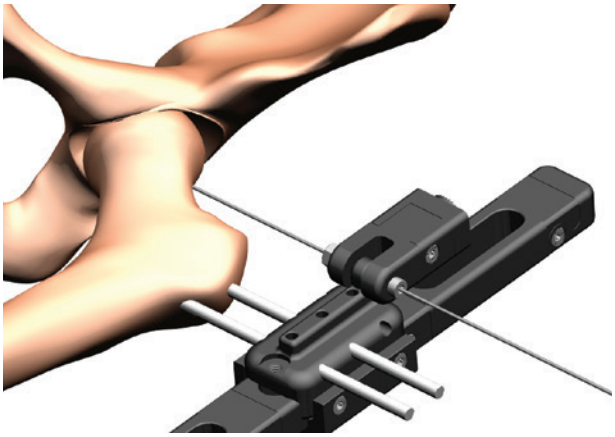
Osteotomize the femur and apply tibial fixation

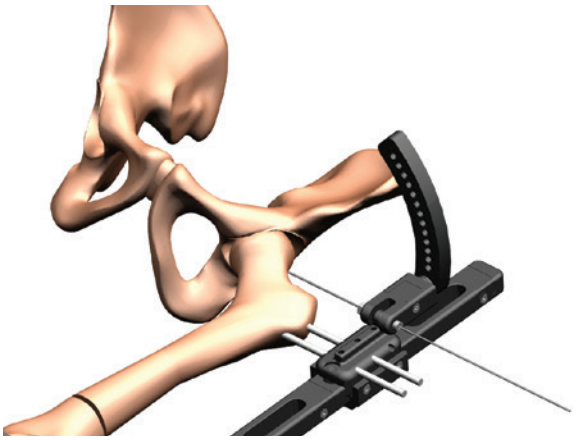
The Rail can now be removed and the femur osteotomized. Once the osteotomy is complete, reapply the Rail and proceed to gain fixation on the tibia as previously described.



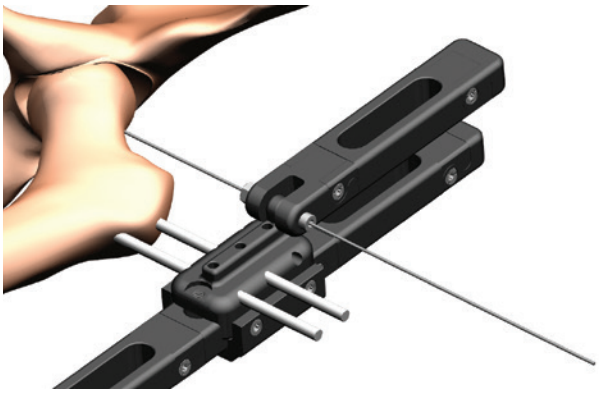
Apply Pelvic Arc to the Rail

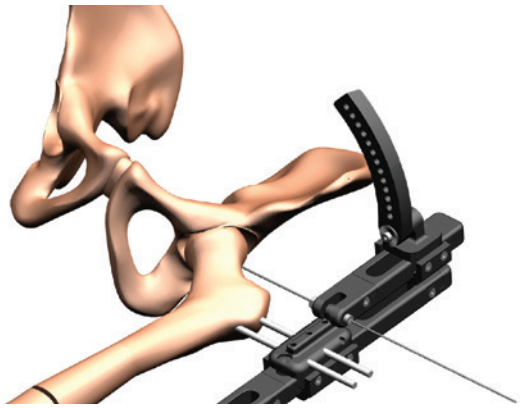
There are two options for attaching a Pelvic Arc to the Rail. The first option is to attach a Rail Arc Rotation End (7193-3339 or Small: 7193-3944) directly to the female hinge such that the poker chip is proximal. A Rail Arc (7193-3336 or Small: 7193-3941) or Short Rail Arc (7193-4654 or Small: 7193-4046) with matching poker chip can be secured to the Rail Arc Rotation End with a 27mm Bolt (7193-4045).





