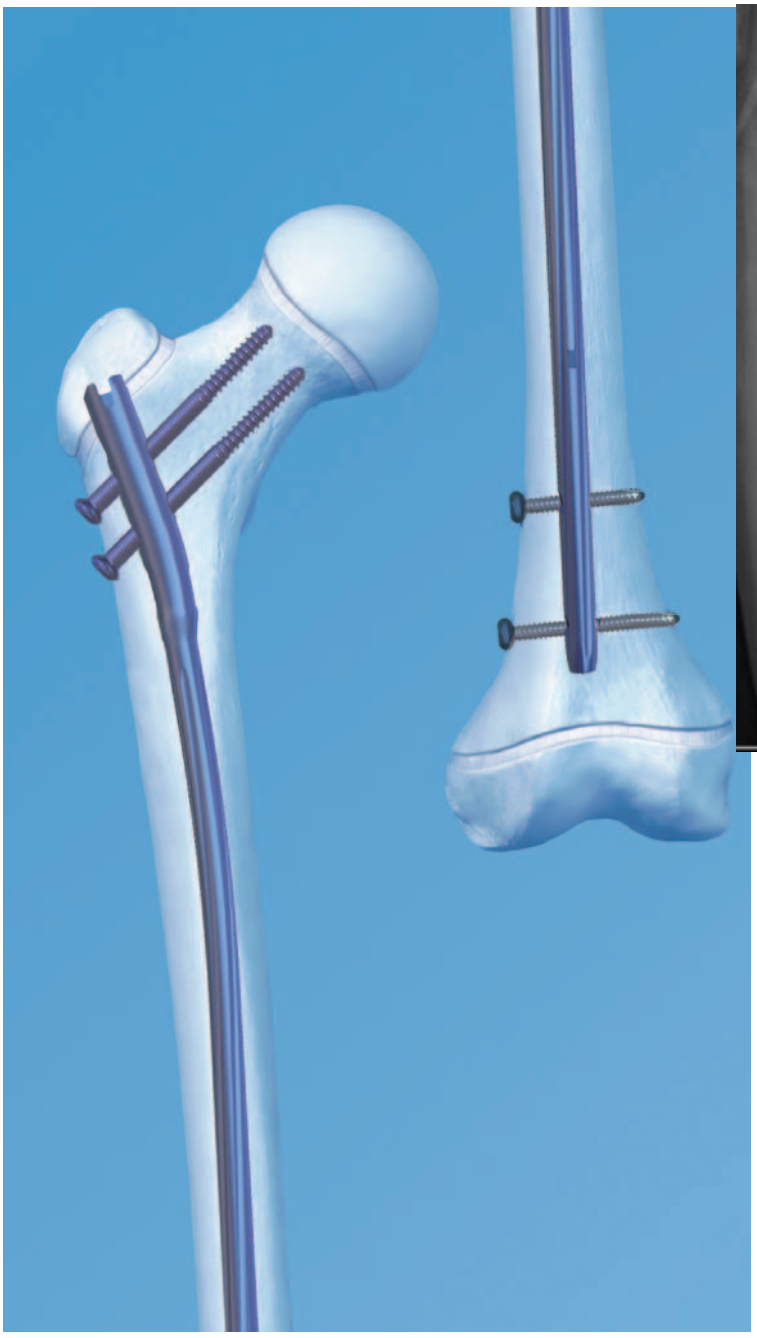
Technique Guide

ADO-S
Adolescent Lateral Femoral Nail.



Adolescent Lateral Femoral Nail System

Nail features
- Design accommodates a lateral entry site through the greater trochanter
- Anatomic nail design
- Titanium cannulated nail for reamed or unreamed techniques
- Lengths from 240 mm to 400 mm, in 20 mm increments
- Designed for use in patients where Titanium Elastic Nails are not large enough and the Lateral Femoral Nail for adults is too large
- 8.2 mm, 9 mm, and 10 mm diameter nails with 11 mm diameter proximal ends

Improved instrumentation
- Easy-to-use instrumentation facilitates the surgical procedure
- Ball-tip reaming rod can be removed through the nail and the insertion instruments, eliminating the need for an exchange tube
- Tailored to the needs of clinic (available as upgrade set for adolescents to Lateral Femoral System for adults or Standard Instrument Set for Adolescent Lateral Femoral Nail)

End caps
- Prevent ingrowth of tissue and facilitate nail extraction
- Self-retaining, T40 Stardrive recess for easy pickup and insertion of the end cap
- Cannulated for insertion over a guide wire
- 0 mm end cap sits flush with the nail
- 5 mm, 10 mm, and 15 mm end caps extend nail height if the nail is overinserted

4.0mm Locking Screws

- Double-lead thread for ease of insertion
- Thread closer to screw head provides better bone purchase in the near cortex and improved stability
- Titanium alloy* for improved mechanical and fatigue properties
- Self-tapping blunt tip
- Self-retaining T25 Stardrive recess allows improved torque transmission, increased resistance to stripping relative to a hex recess, and secure locking screw pickup
- 4.0 mm diameter

5.0 mm hip screws
- Lengths from 50 mm to 125 mm in 5 mm increments
- Self-retaining T25 Stardrive recess
- Titanium alloy*

Indications

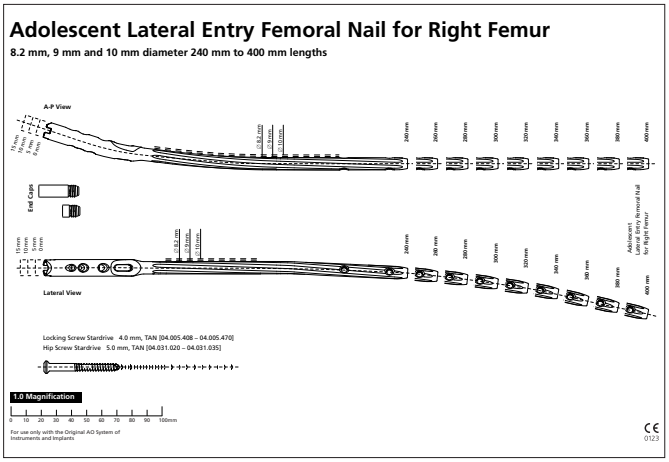
The Adolescent Lateral Femoral Nail is indicated for use in adolescent and small-stature adult patients to stabilize:
- Fractures of the femoral shaft
- Subtrochanteric fractures
- Ipsilateral neck / shaft fractures
- Impending pathologic fractures
- Nonunions and malunions

Preoperative Planning

Use the AO preoperative planner templates for the Adolescent Lateral Femoral Nail to esti-mate nail length and medullary canal diameter.

