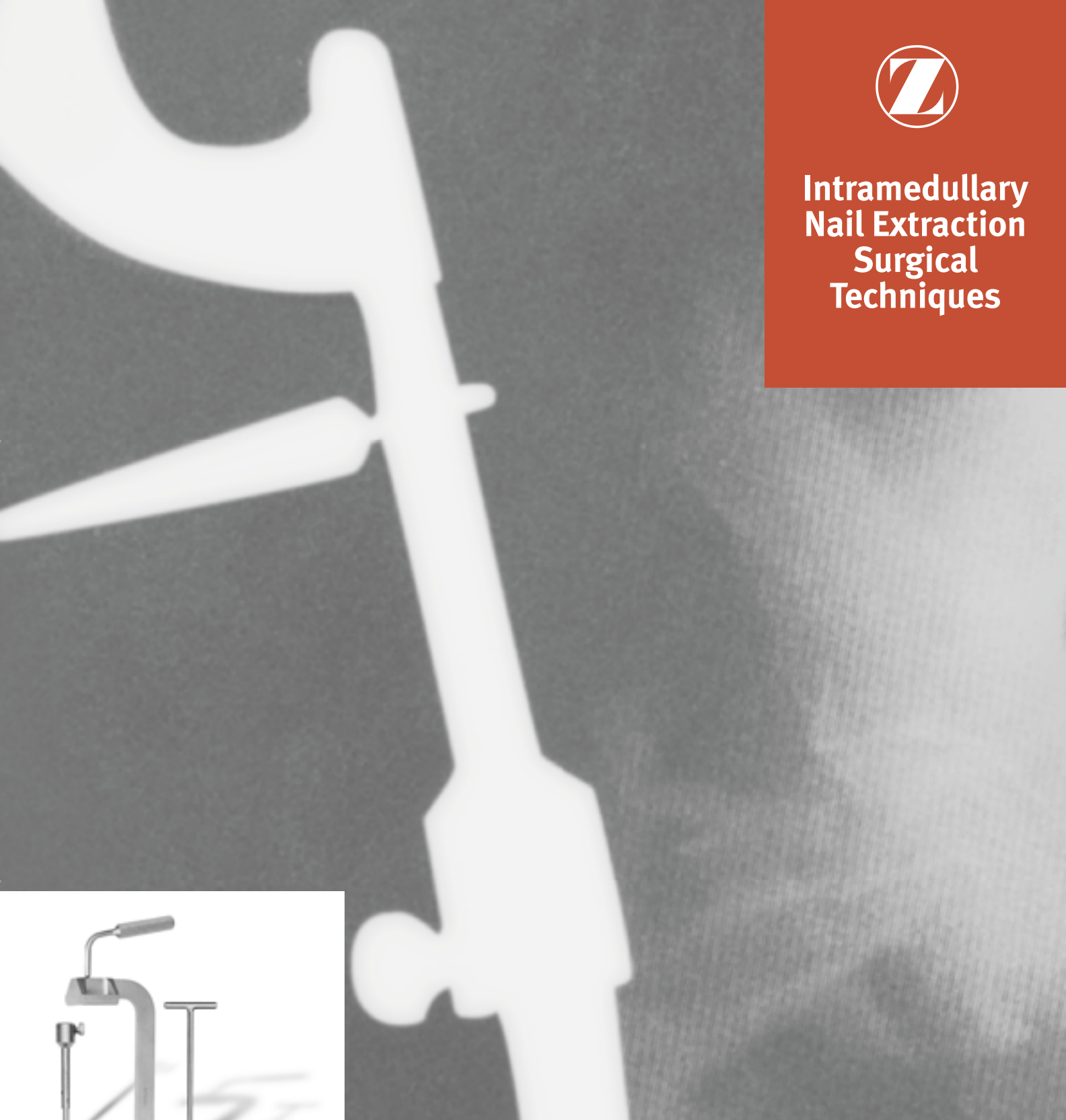




# Intramedullary Nail Extraction Surgical Techniques



Universal Nail Extraction System



## Surgical Techniques For Intramedullary Nail Extraction

Instruments and surgical technique  
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## Intramedullary Nail Extraction Techniques

### Introduction

The *Zimmer*® Intramedullary Nail Extraction Set is a universal system, allowing it to be used with any brand or style of cannulated nail, including tibial, femoral, recon, and humeral nails. The system can be used for simple extractions, as well as broken nails and difficult-to-remove nails.

