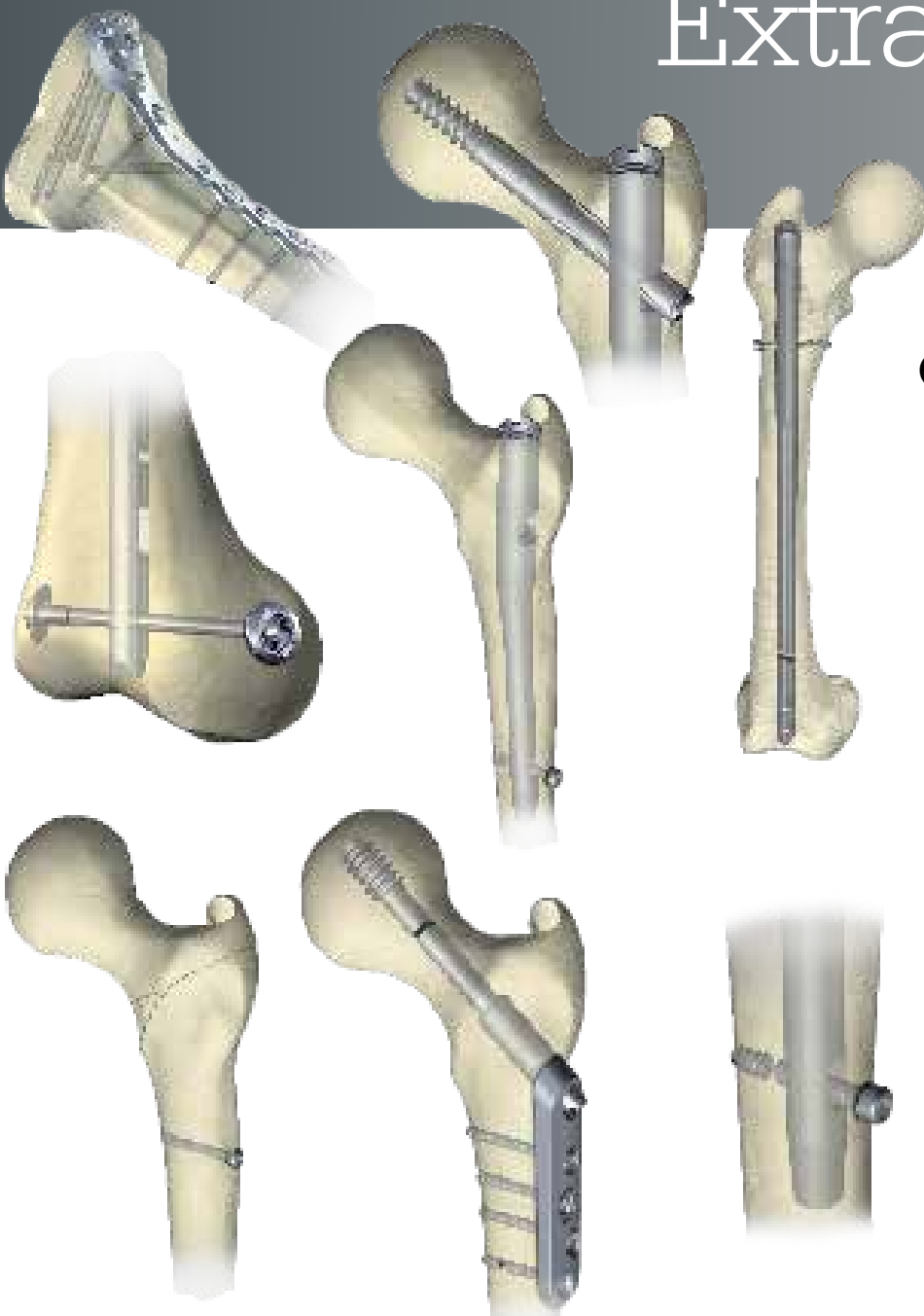


Implant Extraction Set

Operative technique

Module one & two



Implant Extraction Set

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This publication sets forth detailed recommended procedures for using Stryker devices and instruments. It offers guidance that you should heed, but, as with any such technical guide, each surgeon must consider the particular needs of each patient and make appropriate adjustments when and as required.

A workshop training is recommended prior to performing your first surgery.

WARNING

Follow the instructions provided in our cleaning and sterilization guide (OT-RG-1). All non-sterile devices must be cleaned and sterilized before use.

WARNING

Multicomponent instruments must be disassembled for cleaning. Please refer to the corresponding assembly/ disassembly instructions.

Please remember that the compatibility of different product systems has not been tested unless specified otherwise in the product labeling..

Consult Instructions for Use (www.ifu.stryker.com) for a complete list of potential adverse effects, contraindications, warnings and precautions.

WARNING

- The surgeon must warn patients of surgical risks, and make them aware of possible adverse effects.
- The patient should be warned that the device cannot and does not replicate a normal healthy bone, that the device can break or become damaged as a result of strenuous activity or trauma, malunion or nonunion.
- The surgeon must warn the patient that the device has a finite expected service life and may need to be removed at some time in the future.

Precautions and contraindications

Precautions

Stryker Systems have not been evaluated for safety and compatibility in Magnetic Resonance (MR) environment and have not been tested for heating or migration in the MR environment, unless specified otherwise on the product labels and/or respective operative technique.

Contraindications

There are no absolute contraindications for use. The Stryker Generic Instruments are general surgical instruments intended to be used to support orthopedic and/or trauma procedures.

The surgeon's education, training and professional judgment must be relied upon to choose the most appropriate device for the respective surgical procedure.

Cold welded screws require cutting tools for metal to remove the screws. The extraction set does not feature carbide drills or other cutting tools to remove cold welded screws.

Stryker can only recommend use of the extractor instruments with its own products.