To estimate medullary canal diameter, place the template on the AP or lateral x-ray of the femur and measure the diameter of the medullary canal at the narrowest part that will contain the nail.

To estimate nail length, place the template on the AP x-ray of the uninjured femur and select the appropriate nail length based on patient anatomy. When selecting nail size, consider canal diameter, fracture pattern, patient anatomy and post-operative protocol.



Note: Templates are available in two sizes: actual size and 115% magnification in which the image is enlarged 15% to correspond to typical radiographic magnification; however, variations in magnification levels are common.

1

Position patient

Position the patient in the lateral decubitus or supine position on a fracture table or radiolucent operating table. Position the C-arm to allow visualization of the proximal femur in both the AP and lateral planes.

To facilitate access to the medullary canal, abduct the upper part of the body approximately 10°–15° to the contralateral side and adduct the affected limb by 10°–15°.

Affected leg
10°–15° adduction

2
Reduce fracture

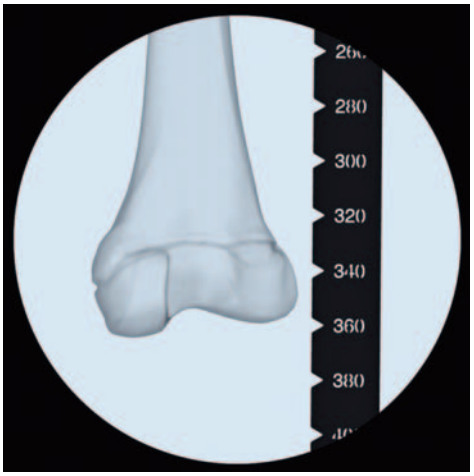
3
Confirm nail length

Instrument	
571674079	Ruler

The required nail length must be determined after reduction of the femoral fracture.

Position the C-arm for an AP view of the proximal femur. With long forceps, hold the ruler alongside the lateral thigh, parallel to and at the same level as the femur. Adjust the ruler until the proximal end is at the desired nail insertion depth. Mark the skin at the proximal end of the ruler.

Move the C-arm to the distal femur. Verify fracture reduction. Align the proximal end of the radiographic ruler to the skin mark, and take an AP image of the distal femur.



Read nail length directly from the ruler image, selecting the measurement proximal to the epiphysis, or at the chosen insertion depth.

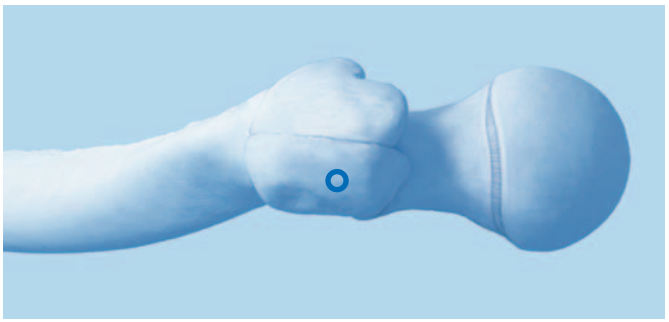
Note: It is recommended to treat the fracture with the longest nail possible without crossing the physis, taking into account patient anatomy or a previous implant. The distal end of the nail should be 15 mm from the physis. Back-hammering or dynamization to close a fracture gap must be taken into account when determining the nail length. A shorter nail should be chosen when back-hammering or dynamization is planned. The dynamic slot allows 7 mm of movement.

Opening the Femur

1 Approach

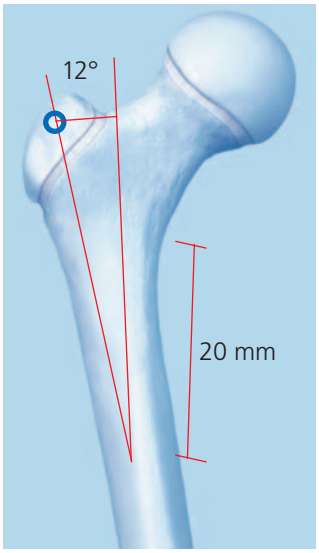
Palpate the posterior edge of the greater trochanter.

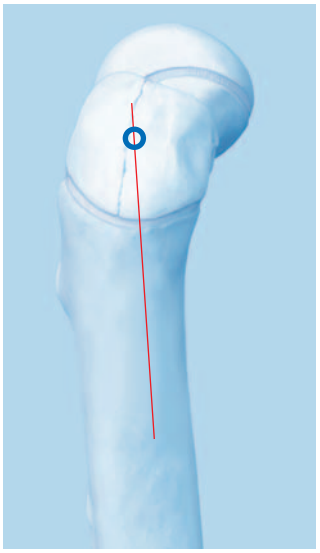
Make a 3 cm incision in line with the central axis of the intramedullary canal in the lateral view, and depending on the anatomy of the patient, 2–5 cm proximal to the tip of the greater trochanter.



2 Determine entry point

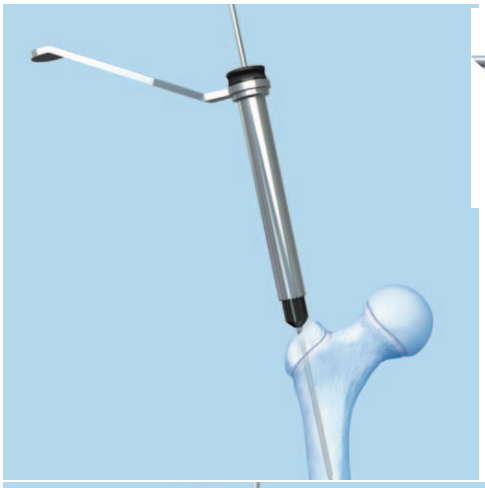
The insertion point is 12° lateral to the greater trochanter, as measured from a point 20 mm distal to the lesser trochanter.

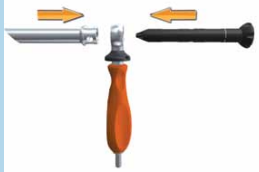




The entry point can also be described as lateral to the greater trochanter at the same level as the superior aspect of the base of the femoral neck (just above the piriformis fossa). This point can be found by extending a line horizontally from the base of the femoral neck to the lateral side of the femur.