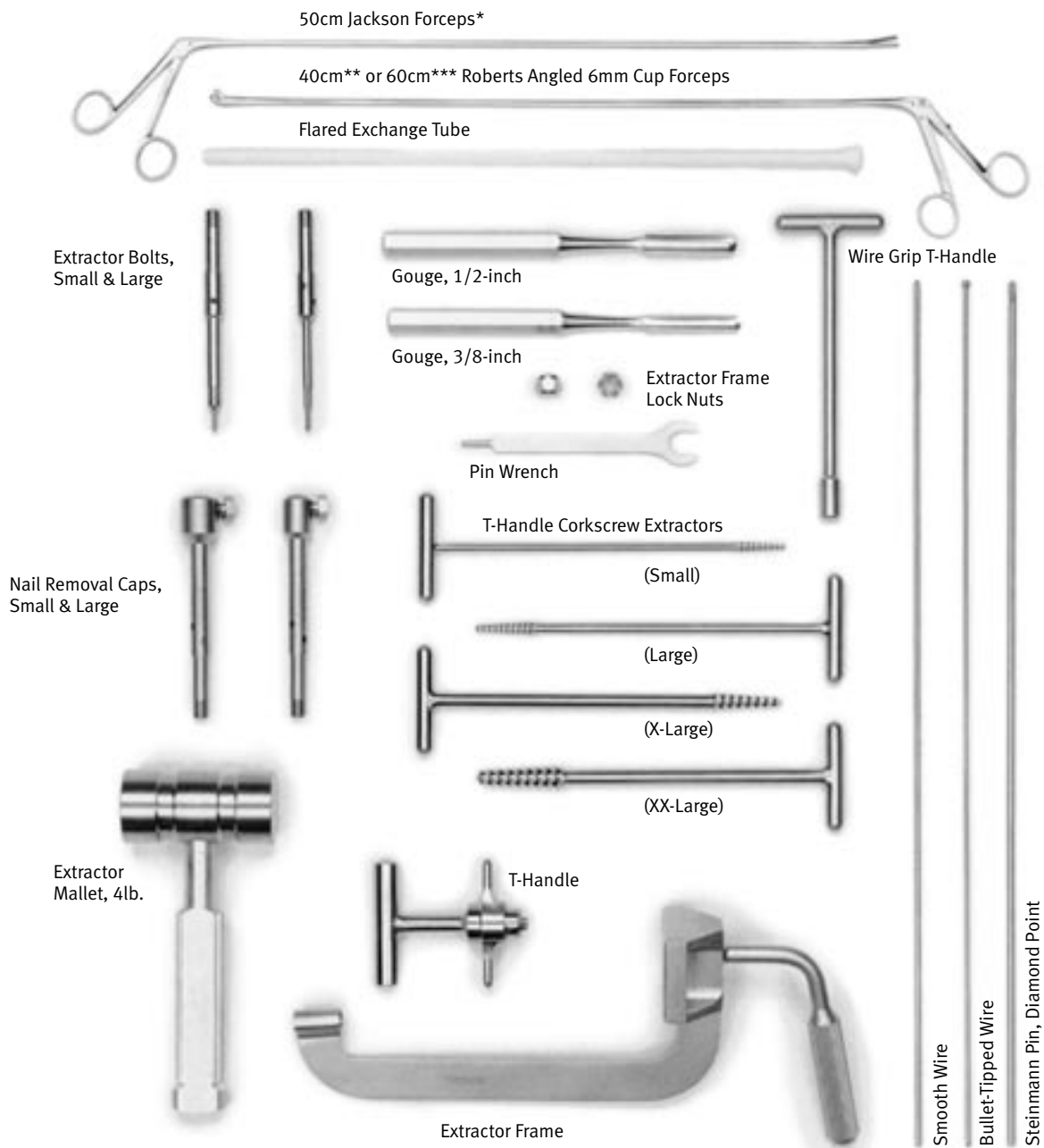
Thorough preoperative planning and preparation are necessary to successfully extract any brand of cannulated nail, especially broken nails. Knowing the exact dimensions and design features of the nail to be removed is very important. It is of particular importance to know the inside diameter of the nail.

