X-BOLT ORTHOPAEDICS

IM Hip Nailing Surgical Technique

Part Code

SURGICAL TECHNIQUE

XNI-028

1. **NAIL SIZE, LEFT OR RIGHT** All nails are sided left or right. For long nails, measure nail length by the distance from the greater trochanter to the superior aspect of patella with long nail ruler, under fluoroscopy.

XNI-019
XNI-013
XNI-007

2. **JIG ASSEMBLY.** Mount nail to jig using M-10 connection bolt and flexi-drive. Remove flexi-drive. Manually check alignment is correct with drill sleeves.

3. **REDUCTION**. Anatomically reduce fracture prior to insertion of nail. Follow all steps on fluoroscopy.

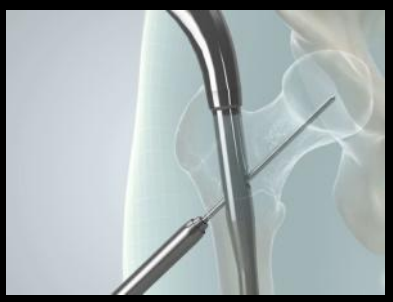
*XNI-010
XNI-004
XNI-005
XNI-002
*XNI-001

4. **ENTRY POINT. Medial to the tip of greater trochanter.** Make a small proximal skin incision in line with expected path. Use Ø3.2mm femoral head guidewire and proximal sleeves, or cannulated awl. Pass long guidewire down intramedullary canal into distal fragment.

XNI-006
XNI-004
XNI-005

5. **REAM.** Use conical reamer to ream proximal femur, with soft tissues protected with proximal sleeves. If distal reaming needed, use flexible reamers in Ø0.5mm increments to Ø12.0mm (Ø2.0mm greater than nail diameter).

6. **NAIL INSERTION.** Insert nail coupled to jig over guidewire (having removed flexi-drive) and advance by hand. **DO NOT HIT alignment jig.** Remove guidewire when nail properly in distal fragment. Gentle final impaction may be performed only if absolutely necessary, onto and via flexi-drive re-inserted into jig, after long guidewire is removed.



XNI-008
XNI-009
*XNI-010

7. **FEMORAL HEAD GUIDEWIRE.** Through the jig and via stab incision, insert inner and outer X-Bolt sleeves. Place Ø3.2mm femoral head guidewire centre-centre in femoral head within 2-3mm of joint line cortex; optimum tip-apex point, checking position on AP and lateral.

XNI-011

8. **MEASURE.** Use guidewire ruler to measure guidewire protrusion from inner sleeve. Note: X-Bolt shortens by 2-3mm from base-end on expansion. Do not bury X-Bolt deep to lateral cortex that could prevent dynamic sliding. **Add approximately +5mm for X-Bolt length.**

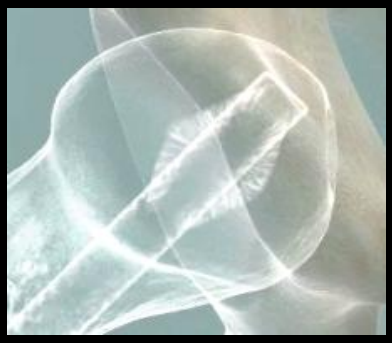
XNI-012

9. **REAM.** Remove inner sleeve. Set Ø9.1mm reamer depth, at base end of stopper. Ream over guidewire to create X-Bolt channel to within 2-3mm of joint line (tip-apex point). Leave reamer temporarily in situ, (but detach from power driver) to prevent alignment jig from sagging/rotation from gravity.

XNI-015
XNI-016
*XNI-017
XNI-018

*XNI-029
XNI-030

10. **DISTAL LOCKING. Short nail:** Insert green and gold sleeves through appropriate (left/right) aperture, choosing dynamic or static distal locking option. Use Ø4.0mm x 305mm drill bit via inner (gold) sleeve. Remove inner (gold) sleeve. Confirm screw length using measuring hook. Insert appropriate Ø5.0mm distal locking screw. **Long Nail:** Use Ø4.0mm x 150mm drill bit for freehand distal locking, in dynamic or static configurations. Screw length is measured with standard depth gauge.



Part Code

11. **INSERT BONE CRUSHER.** Remove reamer and guidewire. This leaves a clear bone channel in femoral head. Insert bone crusher fully deep, to within 2-3mm of joint line (tip-apex point). — XNI-014

12. **DEPLOY BONE CRUSHER.** Deploy liberally at multiple intervals to compact cancellous bone through an arc of 180^{o}, thus creating a small diamond-shaped 360^{o} starter cavity (span 18mm) in femoral head. The X-Bolt subsequently can expand to 24mm span. **Note: It is always necessary to complete this step, regardless of the nature/density of bone.**

13. **INSERT X-BOLT.** Mount the sized X-Bolt onto T-handle screwdriver and advance X-Bolt into position in femoral head with flat aspect facing superiorly. — XNI-022

14. **INSERT FLEXI-DRIVE AND FLEXIBLE SCREWDRIVER.** Insert flexi-drive into hollow metal proximal end of jig. Insert flexible screwdriver though proximal end of flexi-drive to engage pre-loaded set screw within the nail. — XNI-007 XNI-023

15. **ENGAGE SET-SCREW.** Gently advance set screw (light finger grip on screwdriver) to just lightly kiss onto the superior flat aspect of X-Bolt. The set screw prevents rotation, but should not prevent dynamic sliding, which can be confirmed by gently rocking X-Bolt via T-handle screwdriver prior to expansion. ***Option:*** The set screw may be fully tightened down as a final step following X-Bolt expansion if a locked construct is desired.