3 Insert guide wire





Instruments	
571674075	Honeycomb
571674060	Entry Portal Tube
571674092	Entry Portal Handle
571674130	3.2mm x 343mm Brad Point Tip Guide Pin

Assemble the Honeycomb (571674075), Entry Handle (571674092) and Entry Portal Tube (571674060). The pieces will lock in place securely at either 0° or 180°

Remove the trocar. Insert the guide wire through the wire guide.

The guide wire must be inserted laterally at an angle of 12°to the center of the medullary canal. The tip of the guide wire should be centered in the medullary canal 20 mm distal to the lesser trochanter.

Verify that the guide wire position allows adequate clearance on the lateral side of the femur for the opening drill bit.

The guide wire is inserted with it centered in the lateral view.

4

Open proximal femur to medullary canal

Instruments

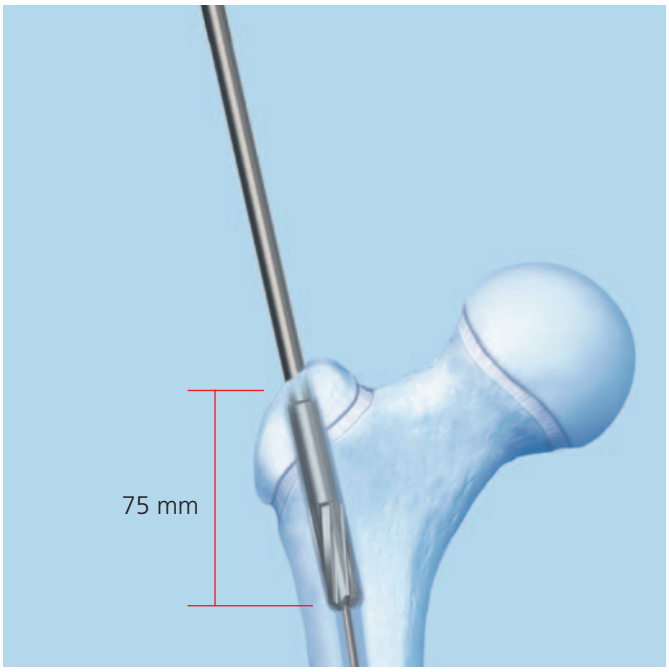
571674060	Entry Portal Tube
571631116	12.5mm Entry Reamer
571631627	2.5mm x 1000mm Ball Tip Guide Rod

Drill to open cortex

Drill through the protection sleeve. Drill the cortex until the drill bit stops in the sleeve.

Remove the guide wire, drill bit and protection sleeve.

Note: Dispose of the guide wire. Do not reuse.



If reaming the medullary canal, proceed to page 17.

Ream to open proximal femur

Insert the 2.5 mm guide rod. Using the flexible reamers, open the proximal femur to a depth of approximately 75 mm, starting with an 8.5 mm reamer and ending with a 13.0 mm reamer.

Alternative technique (with awl)

Alternative instruments

571675000	Awl ∅ 14.0/3.2 mm, cannulated
571674130	3.2mm x 343mm Brad Point Tip Guide Pin

Place the cannulated awl over the guide wire and open the medullary canal. Use a twisting motion to advance the awl to a depth of approximately 75 mm.

Remove the guide wire and awl.

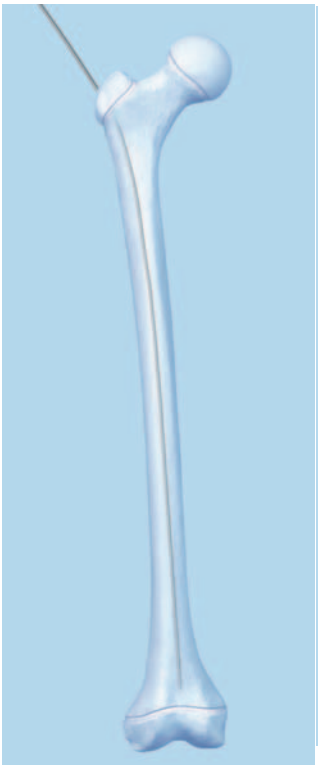
Note: After opening the proximal femur, dispose of the guide wire. Do not reuse.

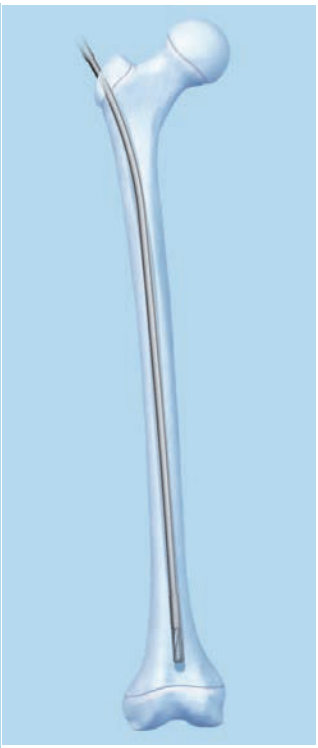
5

Ream medullary canal (optional)

Required set

Instruments	
03010093	Rod Pusher for Reaming Rod with Hexagonal Screwdriver ∅ 8.0 mm
571631627	2.5mm x 1000mm Ball Tip Guide Rod





Inserting the Nail

1

Assemble insertion instruments

Instruments

03010093	Rod Pusher for Reaming Rod with Hexagonal Screwdriver ∅ 8.0 mm
571631021	ADO-S Guide
571631140	Guide Bolt Wrench

Match the tangs on the handle to the notches in the Adolescent Lateral Femoral Nail.
Place the connecting screw into the insertion handle and thread it into the proximal nail end, using the 8 mm hexagonal screwdriver with spherical head.
The Adolescent Lateral Femoral Nails are labeled left or right on the proximal nail end.

Slide the connecting screw onto the reaming rod push rod. Slide the assembly through the insertion handle and match the tangs on the handle to the nail. Tighten using the hex on the reaming rod push rod.

Secure the assembly using the 8 mm hexagonal screwdriver with spherical head.