Product description

Instrument	Stryker systems
Teardrop handle (AO-medium)	For AO-medium bits: <ul style="list-style-type: none"> Screwdriver bits Crown drills (Trephines) Conical extractors male/female
Screwdriver bit 2.5mm (conical)	Screws: <ul style="list-style-type: none"> T2 humeral compression AsnisIII 4.0mm Numelock 4.5mm ISO 2.7mm ISO 3.5mm ISO 4.0mm
Screwdriver bit 3.5mm (conical)	Screws: <ul style="list-style-type: none"> 4mm and 5mm locking screws (T2, S2, Gamma3, IC etc.) T2/S2 end caps T2/S2 femur/tibia compression screws TLN all screws 3.7mm and 4.6mm locking screws Grosse & Kempf AsnisIII 5.0mm Numelock 6.5mm ISO 4.5mm ISO 6.5mm
Screwdriver bit 4mm (conical)	Screws: <ul style="list-style-type: none"> Set Screw for Gamma, Gamma3, Gamma Ti, Dyax-A, AP, AP-J; Proximal Plug for Gamma, Gamma Ti, Dyax, Dyax-A, AP, AP-J
Screwdriver bit 5mm	Screws: <ul style="list-style-type: none"> 6.28mm locking screws AsnisIII 6.5mm and 8.0mm T2, S2, Recon lag screws
Screwdriver bit 6.3mm	Screws: <ul style="list-style-type: none"> T2, S2 condyle screws
Screwdriver bit 8mm	Screws: <ul style="list-style-type: none"> Grosse & Kempf, SCN condyle screws Gamma3 end cap
Screwdriver bit T 8 (Torx)	Screws: <ul style="list-style-type: none"> AxSOS 3.0mm
Screwdriver bit T 15 (Torx)	Screws: <ul style="list-style-type: none"> AxSOS 4.0mm
Screwdriver bit T 20 (Torx)	Screws: <ul style="list-style-type: none"> Alta 3.7mm locking screws AxSOS 5.0mm
Screwdriver bit T 25 (Torx)	Screws: <ul style="list-style-type: none"> Alta 5mm locking screws, lag screws and caps
Conical extractor, male, left hand, small (left hand driving) for diameter range 1–2.5mm	Screws: <ul style="list-style-type: none"> AsnisIII 4.0mm
Conical extractor, male, left hand, 2.5mm (left hand driving, for damaged hex 2.5mm and diameter range 2.3–4mm)	Screws: <ul style="list-style-type: none"> T2 Humerus compression AsnisIII 4.0mm ISO 2.7mm ISO 3.5mm ISO 4.0mm
Conical extractor, male, left hand, 3.5mm (left hand driving, for damaged hex 3.5mm and diameter range 3.3–4mm)	Screws: <ul style="list-style-type: none"> 4mm and 5mm locking screws (T2, S2, Gamma3, IC etc.) T2, S2 end caps T2, S2 femur/tibia compression screws TLN all screws 3.7mm and 4.6mm locking screws Grosse & Kempf AsnisIII 5.0mm ISO 4.5mm ISO 6.5mm
Conical extractor, male, left hand, 4mm (left hand driving, for damaged hex 4mm and diameter range 3.8–4.4mm)	Screws: <ul style="list-style-type: none"> Set Screw for Gamma, Gamma3, Gamma Ti, Dyax-A, AP, AP-J Proximal Plug for Gamma, Gamma Ti, Dyax, Dyax-A, AP, AP-J
Conical extractor, male, left hand, 5mm (left hand driving, for damaged hex 5mm and diameter range 4.8–5.4mm)	Screws: <ul style="list-style-type: none"> 6.28mm locking screws AsnisIII 6.5mm and 8.0mm T2, S2 Recon lag screws
Crown drill 3 (bone drill for broken screws with diameter range \leq 3mm)	N/A
Crown drill 4 (bone drill for broken screws with diameter range \leq 4mm)	N/A

Product description

Instrument	Stryker systems
Crown drill 5 (bone drill for broken screws with diameter range $\leq 5\text{mm}$)	N/A
Crown drill 6.5 (bone drill for broken screws with diameter range $\leq 6.5\text{mm}$)	N/A
Crown drill 8 (bone drill for broken screws with diameter range $\leq 8\text{mm}$)	N/A
Crown drill 10 (bone drill for broken screws with diameter range $\leq 10\text{mm}$)	N/A
Crown drill 12 (bone drill for broken screws with diameter range $\leq 12\text{mm}$)	N/A
Conical Extractor, female, left hand, 3 (left hand driving, for broken screws with diameter range $\leq 3\text{mm}$)	<ul style="list-style-type: none"> ISO 2.7mm screws, Ulna locking screws
Conical Extractor, female, left hand, 4 (left hand driving, for broken screws with diameter range $\leq 4\text{mm}$)	<ul style="list-style-type: none"> T2, S2 4mm locking screws, Grosse & Kempf 3.7mm locking screws ISO screws 3.5mm and 4.0mm, Alta 3.7mm locking screws
Conical Extractor, female, left hand, 5 (left hand driving, for broken screws with diameter range $\leq 5\text{mm}$)	<ul style="list-style-type: none"> 5mm locking screws (T2, S2, Gamma3, IC, Alta etc.) ISO screws 4.5
Conical Extractor, female, left hand, 6.3 (left hand driving, for broken screws with diameter range $\leq 6.3\text{mm}$)	<ul style="list-style-type: none"> 6.28mm locking screws
Teardrop Handle, AO-Medium, cannulated (including rotation rod)	For AO-medium bits: Spreading screwdriver
Spreading Screwdriver Bit 5mm	<ul style="list-style-type: none"> 6.28mm locking screws AsnisIII 6.5mm and 8.0mm T2, S2 Recon lag screws
Spreading Screwdriver Bit 6.3mm	<ul style="list-style-type: none"> T2, S2 condyle screws
Spreading Screwdriver Bit 8mm	<ul style="list-style-type: none"> Grosse & Kempf, SCN condyle screws Gamma3 end cap
Punches 2.7mm	<ul style="list-style-type: none"> For broken screws with diameter range $\leq 3\text{mm}$
Punches 3.7mm	<ul style="list-style-type: none"> For broken screws with diameter range from 3–4mm
Punches 5mm	<ul style="list-style-type: none"> For broken screws with diameter range $>4\text{mm}$
Forceps, (small)	<ul style="list-style-type: none"> For damaged screws, broken screws with diameter $<9\text{mm}$
Forceps, (large)	<ul style="list-style-type: none"> For damaged screws, broken screws with diameter $>9\text{mm}$
Conical Extraction Rod 6mm	Extraction of nails using proximal nail end: T2 humeral
Conical Extraction Rod 8mm	Extraction of nails using proximal nail end: <ul style="list-style-type: none"> Humerus Seidel, T2 proximal humeral, T2 humeral, Alta humeral, TLN (M7), SCN (M8), Alta femoral & tibial, Zickel, IC femoral & tibial, T2, S2 tibial & femoral antegrade/retrograde
Conical Extraction Rod 10mm	Extraction of nails for the proximal nail end: <ul style="list-style-type: none"> Gamma3 All G/K nails (Fem, Tib, SFN, STN, SCN)
Conical Extraction Rod 13mm	Extraction of nails using proximal nail end: <ul style="list-style-type: none"> Gamma, Dyax, Gamma APJ
Extraction Hook, (small)	Extraction of cannulated nails with inner diameter 4.6-5.5mm: <ul style="list-style-type: none"> G&K, Gamma3 (Ti), Seidel, IC, SCN, TLN, T2/S2
Extraction Hook, (large)	Extraction of cannulated nails with inner diameter $\geq 5.6\text{mm}$: <ul style="list-style-type: none"> Gamma, Gamma3 (StSt), Dyax, Dyax-A, AP, AP-J, G&K, IC, SCN, Kuentscher Nails
Extraction Instrument Lag Screw	<ul style="list-style-type: none"> Consisting of handle and extraction rod To be used with the threaded rod and nut for the lag screw extraction
Nut	<ul style="list-style-type: none"> Fastens the extraction rod to the threaded rods and connectors
Threaded Rod M7	<ul style="list-style-type: none"> Threaded into lag screw (Gamma/Dyax-A), fastens connection between extraction rod and connectors
Threaded Rod M5	<ul style="list-style-type: none"> Threaded into lag screw (Omega), fastens connection between extraction rod and connectors
Threaded Rod M4	<ul style="list-style-type: none"> Threaded into lag screw (OHS/OCS), fastens connection between extraction rod and connectors
Spanner SW17	<ul style="list-style-type: none"> Serves for larger torque transmission of the extraction instrument lag screw
Connector, Gamma	<ul style="list-style-type: none"> Fits onto the specific lag screws, over the threaded rod and connects with the extraction instrument lag screw
Connector, Gamma U-Blade	
Connector, Gamma3 U-Blade	
Connector, Dyax	
Connector, Gamma3	
Connector, Omega and Omega Plus	
Connector, OHS/OCS	