Begin with a review of appropriate case x-rays, treatment records, and the operative report of the implantation. Identify the manufacturer and determine the size of the nail to be removed. Obtain the appropriate locking screw removal and extraction adaptors from the manufacturer.

**For broken nails, obtain a nail of the same type and size from the manufacturer to make precise measurements.**

Nail extractions require patience. During the procedure, be prepared to change and adapt the nail removal strategy as the specific case dictates.

**Instruments**



\* Available from Pilling, Prod. No. 505404  
 \*\* Available from Pilling, Prod. No. 505148  
 \*\*\* Available from Pilling, Prod. No. 505152

### Straight Gouges

The Gouges are useful instruments for cleaning around the top of a nail or to assist in loosening a nail that is difficult to remove (Fig. 1). The Gouges have tips that are radiused to fit various nail diameters. Straight Gouges are available in 1/2-inch and 3/8-inch sizes.



Fig 1. Use Gouge to assist in loosening nail prior to removal.

### Simple Nail Extraction

Remove the interlocking screws through percutaneous incisions. Attach the appropriate manufacturer's extraction adaptor to the end of the nail and use their suggested technique to extract the nail (Fig. 2).

**NOTE: If removing a ZMS® or M/DN® Intramedullary Fixation System Nail, DO NOT use the cannulated Locking Bolt for nail removal. Extraction of the nail should be accomplished by using the correct size ZMS or M/DN Extraction Adaptor.**

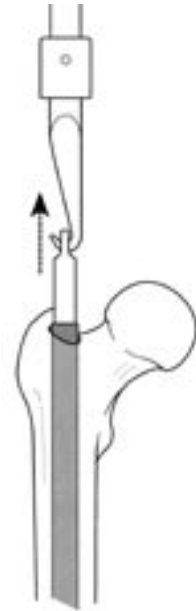


Fig 2. Extract intramedullary nail with appropriate manufacturer's extraction adaptor.

### Broken Cannulated Nail Extraction

Remove the interlocking screws through percutaneous incisions. Then remove the proximal portion of the nail using the extraction device from the appropriate manufacturer (Fig. 3). Insert the Bullet-Tipped Guide Wire into the canal until it contacts the distal portion of the broken nail. Ream at least 1mm greater than the size of the broken nail fragment (Fig. 4). This will open the canal to provide room for the extraction instrumentation and passage into the distal portion of the IM nail.



Fig 3. Extract proximal end of broken intramedullary nail with appropriate manufacturer's extraction adaptor.

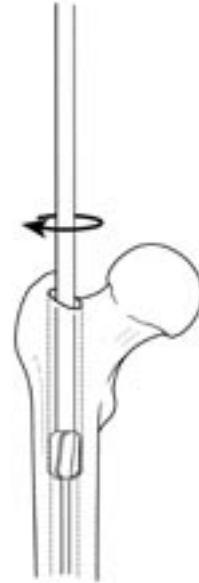


Fig 4. Ream at least 1mm greater than size of broken nail.

Insert the disposable Flared Exchange Tube into the canal until it contacts the distal portion of the broken nail (Fig. 5). This will serve as a guide for the insertion of the guide wires.



**Fig 5.** Insert Flared Exchange Tube into canal until it contacts distal portion of broken nail.

Determine the exact inner diameter of the nail by measuring the sample nail. Place the appropriate size diamond-point Steinmann Pin through the Flared Exchange Tube and through the distal portion of the broken nail to clear bone from the cannulation (Fig. 6). If desired, use the Wire Grip T-Handle to manipulate the pin down the canal. Then remove the Steinmann Pin.



**Fig 6.** Place Steinmann Pin through Exchange Tube and into broken nail to clear bone from cannulation.

Depending on the inner diameter of the cannulation, choose the appropriate size Bullet-Tipped Wire, and place it into the nail fragment until it extends through the distal tip of the nail at least 1/4-inch (Fig. 7). Check the position of the Bullet-Tipped Wire under image intensification.



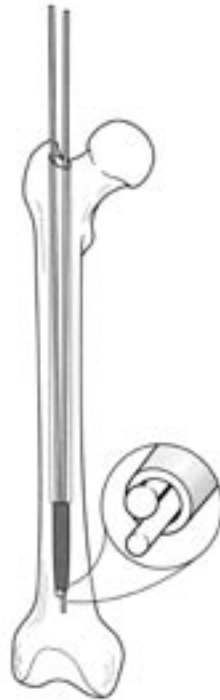
**Fig 7.** Place Bullet-Tipped Wire into nail and through distal tip.