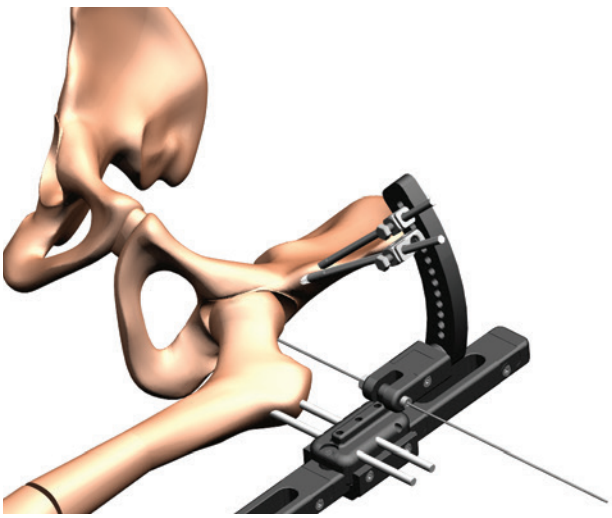
Alternatively, attach either a standard size Rail Segment (7193-3325 or Small: 7193-3931) or a Short Rail Segment (7193-4653 or Small: 7193-4043) along with a Male Rail End Cap (7193-3638 or Small: 7193-3950) to the Female Rail Hinge. Attach a preassembled arc to proximal Rail Segment.





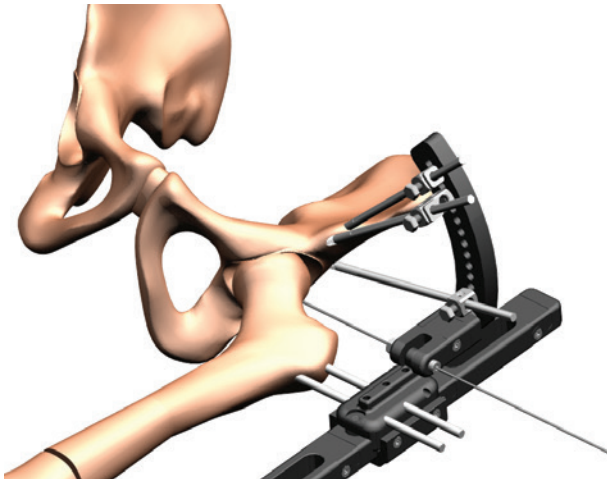
Apply Pelvic Half Pins

Remove any bump from under the buttock to make sure the pelvis is lying level. Rotate the table to tilt the ipsilateral pelvis up. Visualize the triangle of bone above the acetabulum in its maximum profile. This is the correct plane for insertion of two anterior half pins. Attach Rancho Cubes loosely to the arc and use Drill Sleeves to place a 1.8mm Drill Tip Reference Wire (7193-3244) into the triangle in an antero-lateral to posteromedial direction. With the table tilted this appears to be antero-posterior. Drill over the wire with a 4.8mm Cannulated Drill. Remove the wire and insert a 6mm HA Coated Half Pin. Alternatively drill over with a 3.8 mm Cannulated Drill and insert a 4.5 mm HA Coated Half Pin. Insert a second pin in the same direction more proximal or distal to the first. These two Half Pins should be located on the ridge between the Anterior Superior Iliac Spine and the Anterior Inferior Iliac Spine.



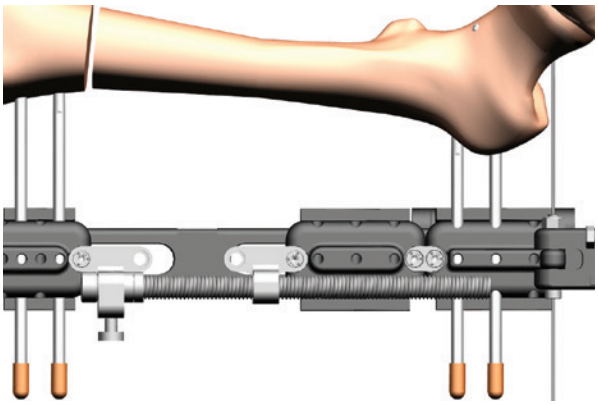
Apply Pelvic Half Pins (continued)

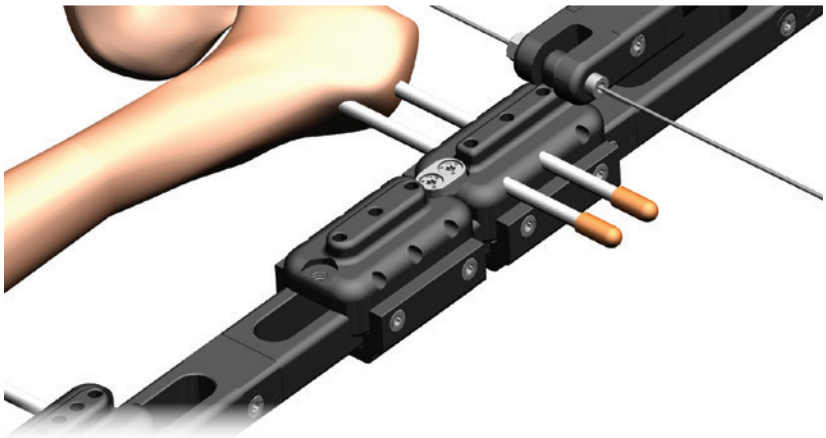
Add a third Half Pin from lateral to medial on the Arc. This Half Pin is critical to stability, should be just proximal to the acetabulum, and should be placed as posterior as possible.