Implants can be subject to change. This can impact the compatibility of extraction instruments. It is therefore required to start the implant extraction with a complete extraction set in order to have access to alternative instruments.

Operative technique

Operative technique

Implant Extraction Set

Screws

After identifying screw type and diameter, extract the screws with the appropriate screwdriver bit by turning the screwdriver counter-clockwise.

To avoid damaging the screw, make sure the screwdriver is in line with the screw axis and fully inserted.

Screws with reverse cutting flutes (e.g. AsnisIII screws, T2 recon lag screws) can be removed using the spreading screwdriver bits and cannulated handle. For spreading screwdriver instructions, see condyle screw removal below.

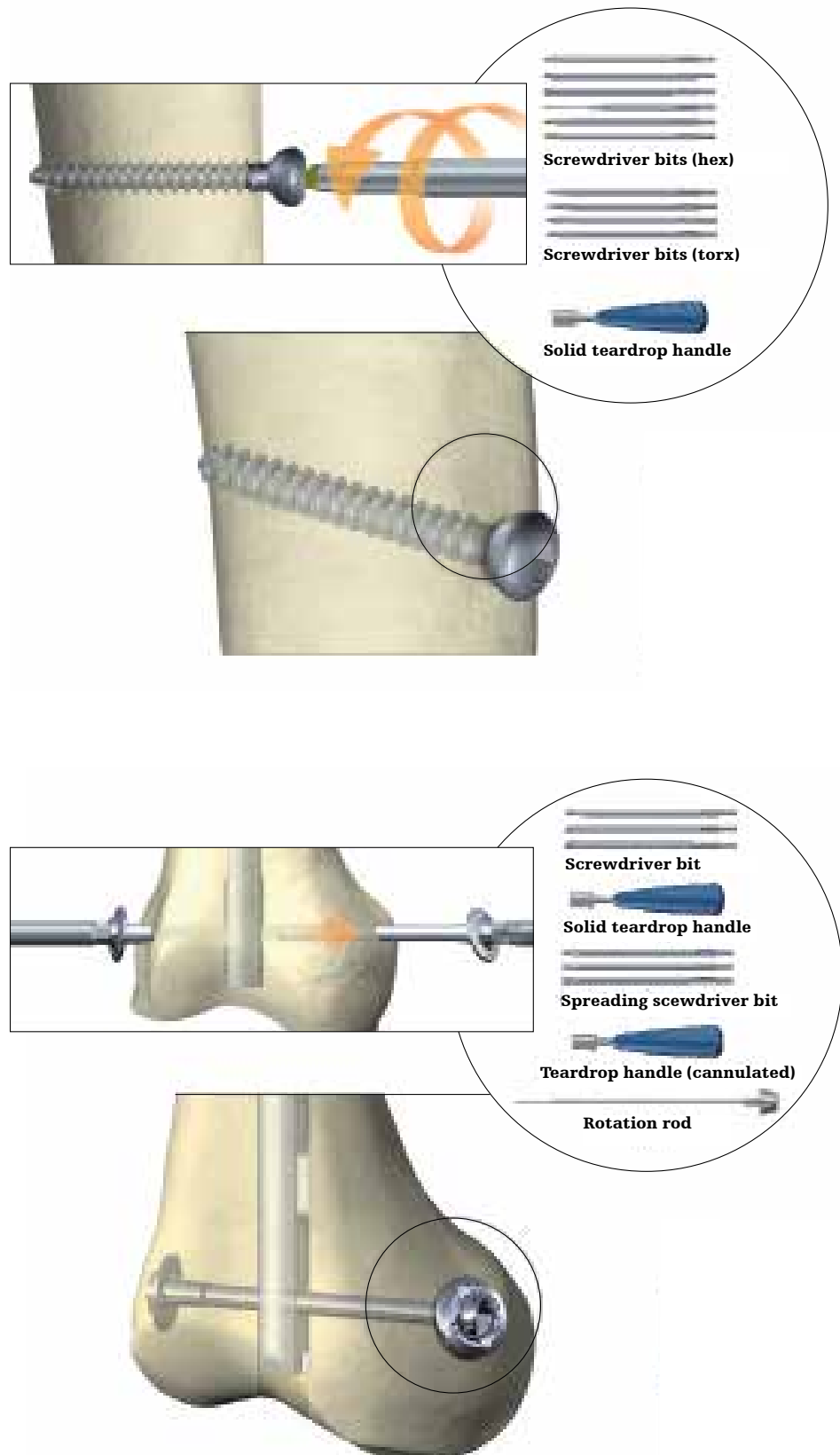
Stryker offers a wide variety of hex (standard, conical, spreading,) and torx screwdrivers. Check the available type and size on the ordering information page.