2
Insert nail

Instruments	
571675081	Canullated Impactor Medium
571674082	Slotted Hammer

Slide the connector into the groove on the insertion handle and secure it using the 11 mm ratchet wrench. If patient anatomy allows, attach the driving cap in the medial position.

Orient the insertion handle in an anterior position. Use the C-arm to verify fracture reduction. Insert the nail as far as possible.

The nail rotates approximately 90° during insertion. The insertion handle rotates from an anterior to a lateral position during insertion of the last one-third of the nail length. If the nail does not rotate to the lateral position, remove the nail and reinsert it with the handle slightly lateral to the sagittal plane.

Monitor nail passage across the fracture, and control in two planes to avoid malalignment.
If desired, insert the nail using light hammer blows.
Lock the head of the hammer in place by tightening the nut onto the threads located below the hammer head. Use the pin wrench if necessary. Strike the driving cap directly.
Optionally, the hammer guide can be threaded onto the driving cap and the hammer can be used as a slide hammer.
Loosen the nut from the threads located below the hammer head and secure the nut onto the threads located above the handle.

Note: Do not mount the aiming arm until the nail has been completely inserted.

3

Check proximal nail position

Insert the nail until it is at or below the femoral opening.

Check final nail position under image intensification in AP and lateral views.

If primary compression or secondary dynamization is planned, it is recommended to overinsert the nail by more than 7 mm, which corresponds to the maximum distance between the positions in static and dynamic modes.

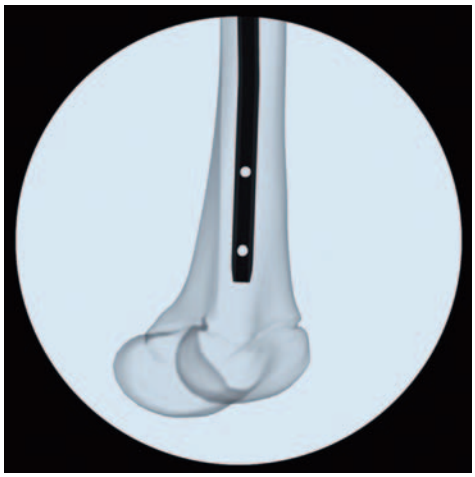
Note: The distance between the markings on the insertion handle is 5 mm and corresponds to the extensions of the end caps. This feature can be used for overinsertion of the nail.

4

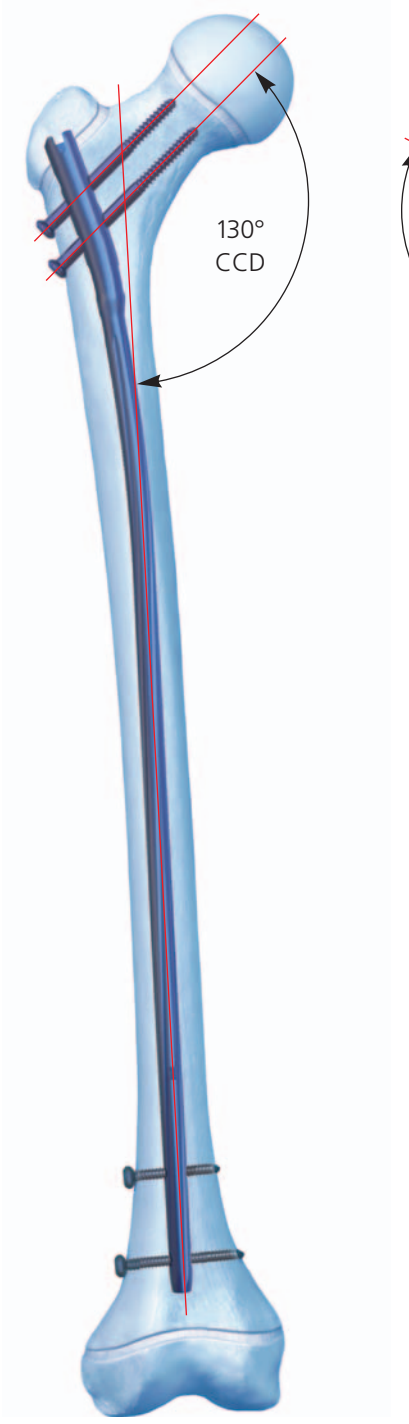
Check distal nail location

Use image intensification to ensure the nail is centered in both AP and lateral views. Verify fracture alignment.

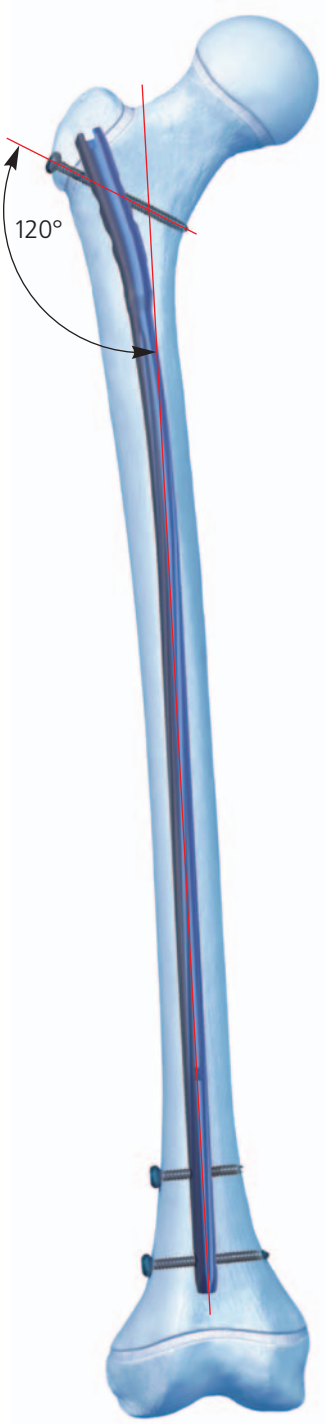
Remove the reaming rod.