16. **EXPAND X-BOLT.** Insert T-handle torque-limiting screwdriver into base of X-Bolt. Standard clockwise turns expand the X-Bolt until a stop is felt, or the 4.5Nm torque limit is reached. Do not use excessive force. If inadvertent resistance is felt, remove the X-Bolt and repeat bone crusher step. Reversal, if necessary, is performed by anticlockwise screwdriver rotation. **NB: X-Bolt must be discarded and replaced if full expansion has been reversed, or if X-Bolt is damaged in any way.**

17. **END-CAP.** Remove jig by de-coupling connector bolt via flexible coupler, using screwdriver shaft through horizontal apertures if greater leverage is required. Reinsert Ø2.4mm x 900mm long guidewire into top of nail. Place appropriate +2mm or +5mm end-cap over long guidewire into top of nail using cannulated 4.0mm-hex screwdriver. Remove long guidewire. — *XNI-001 XNI-024

18. **CLOSURE.** Wound closure and post-operative management as per surgeon's instructions.

(= single packed sterile)*

X-BOLT® : ACHIEVING GREAT RESULTS

The X-Bolt provides strong femoral head fixation and excellent rotational stability, whilst the nail (14.5mm proximal diameter) causes less disruption to the greater trochanter and hip abductors. The novel jig and flexi-drive, pre-loaded set-screw and cannulated end-cap make for simple and fast surgery, without fiddle-factor.

These user-friendly features allow surgeons the ability and freedom to concentrate on the important surgical aspects of:

- ✓ **Fracture Reduction**
- ✓ **Nail Entry Point**
- ✓ **Femoral Head Guidewire Position**

TROUBLESHOOTING

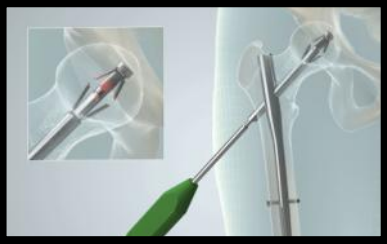
Problem	Possible Cause	Solution
Jig not connecting properly to nail	**Set-screw too high in nail**	Advance set-screw with T-Handle or flexible screwdriver (3.5mm hex)
Difficulty passing long guidewire or nail across fracture site	**Inadequate fracture reduction**	Accurate reduction should be performed, with a low threshold for open reduction or minimally invasive fracture reduction techniques
Femoral head guidewire will not pass through nail	**Long guidewire still in situ**	Remove long guidewire
Ø9.1mm reamer will not pass through nail	**Set-screw blocking progress**	Insert flexi-drive and flexible screwdriver into proximal end of jig and retract the set-screw superiorly
Ø9.1mm reamer will not pass through nail	**Jig sagged due to gravity and lever-arm ('Jig sag')**	Leaving the Ø9.1mm reamer temporarily in-situ will help stabilise jig, as does the distal locking screw when implanted
Ø4.0mm drill-bit won't pass through nail	**Not aligned with the hole**	Tighten jig to nail Ensure not leaning on jig and/or bending jig
Cannot implant distal locking screw after drilling	**Jig sag**	Leave Ø9.1mm reamer in place until distal locking is complete
Bone crusher unable to advance to deep tip-apex point	**Too shallow reaming with Ø9.1mm reamer**	Re-insert guidewire and ream again to deep tip-apex point with Ø9.1mm reamer
Cannot implant X-Bolt after reaming	**Jig sag**	Distal lock before implanting X-Bolt
X-Bolt spins when attempting to deploy	**Set-screw not engaged on flat aspect of X-Bolt shaft**	Rotate X-Bolt until flat aspect faces superiorly and then gently advance set screw (light finger grip on screwdriver) to just lightly kiss onto the superior flat aspect of X-Bolt

REMOVAL INSTRUCTIONS

STANDARD REMOVAL

		Part Code
1.	**STANDARD REMOVAL.** Retract X-Bolt expansion with anticlockwise rotation of screwdriver, inserted into base of X-Bolt. The retraction of the X-Bolt will crush new bone formed within expanded wings.	XNI-022
2.	**REMOVE END-CAP.** When wings fully retracted, insert guidewire into cannulated end-cap. Remove end-cap using 4.0mm-hex cannulated screwdriver.	XNI-024
3.	**LOOSEN SET-SCREW.** Insert 3.5mm-hex screwdriver and loosen set screw sufficiently to enable free passage of X-Bolt through nail aperture.	
4.	**REMOVE X-BOLT.** Insert removal rod into X-Bolt, noting the anticlockwise (left hand) threads. Remove X-Bolt using removal rod, and slap hammer extension, if necessary.	XNI-033 XNI-035
5.	**REMOVE NAIL.** Remove distal locking screw with standard 3.5mm hex screwdriver. Remove nail using removal rod and slap hammer, if necessary.	XNI-034 XNI-035