Apply Distraction/Compression Device

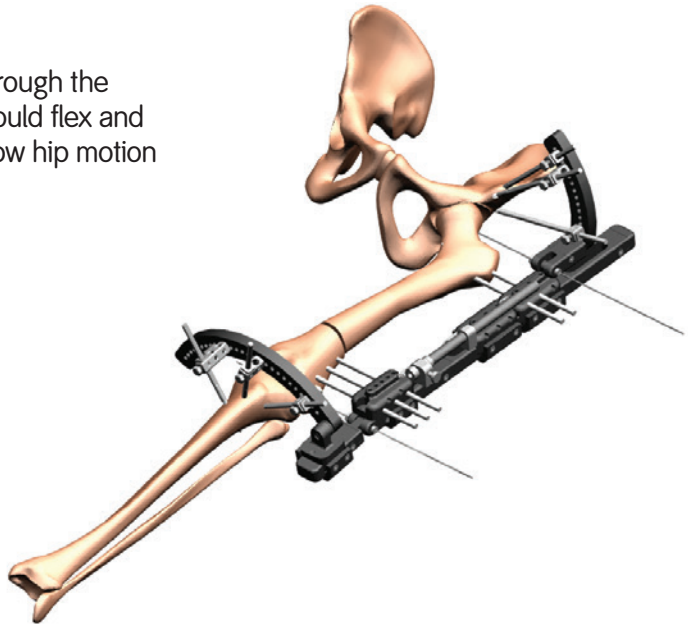
Apply the Distraction/Compression Device (right 7193-4681 or left 7193-4682) between the Static and Moving Clamps using 7mm Rail Bolts (7193-3600). For this construct, a Pre-assembled 3-hole Pin Clamp (7193-4150 and Small: 7193-4153) is used to extend the Moving Clamp by attaching it with a Rail Clamp Connector (7193-3626).