Place a Smooth Wire into the nail next to the Bullet-Tipped Wire. The Smooth Wire should also extend through the distal tip of the nail at least 1/4-inch (Fig. 8). This will provide a wedge that will hold the Bullet-Tipped Wire in place when force is applied to remove the nail (Fig. 9A and 9B). Remove the Flared Exchange Tube.



**Fig 8.** Place Smooth Wire into nail and through distal tip.



**Fig 9A.** Together, Bullet-Tipped Wire and Smooth Wire provide wedge to assist in nail removal.



**Fig 9B.** X-ray showing nail being removed using Bullet-Tipped Wire and Smooth Wire together.

Attach the Wire Grip T-Handle to the proximal end of the Bullet-Tipped Wire only (Fig. 10). Realign the fracture so the nail does not become lodged at the fracture site during extraction.

Pull on the Wire Grip T-Handle to remove the distal portion of the broken nail. Push on the Smooth Wire while pulling on the Bullet-Tipped Wire (Fig. 10). The broken nail should come out with this technique. If necessary, use the Extractor Mallet to lightly tap on the large diameter handle of the Wire Grip T-Handle. Do not strike the small arms of the handle.



**Fig 10.** Pull on Wire Grip T-Handle to remove broken nail.

### Stripped Proximal Nail Extraction

If the threads on the proximal end of the nail are stripped, or if an instrument has broken off within the proximal area, the Nail Removal Cap can be used to extract the nail.

Remove the interlocking screws through percutaneous incisions. Loosen the screw on the Nail Removal Cap and slide the large open end over the outer portion of the nail. When it is seated down over the proximal portion of the nail, use the Pin Wrench to tighten the screw until the Nail Removal Cap is firmly secured to the nail (Fig. 11). Insert the Extractor Frame over the proximal threaded end of the cap. Secure the cap with a locking nut (Fig. 12). Remove the nail by tapping the flat of the Extractor Frame with the Extractor Mallet (Fig. 13). Nail Removal Caps are available in a small (up to 10mm) and large (10mm - 16mm) size to adapt to various nail diameters.



Fig 11. Secure Nail Removal Cap over proximal portion of nail.



Fig 12. X-ray showing Nail Removal Cap and Extractor Frame in position to remove nail.

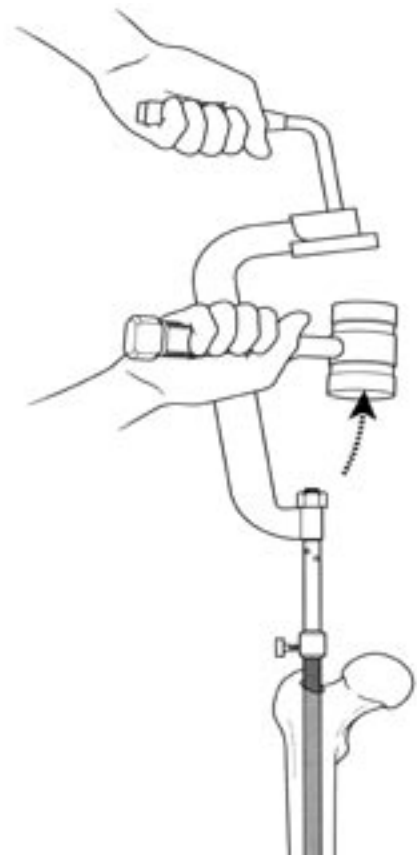


Fig 13. Tap Extractor Frame as shown to withdraw nail.

**Incarcerated Nail Extraction**

Remove the interlocking screws through percutaneous incisions. Insert the appropriate extraction adaptor and instrument to back the nail out as far as possible (at least 3cm - 5cm, if possible).

Attach the Wire Grip T-Handle to an appropriate diameter diamond-point Steinmann Pin. Insert the pin into the cannulated portion of the nail and gently advance to the bottom of the nail to clear bone from the cannulation (Fig. 14). Check the position with image intensification.



**Fig 14.** Use Steinmann Pin to clear bone from the cannulation.

Then use the Wire Grip T-Handle to work the pin down the nail’s grooves (eg. Lottes, Snyder) anteriorly, posteriorly, medially and laterally (Fig. 15).