For condyle screw removal, assemble the necessary screwdrivers: The 6.3mm hex screwdriver bit with the solid teardrop handle (for the nut) and the 6.3mm hex spreading screwdriver bit with the cannulated teardrop handle (in combination with the rotation rod) as shown in the illustration.

Make sure to tighten the rotation rod until the tip of the screwdriver spreads firmly and fully into the screw head.

A screwdriver needs to be inserted from each side of the condyle screw using one to stabilize the nut and the spreading screwdriver to loosen and extract the condyle screw. If necessary, use the spreading screwdriver to remove the nut in a second step.

The condyle screw is extracted by turning the screwdriver in a counter-clockwise direction.



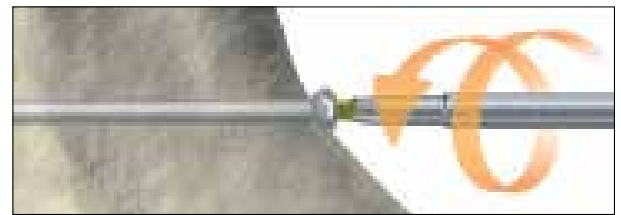
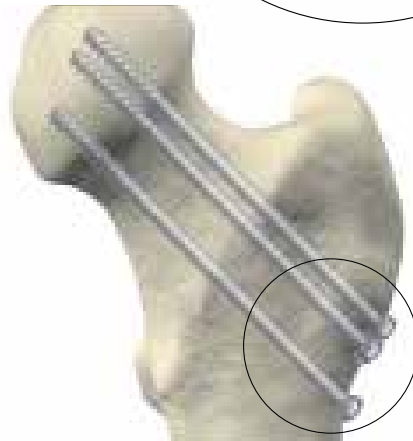
Operative technique

Never use a worn or damaged screwdriver to remove screws. Reverse cutting flutes are present for this reason. It is recommended that the solid screwdriver be used for screw removal. The solid screwdriver applies greater torque and may reduce the potential for damaging the hexagonal tip on the screwdriver. Strong bone formation around the implant is possible in the pediatric cases using partially threaded screws. This may lead to difficult implant removal with an increased risk of screw head breakage or stripping of screw hexagonal head.



If the oblique direction of the screw (approximately 135° to the shaft) is not changed, then the reverse flutes are not in an optimal position to cut the cortex. If the screw head is placed under traction and the angle of the screw is brought to a perpendicular position relative to the bone, cutting the cortex will progress and facilitate screw removal.

Be sure to use the solid screwdriver in combination with the appropriate sized screwdriver bits or the cannulated screwdriver with the spreading screwdriver bits. Proceed as described above.

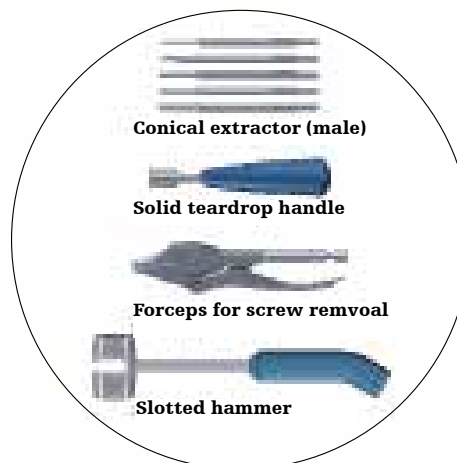


Damaged screw head

Screw stripping is commonly caused by slippage of a screwdriver that is not correctly aligned with the screw axis and/or fully seated. This may occur either during insertion or, more commonly, during attempted screw removal.

The appropriate sized conical extractor (based on the size of the screw head hex/torx) is inserted firmly into the screw head. Lightly tapping the conical extractor with a slotted hammer may be tried if purchase is not initially obtained with manual pressure. It is at the surgeon's discretion if and how hard to use the hammer.

Assemble the selected conical extractor (male) with the teardrop-handle and turn it counter-clockwise while applying pressure in line with the



screw axis, extracting the screw at the same time. If the screw does not come completely out, the forceps can be used to complete the extraction.

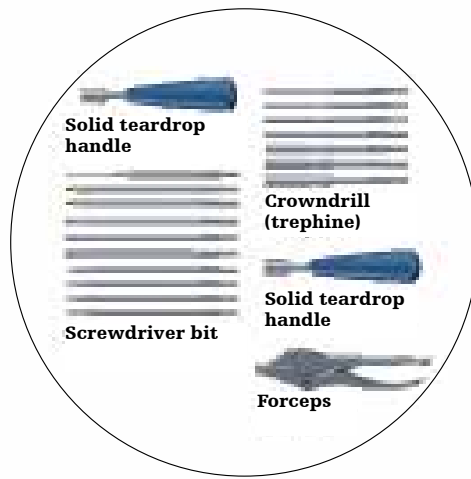


Technical details

Plates

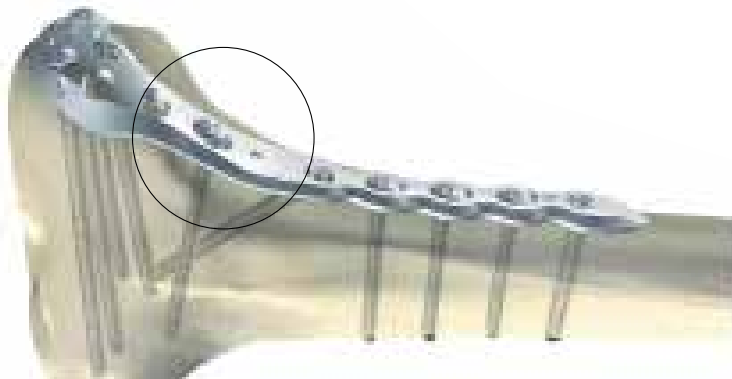
To remove any plate, first extract all screws by using the appropriate size screwdriver bits. Remove the plate by using a regular forceps.

The development of locking plate technology has led to “cold welding” of screws to the plates. In this case, cutting tools for metal have to be used for the removal of the screws. In order to help protect the soft tissue from excessive heat and metal debris accumulation, irrigation and suction should be used in combination with cutting tools.