Locking Options



Proximal locking with recon locking



Proximal locking with 120° locking screw

Proximal locking with dynamization

Proximal locking with static transverse locking screw

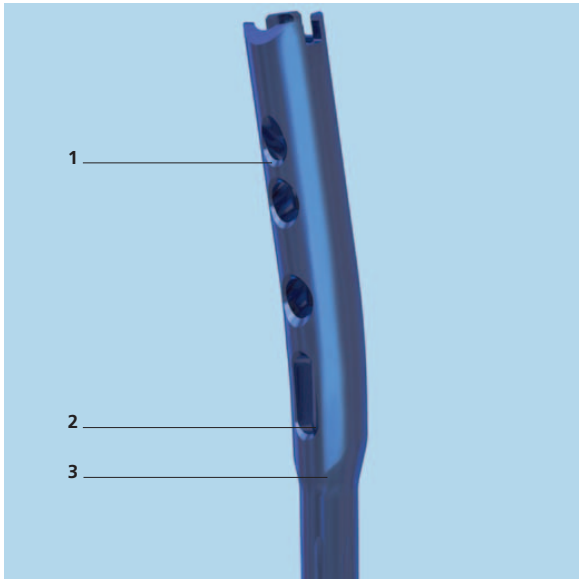
1

Choose locking option

For standard locking, three targeted proximal locking options are possible:

1 120° antegrade locking
2 Dynamic locking (LM)
3 Static locking (LM)

For immediate dynamization, insert one proximal locking screw through the dynamic slot. If dynamization may be required in the future, use the dynamic locking option with the 120° antegrade locking hole.



2

Mount aiming arm

Instruments

03010092	Screwdriver, hexagonal with spherical head
571631022	ADO-S Drop

Confirm that the nail is securely connected to the insertion handle using the 8 mm ball hex screwdriver. Mount the aiming arm to the insertion handle.

3

Insert trocar assembly

Instruments

571674072	4.0mm Drill Sleeve Trocar

Insert the three-part trocar assembly (protection sleeve, drill sleeve and trocar) through the desired hole in the aiming arm, make a stab incision and insert the trocar to the bone. Remove the trocar.
If using the 120° antegrade locking option, insert the trocar assembly through the hole labeled 120° on the insertion handle.
Note: Do not exert forces on the aiming arm, protection sleeve, drill sleeves or drill bits. Such force may prevent accurate targeting through the proximal locking holes and damage the drill bits.

4

Drill and determine locking screw length
Instrument

571631110 4.0mm Long Pilot Drill

Ensure that the drill sleeve is pressed firmly to the lateral cortex. Drill through both cortices until the tip of the drill bit just penetrates the far cortex.
Confirm drill bit position.
Ensure that the drill sleeve is pressed firmly to the lateral cortex and read the measurement from the calibrated drill bit at the back of the drill sleeve. This measurement corresponds to the appropriate length locking screw. Remove the drill bit and drill sleeve.

Alternative instrument

571631189 Screw Depth Gauge

After drilling both cortices, remove the drill bit and drill sleeve.

Disassemble the depth gauge into two parts: the outer sleeve and the measuring device with hook. Insert the measuring device into the protection sleeve. Make sure that the hook grasps the far cortex.

Ensure that the protection sleeve is firmly pressed against the lateral cortex.

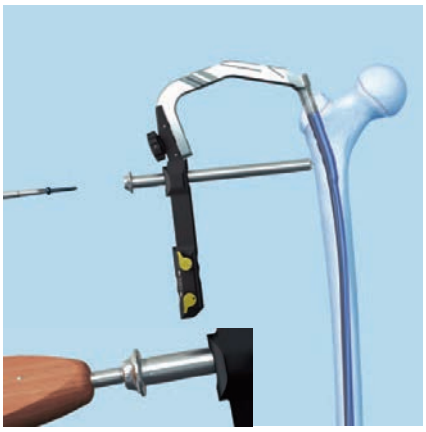
Read the measurement from the back of the protection sleeve, which indicates the appropriate length locking screw

5

Insert locking screw
Instrument

571631066 Medium Hexdriver

Insert the appropriate length locking screw through the pro-tection sleeve using the Medium Hexdriver. Verify locking screw length under image intensification.
The tip of the locking screw should not project more than 2 mm to 4 mm beyond the far cortex.
Note: A groove on the screwdriver provides a rough indication that the locking screw is fully inserted through the sleeve.
Repeat for a second proximal locking screw if desired.



Proximal Locking – Recon

1

Confirm nail position

In the AP view, adjust the nail insertion depth to ensure that the two hip screws can be placed into the femoral head.

Adjust nail position for correct anteversion.

2

Mount aiming arm
Instruments

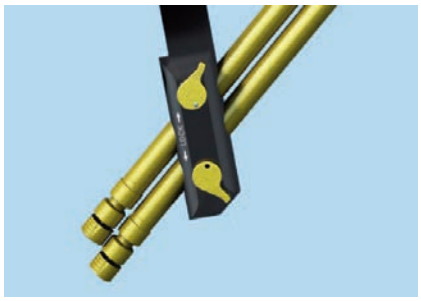
571631022	ADO-S Drop

Confirm that the nail is securely connected to the insertion handle using the screwdriver, hexagonal with spherical head

3

Insert guide wires for hip screws
Instruments

571631152	9.0mm Drill Sleeve
571674083	4.0mm Inner Drill Sleeve
571674130	3.2mm x 343mm Brad Point Tip Guide Pin



Insert both three-part trocar combinations (inner drill sleeve, drill sleeve, and trocar) through the aiming arm. Make a stab incision and insert the trocars to the bone. Following the arrows on the aiming arm, rotate the cams so that the protection sleeves are locked in the aiming arm. This will ensure proper measurement for the hip screws. Remove the inferior trocar.

In case of an arrested or closed physis, insert a guide wire into the femoral head, stopping approximately 5 mm from the subchondral bone.
If the physis in the femoral head is not fully arrested, stop the wire short of the physis. Check the guide wire placement radiographically in both planes.
Remove the superior trocar and repeat steps for second guide wire.
Note: Do not exert force on the aiming arm, protection sleeves, or drill sleeves. Such force may prevent accurate targeting through the locking holes.

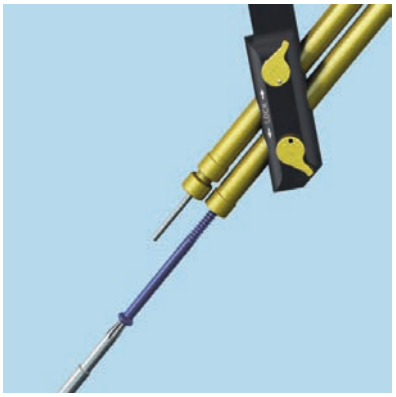
4

Determine length and drill for inferior hip screw
Instruments

571674130 3.2mm x 343mm Brad Point Tip Guide Pin
Measure for the inferior screw.
Ensure the protection sleeve is pressed firmly to the lateral cortex. Remove the wire guide and insert the specialty measuring device over the guide wire, into the protection sleeve, and to the bone. Read the length of the required hip screw directly on the measuring device.
Remove the measuring device and the inferior guide wire.
Attach the fixation sleeve to the stepped drill bit for the appropriate length screw.
Guide the stepped drill bit through the protection sleeve to the bone. Drill to the stop.