**WARNING: When the diamond-point Steinmann Pin is advanced, use image intensification to visualize the pin. This will allow observation of the pin tip to help ensure that the pin is tracking close to the nail.**



**Fig 15.** As necessary, work pin down flutes of nail to loosen.

**If resistance at the callous prevents passage of the pin, back the pin out and use a power driver to drive it down (Fig. 16).**

If the nail has a slot or saw cut, insert the pin down the open side of the nail. Be certain that the pin’s tip contacts the inside wall. If resistance is felt at the slot or saw cut preventing contact with the inner wall, use a smaller pin.

The nail should now be ready for extraction. Use the extraction device of choice to remove the nail. The C-Frame and mallet will work effectively in extracting any nail with 1/4 - 20 proximal threads.



**Fig 16.** If necessary, use power to work pin down sides of nail.

## Optional Instrumentation Used For Extraction

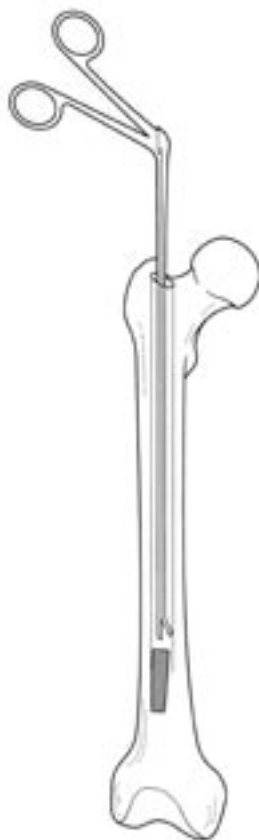
### Grasping Forceps

This instrument is useful for grasping nail or screw fragments in the medullary canal when only minimal force is required to extract the fragment. It is an optional instrument in the extraction set.

After removing the proximal portion of the broken nail and reaming the proximal canal, insert the Grasping Forceps into the canal. Grasp the distal portion of the broken nail and pull to remove it (Fig. 17A and 17B).



**Fig 17A.** X-ray showing nail fragment being removed using Grasping Forceps.

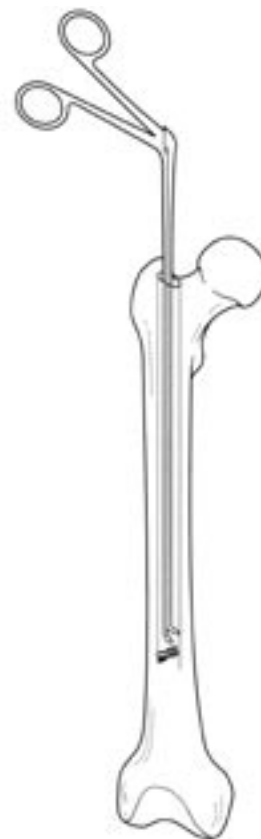


**Fig 17B.** Insert Grasping Forceps into canal to remove nail fragment(s).

### Angled 6mm Cup Forceps

This instrument is useful for obtaining biopsies of pathologic lesions or for the removal of bone intrusions and fragments in the medullary canal, as well as small screw fragments.

If removing a screw fragment, remove the nail and ream the proximal canal. Then insert the Angled 6mm Cup Forces into the canal. Grasp the screw fragment and slowly manipulate it up the canal (Fig. 18).



**Fig 18.** Insert 6mm Cup Forceps into canal to remove bony intrusions or screw fragments.

### T-Handle Corkscrew Extractor

The T-Handle Corkscrew Extractor is useful in the removal of nails with stripped threads, and older-type cannulated Cloverleaf Nails, which do not have proximal threads.

If removing a broken IM nail, remove the proximal portion of the nail and ream the proximal canal. Then, insert the appropriate size T-Handle Corkscrew Extractor into the canal (Fig. 19). Turn the T-Handle clockwise while tapping with a mallet (Fig. 20). Continue turning the T-Handle and tapping until the distal portion of the broken nail is extracted.

**NOTE:** This technique is effective if the distal fragment of the nail is within approximately 20cm of the canal opening.