WARNING

If screws are cold welded to the plate, carbide drills may be required. The extraction set does not feature carbide drills or any other instruments to remove cold welded screws.



Operative technique

Implant Extraction Set

Broken screws

In case of a broken screw shaft:

Step 1

Remove the screw head portion in order to gain access to the remaining part of the screw shaft. The screw head can be removed with the appropriate screwdriver as described on page 6.

Step 2

Use the drift punch to extract the remaining part of the screw.

If difficulties are encountered with the above process, overdrill the remaining part of the screw with a crown drill before proceeding with the drift punch.

In case of a torn-off screw head:

Step 1

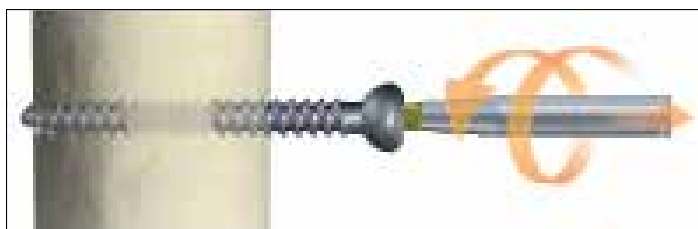
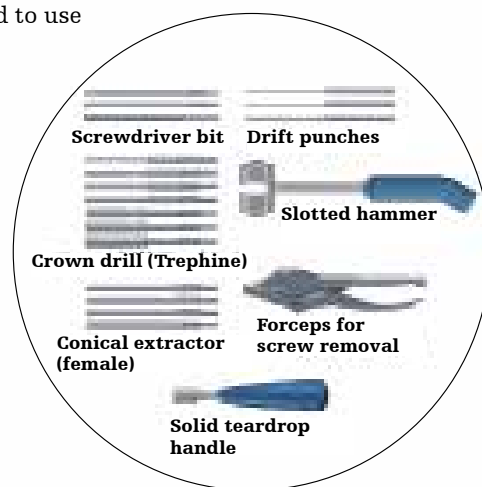
Overdrill the remaining part of the screw with a crown drill. Use another crown drill, one size larger, in order to create space for the female conical extractor/drift punch. It may be necessary to start with light pressure on the crown drill in order to avoid the drill walking on the cortex surface before applying additional pressure to penetrate the bone. Light tapping with the slotted hammer may be required. It remains at the surgeon's own discretion if and how hard to use the slotted hammer.

Alternatively, the optional counter-sink (6mm or 8mm) can be used to create a path for the crown drill.

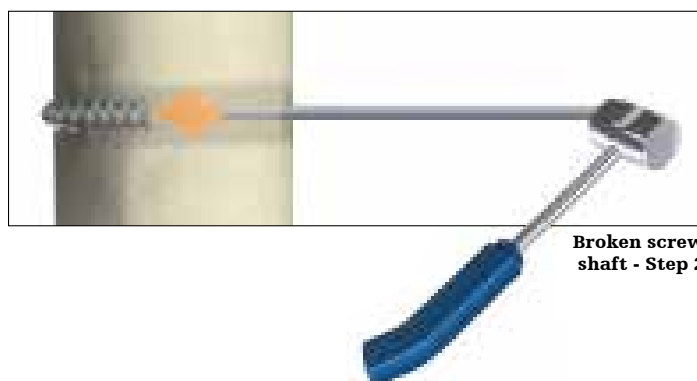
Step 2

Remove the remaining part of the screw with the conical extractor, (female) if the screw is broken close to the first cortex or with the help of a drift punch if the screw is broken close to the second cortex.

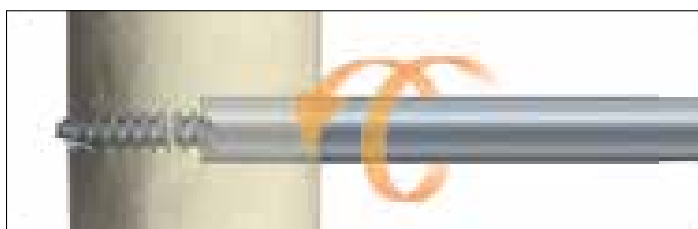
This procedure can also be applied to broken intramedullary nail locking screws.



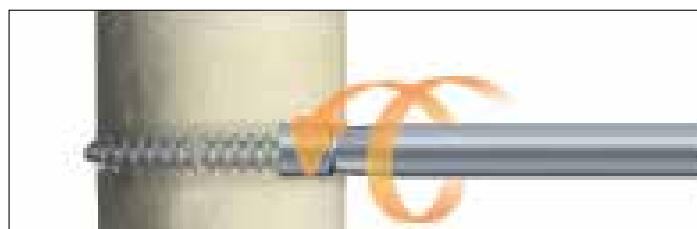
Broken screw shaft - Step 1



Broken screw shaft - Step 2



Torn-off screw head - Step 2



Torn-off screw head - Step 2

Operative technique

Broken cannulated screws

To remove the torn-off head:

Step 1

Select the appropriate spreading screwdriver bit. Attach cannulated teardrop handle. Insert rotation rod through the top of the teardrop handle. Insert tip into the screw head and turn rotation rod to engage and remove screw head.

To remove remaining screw body (parts):

Step 2

Insert the conical extractor (male) and extract the remaining screw body turning the conical extractor in a counter-clockwise fashion.

If steps 1 and 2 are unsuccessful for screw removal:

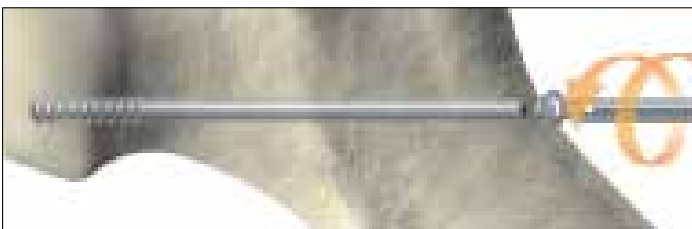
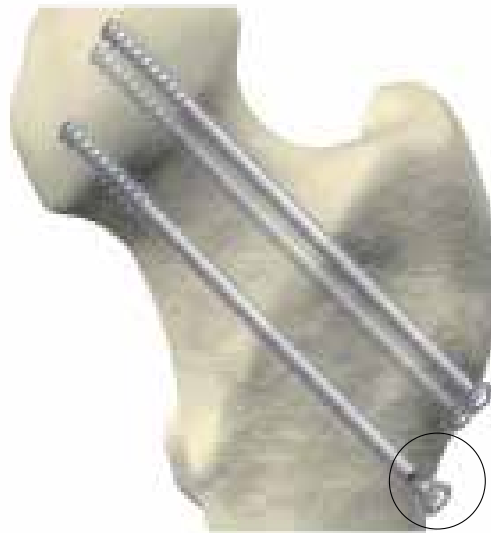
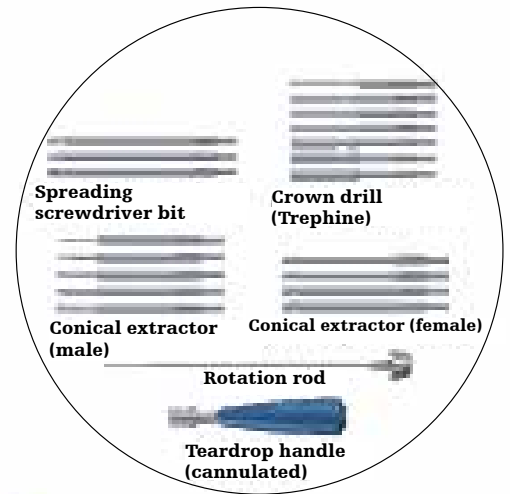
Step 3

Overdrill the shaft using the crown drill.

Step 4

Use a conical extractor (female) for screw removal.

If the attempt for screw removal is not successful, follow the standard procedure for broken screw removal described on page 8.



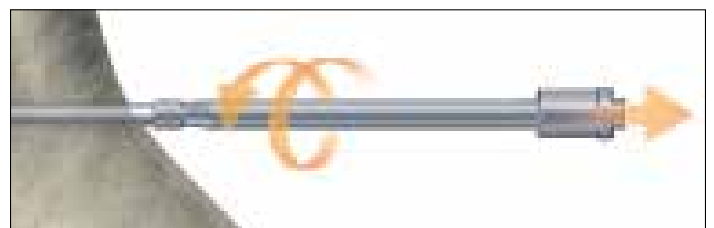
Cannulated screw removal - Method A - Step 1



Cannulated screw removal - Method A - Step 2



Cannulated screw removal - Method B - Step 1



Cannulated screw removal - Method B - Step 2

Operative technique

Lag screws

An incision is made over the proximal end of the nail. The end cap, if used, is removed using the appropriate screwdriver bit followed by removal of the set screw using the 4.0mm screwdriver as shown in the image below ①.

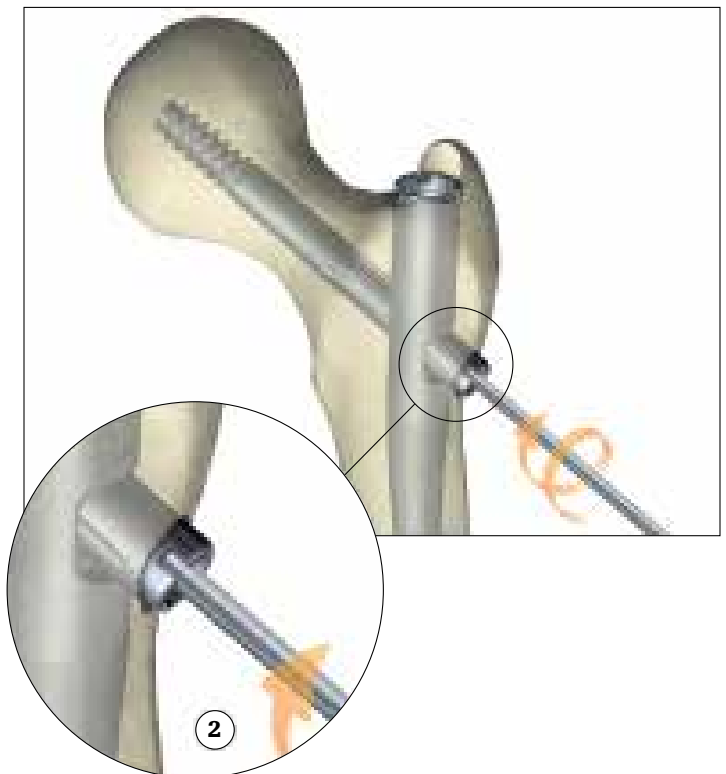
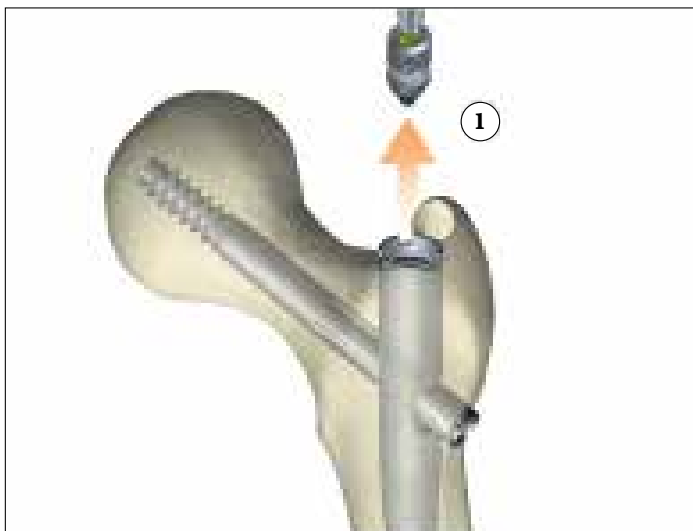
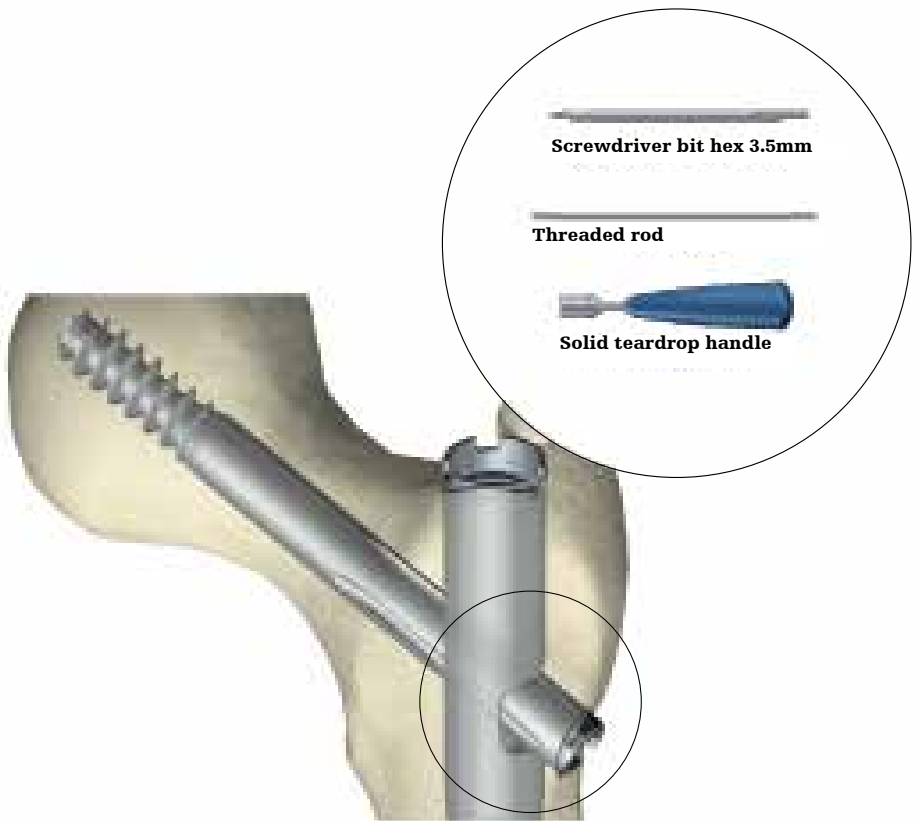
Make a small incision through the old scar distal to the greater trochanter to expose the outer end of the lag screw.