5

Insert inferior hip screw
Instrument



571631070 Long Hexdriver
571631066 Medium Hexdriver
Insert the appropriate hip screw through the protection sleeve into the femoral neck using the long Hexdriver.
Verify the position of the locking screw under image intensification in both planes.
A groove on the screwdriver indicates when the locking screw is fully inserted.

6

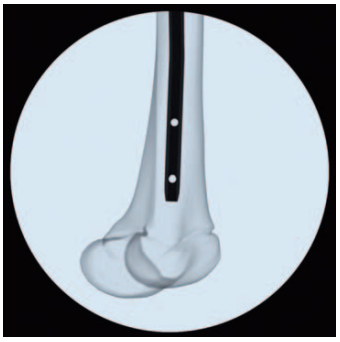
Insert superior hip screw

Repeat steps 3 through 5 for the superior hip screw.

Distal Locking

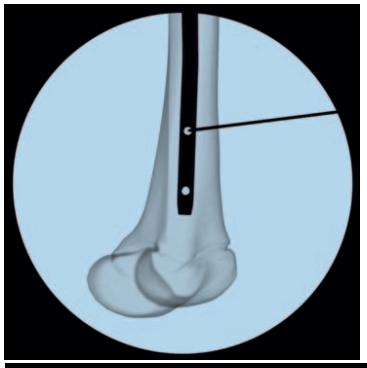
1

Distal locking
There are two transverse distal locking holes.



2

Align image
Check the reduction and correct alignment of the fragments and leg length before locking the nail.
Align the C-arm with the hole in the nail closest to the fracture until a perfect circle is visible in the center of the screen.



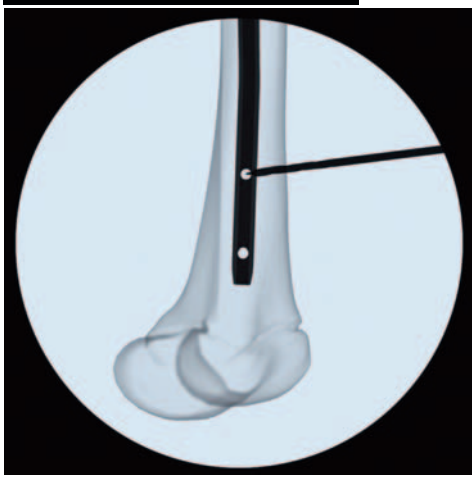
3

Determine incision point
Place a Kirschner wire on the skin over the center of the hole to mark the incision point and make a stab incision.

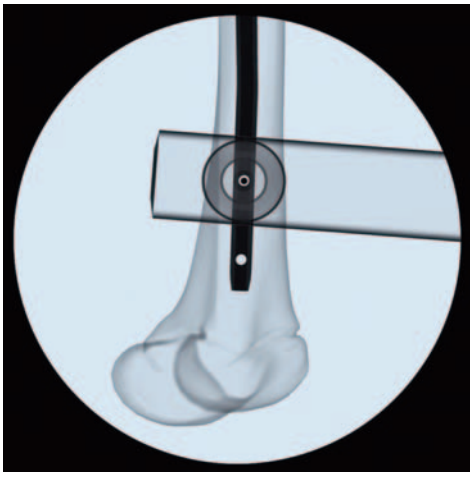
4

Drill
Standard locking with locking screws
Instrument

571631117 4.0mm Short Drill



If using the standard freehand technique, insert the tip of the drill bit through the incision and down to the bone.
Incline the drive so that the tip of the drill bit is centered over the locking hole. Hold the drill bit in this position and drill through both cortices.
Technique tip: For greater drill bit control, discontinue drill power after perforating the near cortex. Manually guide the drill bit through the nail before resuming power to drill the far cortex.

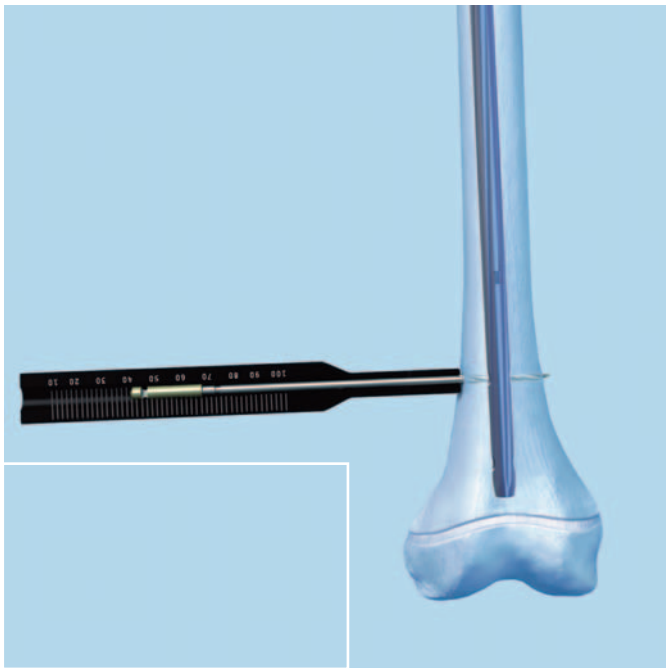


5

Determine locking screw length
Instruments

571631117	4.0mm Short Drill

Stop drilling immediately after penetrating the far cortex.
Disassemble the power drive or radiolucent drive from the drill bit.
Ensure the correct position of the drill bit in regard to the far cortex of the femur.
Place the direct measuring device onto the drill bit. Read the graduation on the measuring device at the end of the drill bit. This corresponds to the appropriate locking screw length.
Note: Drill bit location with respect to the far cortex is critical for measuring the appropriate locking screw length.