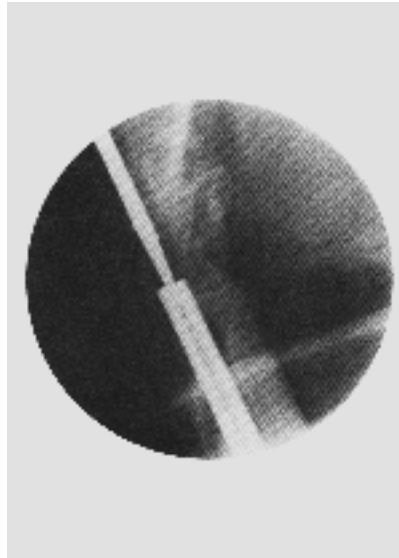


Fig 19. X-ray showing use of T-Handle Corkscrew Extractor in removal of nail.

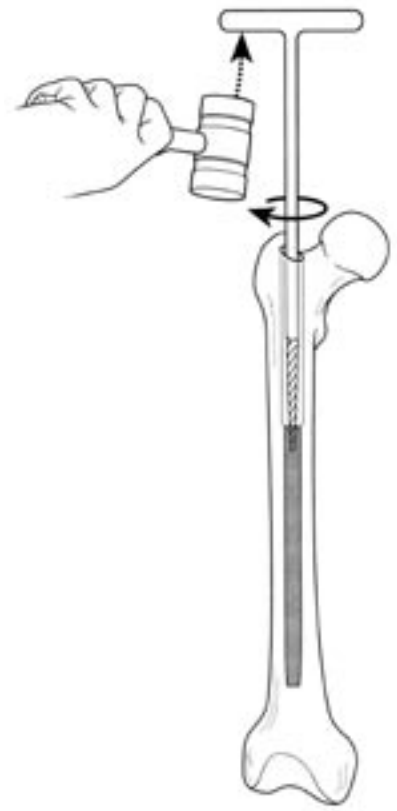


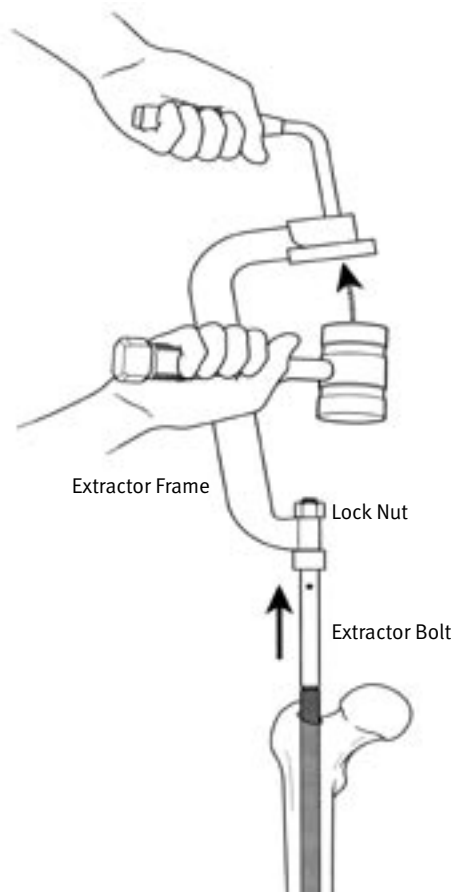
Fig 20. Turn handle of T-Handle Corkscrew Extractor clockwise while tapping with Extractor Mallet.

### Extractor Frame

This instrument is useful for extracting nails using an Extractor Bolt, as well as using the Nail Removal Cap when extracting nails with stripped proximal threads (Refer to page 8).

When using an Extractor Bolt, insert the proper size bolt into the threaded portion of the nail and tighten with the Pin Wrench. Attach the Extractor Frame to the bolt and secure it by tightening the Lock Nut with the Pin Wrench.

Use the Extractor Mallet to tap on the large plate of the Extractor Frame, and remove the nail (Fig. 21). Two Extractor Bolt sizes are available: small (1/4 - 20 threads); and large (3/8 - 16 threads).