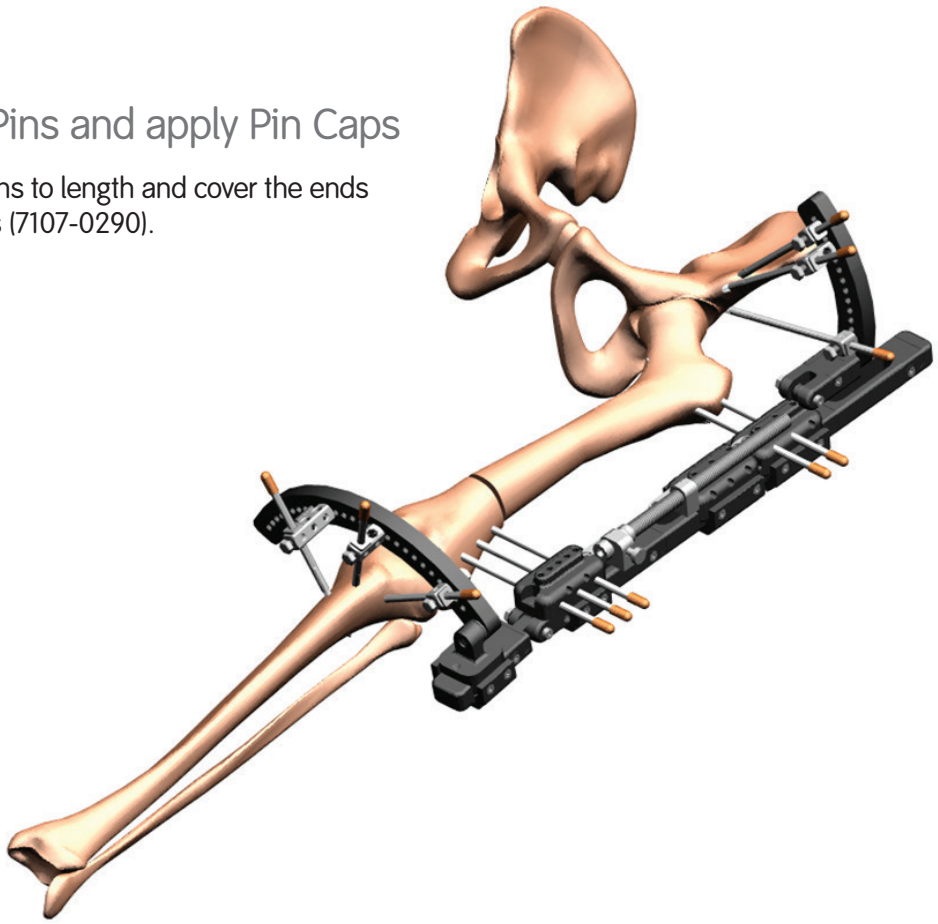
Test hip range of motion

Test the tracking of the hip motion through the Hip Hinge. Both the hip and knee should flex and extend in the same plane. Do not allow hip motion in any other plane.



Cut Half Pins and apply Pin Caps

Cut all Half Pins to length and cover the ends with Pin Caps (7107-0290).



Catalog

MRS Components

Rail Segments

Cat. No.	Description
7193-3325	Rail
7193-4653	Rail Short
7193-3931	Small Rail
7193-4043	Small Rail Short

Rail End Caps

Cat. No.	Description
7193-3639	Rail Female Cap
7193-3638	Rail Male Cap
7193-3950	Small Rail Male Cap
7193-3951	Small Rail Female Cap

Pre-Assembled Pin Clamps

Cat. No.	Description
7193-4150	Rail Upper 3-Hole Clamp Assembly
7193-4153	Small Rail Upper 3-Hole Clamp Assembly

Upper Pin Clamps

Cat. No.	Description
7193-3340	Rail Upper 1-Hole Clamp
7193-3326	Rail Upper 3-Hole Clamp
7193-3330	Rail Upper 3-Hole Stacked Clamp
7193-3324	Rail Upper 5-Hole Stacked Clamp
7193-4622	Rail Overhang Clamp
7193-3945	Small Rail Upper 1-Hole Clamp
7193-3932	Small Rail Upper 3-Hole Clamp
7193-4048	Small Rail Upper 3-Hole Clamp Short
7193-3936	Small Rail Upper 3-Hole Stacked Clamp
7193-3930	Small Rail Upper 5-Hole Stacked Clamp
7193-4623	Small Rail Overhang Clamp

Lower Pin Clamps

Cat. No.	Description
7193-3337	Rail Lower 1-Hole Clamp
7193-3342	Rail Lower 2-Hole Clamp
7193-3329	Rail Lower 2-Hole Long Clamp
7193-3942	Small Rail Lower 1-Hole Clamp
7193-3947	Small Rail Lower 2-Hole Clamp
7193-3935	Small Rail Lower 2-Hole Long Clamp

Lower Anterior-Posterior Angle Pin Clamps

Cat. No.	Description
7193-3331	Rail Anterior Posterior 1-Hole Angle Clamp
7193-3332	Rail Anterior Posterior 2-Hole Angle Clamp
7193-3937	Small Rail Anterior Posterior 1-Hole Angle Clamp
7193-3938	Small Rail Anterior Posterior 2-Hole Angle Clamp

Proximal/Distal Angular Correction Clamps

Cat. No.	Description
7193-3333	Rail Proximal Right Distal Left Angle Clamp
7193-3341	Rail Proximal Left Distal Right Angle Clamp
7193-3939	Small Rail Proximal Right Distal Left Angle Clamp
7193-3946	Small Rail Proximal Left Distal Right Angle Clamp
7193-4050	Small Proximal Right/ Distal Left 2 Hole Angle Clamp
7193-4051	Small Proximal Left/ Distal Right 2 Hole Angle Clamp

Pre-Assembled Rail Knee Hinges

Cat. No.	Description
7193-4151	Rail Knee Hinge Assembly
7193-4154	Small Rail Knee Hinge Assembly

Male Rail Hinges

Cat. No.	Description
7193-3327	Rail Male Hinge
7193-3933	Small Rail Male Hinge

Female Rail Hinges

Cat. No.	Description
7193-3328	Rail Female Hinge
7193-3934	Small Rail Female Hinge

Upper Hip Hinge Clamps

Cat. No.	Description
7193-4039	Rail Hip Hinge – High Profile
7193-4040	Rail Hip Hinge – Low Profile
7193-4041	Small Rail Hip Hinge – High Profile
7193-4042	Small Rail Hip Hinge – Low Profile