The threaded rod is then attached and tightened into the lateral, exposed end of the lag screw ②.

For Gamma implants: position the K-wire through the lag screw.

The threaded rod is inserted over the K-wire (when used for Gamma) and tightened into the lateral, exposed end of the lag screw.

Remove the K-wire, if used.



Operative technique

Check that ingrowth does not obstruct secure engagement of the extraction device, otherwise the implant or the instrument may be damaged and extraction will be more difficult.

Slide the appropriate connector over the threaded rod before adding the extraction rod & nut as shown in the picture (3).

NOTICE

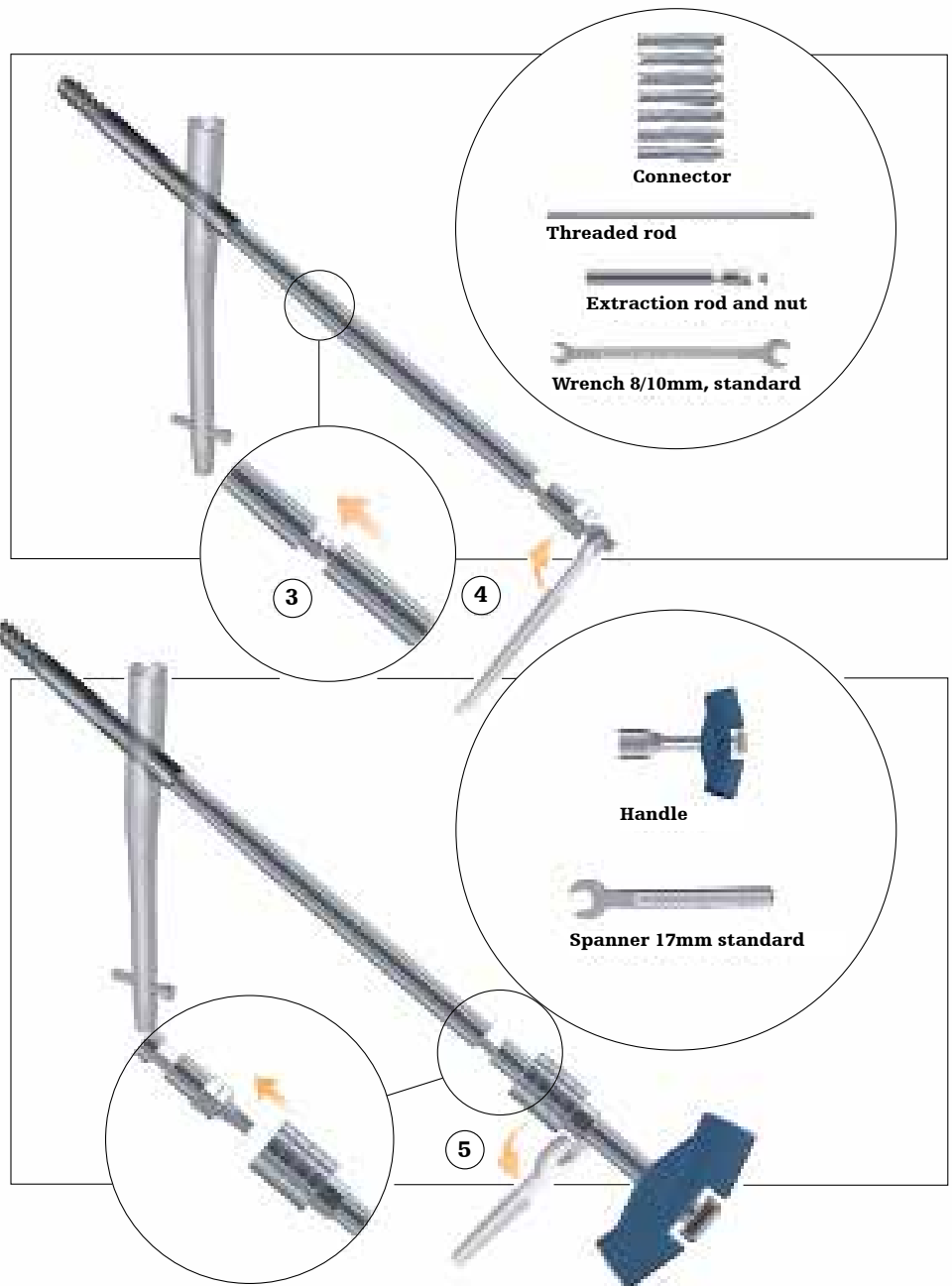
The Gamma3 lag screw was selected as an example to demonstrate lag screw removal.

However, different connectors are available for other implants including a lag screw. See details in the Implant Extraction Set System Component Guide (IES-BR-1).