**Fig 21.** Use Extractor Mallet to tap on large plate of Extractor Frame to remove nail.

Prod. No.	Description
00-0409-002-00	IM Nail Extraction Set #1 (contains the following)
00-0409-005-00	4 lb. Extractor Mallet
00-0409-011-00	Extractor Frame
00-0409-012-00	Small Extractor Frame Bolt (2)
00-0409-013-00	Large Extractor Frame Bolt (2)
00-0409-014-00	Extractor Frame Lock Nut (2)
00-0409-015-00	Large Pin Wrench (2)
00-0409-016-00	T-Handle
00-2884-000-02	Gouge 1/2 Straight
00-2884-000-06	Gouge 3/8 Straight
00-0409-090-00	Instrument Case No. 1

Prod. No.	Description
00-0409-003-00	IM Nail Extraction Set #2 (contains the following)
00-0409-080-00	Nail Removal Cap Small
00-0409-081-00	Nail Removal Cap Large
00-0486-002-00	Corkscrew Nail Extraction Small
00-0486-003-00	Corkscrew Nail Extraction Large
00-0486-004-00	Corkscrew Nail Extraction XL
00-0486-005-00	Corkscrew Nail Extraction XXL
00-2237-053-00	Wire Grip T-Handle
00-0409-095-00	Instrument Case No. 2

Prod. No.	Description
00-0409-004-00	IM Nail Extraction Pin Wire Set (contains the following)
00-0409-021-00	Diamond-Point Pin 2.4mm x 60cm
00-0409-022-00	Diamond-Point Pin 3.2mm x 60cm
00-0409-023-00	Diamond-Point Pin 4.0mm x 60cm
00-0409-024-00	Diamond-Point Pin 5.0mm x 60cm
00-0409-031-00	2.8mm x 1.6mm Bullet-Tip Ext Wire
00-0409-032-00	4.0mm x 2.4mm Bullet-Tip Ext Wire
00-0409-033-00	5.0mm x 3.2mm Bullet-Tip Ext Wire
00-0409-034-00	6.0mm x 3.2mm Bullet-Tip Ext Wire
00-0409-041-00	1.6mm x 60cm Smooth Ext Wire
00-0409-042-00	2.0mm x 60cm Smooth Ext Wire
00-0409-043-00	3.2mm x 60cm Smooth Ext Wire
00-0409-044-00	4.0mm x 60cm Smooth Ext Wire
00-0409-099-01	Pin and Wire Case Lid
00-2237-048-00	Flared Exchange Tube (Box)
00-0409-097-00	Instrument Case No. 2 Pin/Wire Tray

Prod. No.	Description
00-0409-006-00	IM Nail Extraction Complete Set (contains the following)
00-0409-011-00	Extractor Frame
00-0409-012-00	Small Extractor Frame Bolt (2)
00-0409-013-00	Large Extractor Frame Bolt (2)
00-0409-014-00	Extractor Frame Lock Nut (2)
00-0409-015-00	Large Pin Wrench (2)
00-0409-016-00	T-Handle
00-0409-021-00	Diamond-Point Pin 2.4mm x 60cm
00-0409-022-00	Diamond-Point Pin 3.2mm x 60cm
00-0409-023-00	Diamond-Point Pin 4.0mm x 60cm
00-0409-024-00	Diamond-Point Pin 5.0mm x 60cm
00-0409-031-00	2.8mm x 1.6mm Bullet-Tip Ext Wire
00-0409-032-00	4.0mm x 2.4mm Bullet-Tip Ext Wire
00-0409-033-00	5.0mm x 3.2mm Bullet-Tip Ext Wire
00-0409-034-00	6.0mm x 3.2mm Bullet-Tip Ext Wire
00-0409-041-00	1.6mm x 60cm Smooth Ext Wire
00-0409-042-00	2.0mm x 60cm Smooth Ext Wire
00-0409-043-00	3.2mm x 60cm Smooth Ext Wire
00-0409-044-00	4.0mm x 60cm Smooth Ext Wire
00-0409-080-00	Nail Removal Cap Small
00-0409-081-00	Nail Removal Cap Large
00-0486-002-00	Corkscrew Nail Extraction Small
00-0486-003-00	Corkscrew Nail Extraction Large
00-0486-004-00	Corkscrew Nail Extraction XL
00-0486-005-00	Corkscrew Nail Extraction XXL
00-2237-048-00	Flared Exchange Tube (Box)
00-2237-053-00	Wire Grip T-Handle
00-2884-000-02	Gouge 1/2 Straight
00-2884-000-06	Gouge 3/8 Straight
00-0409-090-00	Instrument Case No. 1
00-0409-095-00	Instrument Case No. 2

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