End Cap Insertion

1

Insert end cap

Instruments	
03010110	Screwdriver Stardrive, T40, cannulated length 300 mm

Choose an end cap with the appropriate extension; 0 mm if the nail is not overinserted, 5 mm, 10 mm or 15 mm if the nail is overinserted.

The end caps are cannulated for use over a guide wire, if necessary.

Remove the nail insertion instruments.

Optionally, for insertion of the 0 mm end cap, remove the connecting screw only. The insertion handle can remain to help align the end cap to the top of the nail. The 0 mm end cap fits through the barrel of the insertion handle.

Insert the guide wire into the proximal end of the nail.

Engage the end cap with the cannulated screwdriver by exerting axial pressure. To prevent cross-threading, align the end cap with the nail axis and turn the end cap counterclockwise, until the thread of the end cap aligns with that of the nail.

Turn the end cap clockwise to thread the end cap into the nail.

Remove the guide wire and screwdriver.

Implant Removal

1

Remove end cap and locking screws

Instruments	
03010107	Screwdriver Stardrive, T25, length 330 mm
03010110	Screwdriver Stardrive, T40, cannulated, length 300 mm

Implant removal is an optional procedure.

Clear the Stardrive recess of the end cap and the locking implants of any ingrown tissue. Insert the guide wire for easy alignment of the screwdriver in the cannulated end cap. Remove the end cap using the T40 screwdriver.

Remove all locking screws except one proximal locking screw.

2

Attach extraction screw and hammer guide

Instruments	
03010107	Screwdriver Stardrive, T25, length 330 mm
571631320	Nail Extractor
571674082	Slotted Hammer

Before removing the final locking screw, screw the extraction screw into the nail and tighten it. The locking screw will prevent nail rotation as the extraction screw is tightened.

Attach the hammer guide to the extraction screw.

Remove the remaining locking screw with the screwdriver.

3

Remove nail

Instrument

Extract the nail by applying gentle blows with the hammer.

Note: The nail will rotate about 90°, similar to the movement during the insertion.

Implants

Adolescent Lateral Femoral Nail
- Available for left or right femur
- Anatomic nail design based on a femoral canal tracing study[3]

Material
- Titanium-6% aluminum-7% niobium alloy

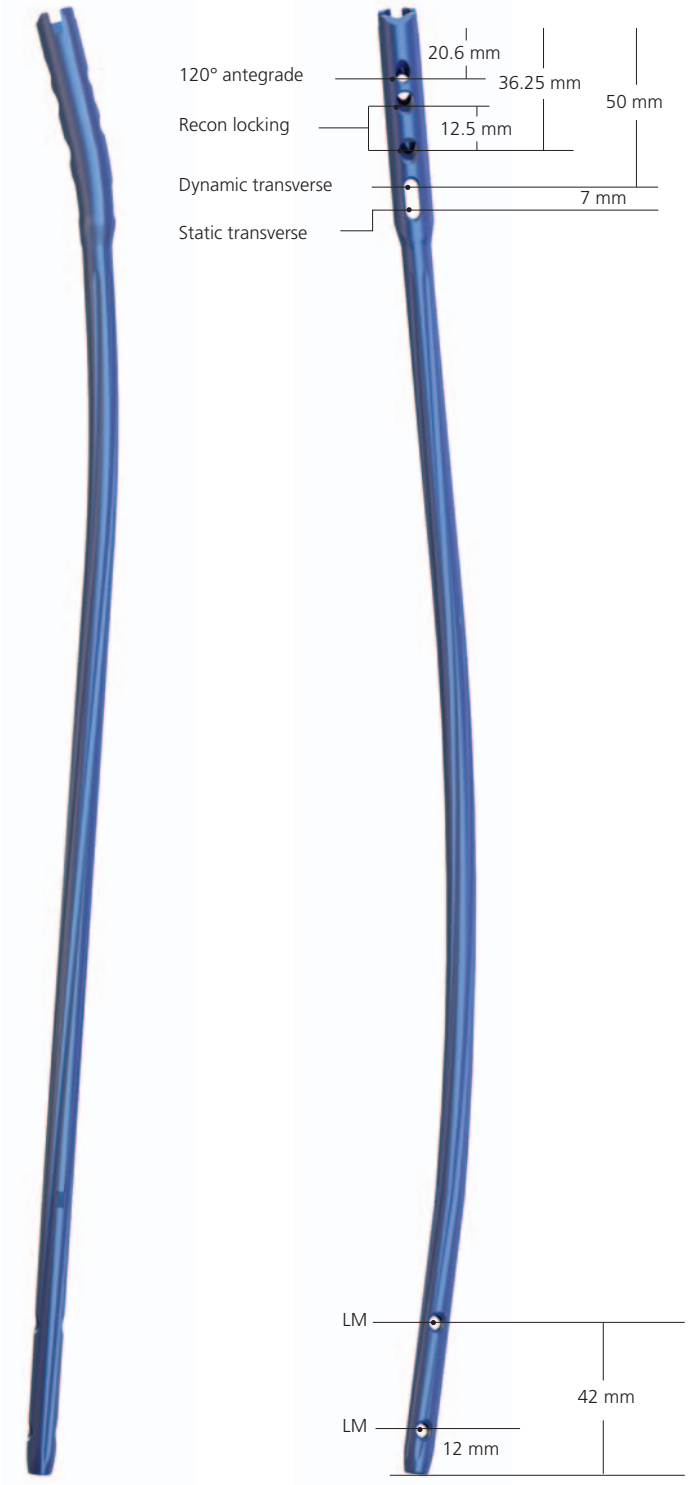
Diameters
- 8.2 mm, cannulated
- 9.0 mm, cannulated
- 10.0 mm, cannulated

Lengths
- 240 mm through 400 mm in 20 mm increments

Cross Section
- Helical fluted

Proximal locking
- Dynamization slot (LM)
- Static transverse locking hole (LM)
- 120° antegrade locking
- Two recon locking holes

Distal locking
- Two transverse locking holes (LM)