Finish assembly of the lag screw extraction device by tightening the nut (4) and attaching the T-handle (5) in a final step as shown in the picture.

The lag screw is extracted by counter-clockwise rotation and pulling (6).

Use the 7mm spanner wrench if higher forces are required for the removal of the lag screw.



Operative technique

Intramedullary nails

When removing an intramedullary nail, it is helpful to identify the nail brand and its diameter in order to choose the correct instrumentation.

The end cap, if used, is removed using a screwdriver. If bone ingrowth obstructs access to the nail, use of either a crown drill, pick (not supplied), or curette (not supplied) may provide access.

Remove the distal/proximal screw with the appropriate screwdriver bit. Do not take out the screws of the driving (proximal) end until the conical extraction rod is attached to the top of the nail in order to avoid rotation.

Insert the conical extraction rod into the driving end of the nail.

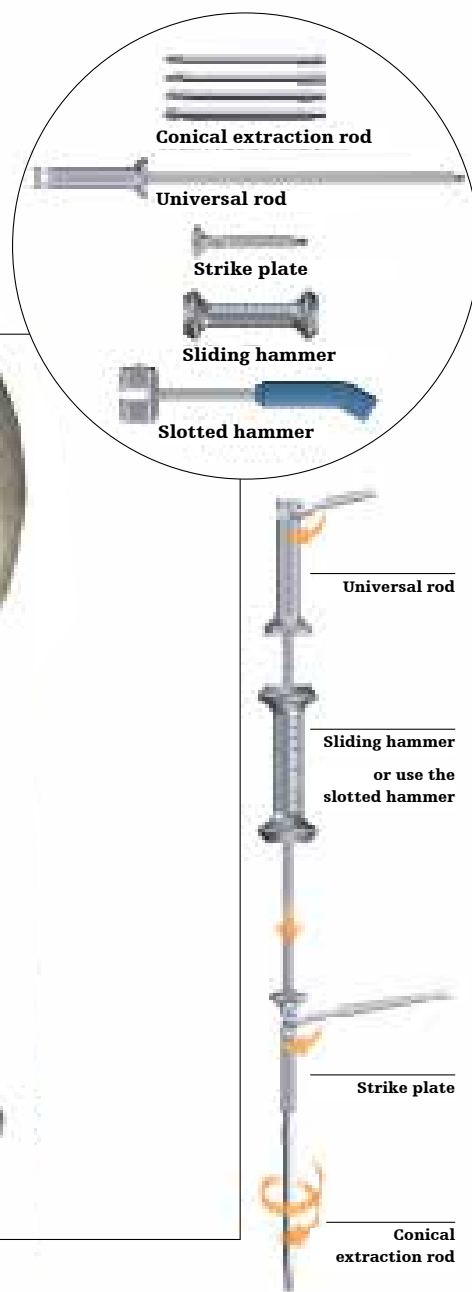
Lightly hammer the conical extractor in order to fully engage the cutting flutes.

Connect the strike plate and the universal rod either adding the sliding or slotted hammer as shown in the picture.

Remove the remaining locking screws and confirm with fluoroscopy that locking screws have been removed before using either hammer to remove the nail.

CAUTION

Special care must be taken to check if the nail moves off-center from the entry point when screws are removed. Any attempt to remove a nail that is off-center may result in fractures of the distal condylar region.



Step 1



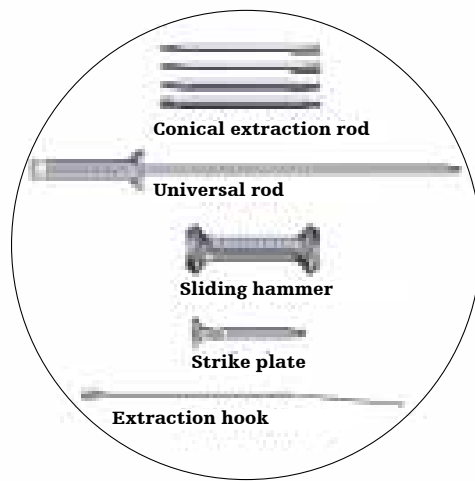
Step 2

Operative technique

Broken intramedullary nails

Removal of broken intramedullary nails may be particularly challenging. Stryker developed a system that can be used for the removal of many cannulated intramedullary nails.

Remove the distal screw with the appropriate screwdriver bit. Do not take out the proximal screws until you have attached the conical extraction rod to the top of the nail in order to avoid rotation.



An incision is made over the proximal end of the nail. The end cap, if used, is removed using a screwdriver. If bone ingrowth obstructs the access to the nail, the use of either a chisel/pick (not provided) or a crown drill will facilitate removal.

Connect the universal rod and the strike plate to the extraction rod (center of page) either adding the sliding or the slotted hammer.

Step 1

Insert the nail extraction device into the proximal end of the nail, tightening it as firmly as possible.

Step 2

Remove the proximal screws before using either hammer to remove the nail.

Step 3

After removal of the proximal nail end, exchange the conical extraction rod for the extraction hook (as shown to the left). Insert extraction hook into the cannulation of the nail fragment.

Under fluoroscopy, verify that the hook has passed through the nail end. Make sure that the hook takes a hold at the end of the nail before pulling to remove it.

Step 4

Use the sliding or the slotted hammer to pull out the remaining part of the nail.



Broken intramedullary nails - Step 1

Broken intramedullary nails - Step 2



Broken intramedullary nails - Step 3

Broken intramedullary nails - Step 4

Trauma & Extremities

This document is intended solely for the use of healthcare professionals. A surgeon must always rely on his or her own professional clinical judgment when deciding whether to use a particular product when treating a particular patient. Stryker does not dispense medical advice and recommends that surgeons be trained in the use of any particular product before using it in surgery.

The information presented is intended to demonstrate a Stryker product. A surgeon must always refer to the package insert, product label and/or instructions for use, including the instructions for Cleaning and Sterilization (if applicable), before using any Stryker product. Products may not be available in all markets because product availability is subject to the regulatory and/or medical practices in individual markets. Please contact your Stryker representative if you have questions about the availability of Stryker products in your area.

The Instructions for Use, Operative Techniques, Cleaning instructions, patient information leaflets and other associated labeling may be requested online at www.ifu.stryker.com or www.stryker.com.

If saving the Instructions for Use, Operative Techniques, Cleaning instructions from the above mentioned websites, please make sure you always have the most up to date version prior to use.

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