Pre-Assembled Rail Arc Assembly

Cat. No.	Description
7193-4152	Rail Arc Assembly
7193-4155	Small Rail Arc Assembly
7193-4820	Small Rail Arc Assembly Short

Rail Arc

Cat. No.	Description
7193-4625	Rail Arc
7193-4654	Rail Arc Short
7193-4627	Small Rail Arc
7193-4628	Small Rail Arc Short
7193-4629	Rail Arc 180
7193-4630	Small Rail Arc 180

Rail to Arc Connection

Cat. No.	Description
7193-4624	Rail To Arc Connection – Threaded
7193-4626	Small Rail To Arc Connection – Threaded

Rail Arc Rotation Connection

Cat. No.	Description
7193-3338	Rail Arc Rotation Connection
7193-3943	Small Rail Arc Rotation Connection

Rail Arc Rotation End

Cat. No.	Description
7193-3339	Rail Arc Rotation End
7193-3944	Small Rail Arc Rotation End

Distraction/Compression Device

Cat. No.	Description
7193-4681	Rail Distractor Low Profile Right
7193-4682	Rail Distractor Low Profile Left
7193-3334	Rail Distractor 100mm
7193-3344	Rail Distractor 50mm

Miscellaneous

Cat. No.	Description
7193-3343	Rail Clamp Connector Extended
7193-3626	Rail Clamp Connector

Nuts and Bolts

Cat. No.	Description
7193-3598	6mm Rail Set Screw
7193-3599	6mm x 5mm Rail Bolt
7193-3600	6mm x 7mm Rail Bolt
7193-3602	6mm x 30mm Rail Bolt
7193-3603	6mm x 38mm Rail Bolt, Cannulated
7193-4045	6mm x 27mm Rail Bolt
7193-4044	6mm x 28mm Rail Bolt, Cannulated Rail Bolt
7193-3703	6mm Locking Nut

Instruments

Drill Bits

Cat. No.	Description
7193-3244	1.8mm Drill Tip Wires
7193-4029	4.8mm Short Drill For Half Pins
7193-3346	4.8mm Long Drill For Half Pins
7193-4030	3.8mm Short Drill For Half Pins
7193-4025	3.8mm Long Drill For Half Pins
7193-4031	3.2mm Short Drill For Half Pins
7193-4026	3.2 mm Long Drill For Half Pins

Cannulated Drill Bits

Cat. No.	Description
7193-4032	4.8mm/1.8mm Short Cannulated Drill For Half Pins
7193-3348	4.8mm/1.8mm Long Cannulated Drill For Half Pins
7193-4033	3.8mm/1.8mm Short Cannulated Drill For Half Pins
7193-4027	3.8mm/ 1.8mm Long Cannulated Drill For Half Pins
7193-4034	3.2mm/1.8mm Short Cannulated Drill For Half Pins
7193-4028	3.2mm/1.8mm Long Cannulated Drill For Half Pins

Drill Sleeves

Cat. No.	Description
7193-3699	4.8mm Drill Sleeve
7193-4018	4.8mm Long Drill Sleeve
7193-4021	3.8mm Drill Sleeve
7193-4019	3.8mm Long Drill Sleeve
7193-4022	3.2mm Drill Sleeve
7193-4020	3.2mm Long Drill Sleeve
7193-4023	1.8mm Long Drill Sleeve
7193-4024	1.8mm Drill Sleeve

Miscellaneous Instruments

Cat. No.	Description
10-2905	10mm Box Wrench
7105-3006	6mm Allen Wrench
7117-3543	Tear Drop Handle
7193-4035	T20 Short Angled Self-Ret Screwdriver Shaft
7193-4037	T20 Short Self-Ret Screwdriver Shaft
7193-4655	T20 Short Driver (jeweler)

Optional Extras for MRS

These are not included in the standard set configuration and must be ordered separately

Cat. No.	Description
7193-4658	Rail Collapse Limiter
7193-4659	Small Rail Collapse Limiter
7193-4844	Rail 226mm
7193-4845	Rail 339mm
7193-4846	Small Rail 226mm
7193-4847	Small Rail 339mm

References

1. Catagni MD, Maurizio. Atlas for the Insertion of Transosseous Wires and Half-Pins Ilizarov Method. Ed. Antonio Bianchi Maiocchi, MD. Milan: Medicalplastic srl, 2003

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