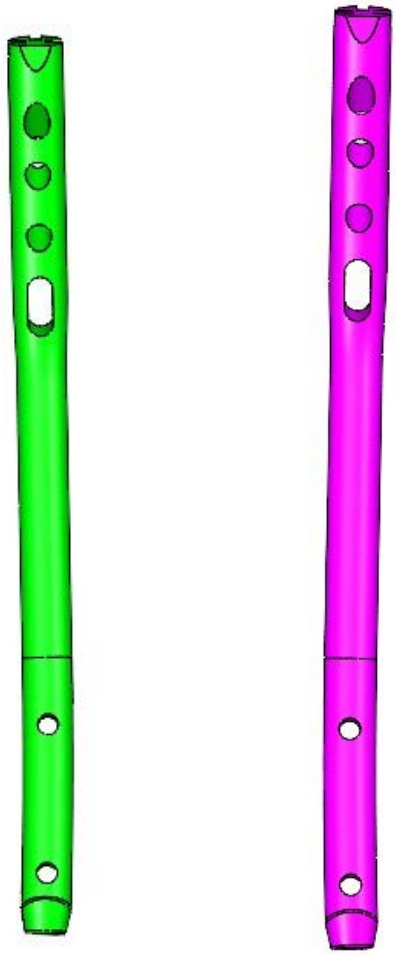


ADO-S

Length (mm)	∅ mm	Right	Left
240	8.2	4004018224	4004028224
260	8.2	4004018226	4004028226
280	8.2	4004018228	4004028228
300	8.2	4004018230	4004028230
320	8.2	4004018232	4004028232
340	8.2	4004018234	4004028234
360	8.2	4004018236	4004028236
380	8.2	4004018238	4004028238
400	8.2	4004018240	4004028240

Length (mm)	∅ mm	Right	Left
240	9	4004010924	4004020924
260	9	4004010926	4004020926
280	9	4004010928	4004020928
300	9	4004010930	4004020930
320	9	4004010932	4004020932
340	9	4004010934	4004020934
360	9	4004010936	4004020936
380	9	4004010938	4004020938
400	9	4004010940	4004020940

Length (mm)	∅ mm	Right	Left
240	10	4004011024	4004021024
260	10	4004011026	4004021026
280	10	4004011028	4004021028
300	10	4004011030	4004021030
320	10	4004011032	4004021032
340	10	4004011034	4004021034
360	10	4004011036	4004021036
380	10	4004011038	4004021038
400	10	4004011040	4004021040



ADO-S End Cap
∅ 8.2 mm, Titanium Alloy (TAN), (dark purple)*
– Titanium alloy**
– Protect nail threads from tissue ingrowth
– Cannulated to allow insertion over a guide wire
– T40 Stardrive recess

0 mm: Sits flush with end of nail

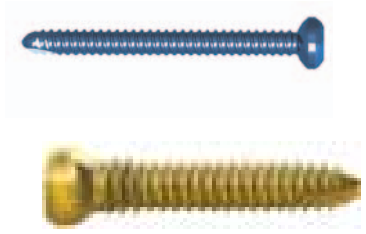
5 mm, 10 mm and 15 mm extensions: Extend nail height if nail is overinserted

	Extension (mm)
1004031000	0
1004031005	5
1004031010	10
1004031015	15

Hip Screw Stardrive ∅ 5.0 mm, self-tapping, Titanium Alloy (TAN), (dark purple)*
– Titanium alloy**
– Lengths: 50 mm – 125 mm (5 mm increments)
– 3.2 mm core diameter
– Partially threaded
– Self-tapping, blunt tip
– T25 Stardrive recess for improved torque transmission and self-retention on screwdriver

	Length (mm)		Length (mm)
1004031020	50	1004031028	90
1004031021	55	1004031029	95
1004031022	60	1004031030	100
1004031023	65	1004031031	105
1004031024	70	1004031032	110
1004031025	75	1004031033	115
1004031026	80	1004031034	120
1004031027	85	1004031035	125

Locking Screw Stardrive ∅ 4.0 mm, for Medullary Nails, Titanium Alloy (TAN), (dark blue)*
– Titanium alloy**
– Lengths: 18 mm – 80 mm (2 mm increments)
– 3.3 mm core diameter
– Fully threaded
– Self-tapping, blunt tip
– T25 Stardrive recess for improved torque transmission and self-retention on screwdriver



	Length (mm)		
1034404020	20	1034404050	50
1034404025	25	1034404055	55
1034404030	30	1034404060	60
1034404035	35	1034404065	65
1034404040	40	1034404070	70
1034404045	45	1034404075	75
		1034404080	80

*Available nonsterile or sterile-packed. Add "S" to catalog number to order sterile product.
**Titanium-6% aluminum-7% niobium alloy

ADO-S Guide
Cat. No. 571631021

ADO-S Guide Bolt
Cat. No. 571631026

Cannulated Impactor - Medium
Cat. No. 571675081

Slotted Hammer
Cat. No.571674082

Nail Extractor
Cat. No. 571631320

Guide Bolt Wrench
Cat. No. 571631140

ADO-S Drop
Cat. No.571631022

9.0mm Drill Sleeve
Cat. No. 571631152

4.0mm Inner Drill Sleeve
Cat. No. 571674083

Screw Depth Gauge
Cat. No. 571631189

Screw Length Sleeve
Cat. No. 571674085

Screwdriver Release
Cat. No. 571674084

Medium Hexdriver
Cat. No. 571631066

Long Hexdriver*
Cat. No.571631070

Short Hexdriver
Cat. No.571631068

4.0mm Long Pilot Drill**
Cat. No. 571631110

4.0mm Short Drill*
Cat. No. 571631117

2.5mm x 1000mm Ball Tip Guide Rod Cat. No. 571631627

3.2mm x 343mm Brad Point Tip Guide Pin
Cat. No. 571674130

Instruments

Ruler
Cat. No.571674079

Honeycomb
Cat. No.571674075

Entry Portal Tube
Cat. No.571674060

Entry Portal Handle
Cat. No. 571674092

12.5mm Entry Reamer
Cat. No. 571631116

14mm Channel Reamer
Cat. No. 571631023

T-handle
Cat. No.571674076

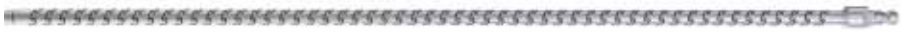
3.2mm T-handle Trocar
Cat. No. 571674074

Gripper
Cat. No 571674080

Cannulated Awl
Cat. No. 571675000

Obturator
Cat. No 571674078

Reamer Heads
Cat. No.571118231 to 571118256*



Flexible Reamer Shaft
Cat. No.571118200

Reducer
Cat. No.571674077

Set Screwdriver
Cat. No.571665014

Adolescent Lateral Femoral Nail Instrument Set