BROKEN REMOVAL



1.	**BROKEN REMOVAL.** In the rare event of X-Bolt breaking at the wing elbows, continue anticlockwise turns to disengage drive screw from deep parachute fragment.	XNI-022
2.	**END-CAP AND SET-SCREW.** Remove end-cap and loosen set-screw, as described above.	XNI-024
3.	**REMOVE SHAFT OF X-BOLT.** Insert removal rod into base of X-Bolt, noting the anticlockwise (left hand) threads. Remove X-Bolt shaft and drive screw, leaving the parachute fragment in-situ.	XNI-033 XNI-035
4.	**REMOVE NAIL.** Remove distal locking screw and nail, as described above.	XNI-034 XNI-035
5.	**PARACHUTE FRAGMENT.** If removal of parachute fragment is desired (it may be left in-situ or removed with femoral head if converting to arthroplasty), place grasper guidewire into right-hand threads of the parachute fragment until a stop is felt.	*XNI-038
6.	**PARACHUTE GRASPER.** Slide grasper over guidewire, under fluoroscopy and flatten parachute wings in orthogonal planes. The parachute fragment is removed by manually pulling backwards on the guidewire.	XNI-037

ORDERING INFORMATION

X-Bolt®
stainless steel
Ø 9.0mm

Code	Description
XBB-080	80mm X-Bolt
XBB-085	85mm X-Bolt
XBB-090	90mm X-Bolt
XBB-095	95mm X-Bolt
XBB-100	100mm X-Bolt
XBB-105	105mm X-Bolt
XBB-110	110mm X-Bolt
XBB-115	115mm X-Bolt
XBB-120	120mm X-Bolt
XBB-125	125mm X-Bolt

IM Hip Nail
stainless steel
130-degree
4^{o} valgus
14.5mm proximal diameter
10.0mm distal diameter
2.0m radius bend for long nails
All sided Left or Right
Pre-loaded set-screw

XNN-191	195mm -Short- IM Hip Nail (left)
XNN-192	195mm -Short- IM Hip Nail (right)
XNN-341	340mm X-Bolt Nail (left)
XNN-342	340mm X-Bolt Nail (right)
XNN-361	360mm X-Bolt Nail (left)
XNN-362	360mm X-Bolt Nail (right)
XNN-381	380mm X-Bolt Nail (left)
XNN-382	380mm X-Bolt Nail (right)
XNN-401	400mm X-Bolt Nail (left)
XNN-402	400mm X-Bolt Nail (right)
XNN-421	420mm X-Bolt Nail (left)
XNN-422	420mm X-Bolt Nail (right)

Nail End-Cap
stainless steel
Cannulated 4.0mm-hex socket

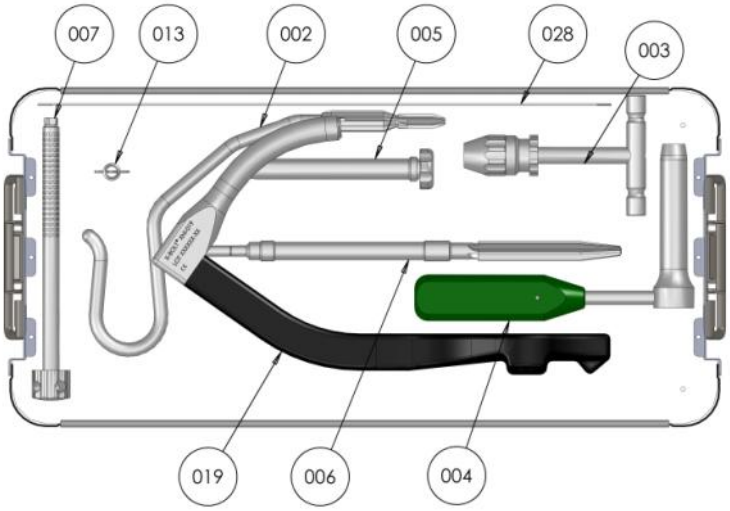
XNE-002	End-cap +2.0mm
XNE-005	End-cap +5.0mm

Distal Locking Screw
stainless steel
Ø 5.0mm, self-tapping

XND-030	30mm x Ø5.0mm Distal locking screw
XND-035	35mm x Ø5.0mm Distal locking screw
XND-040	40mm x Ø5.0mm Distal locking screw
XND-045	45mm x Ø5.0mm Distal locking screw
XND-050	50mm x Ø5.0mm Distal locking screw
XND-055	55mm x Ø5.0mm Distal locking screw

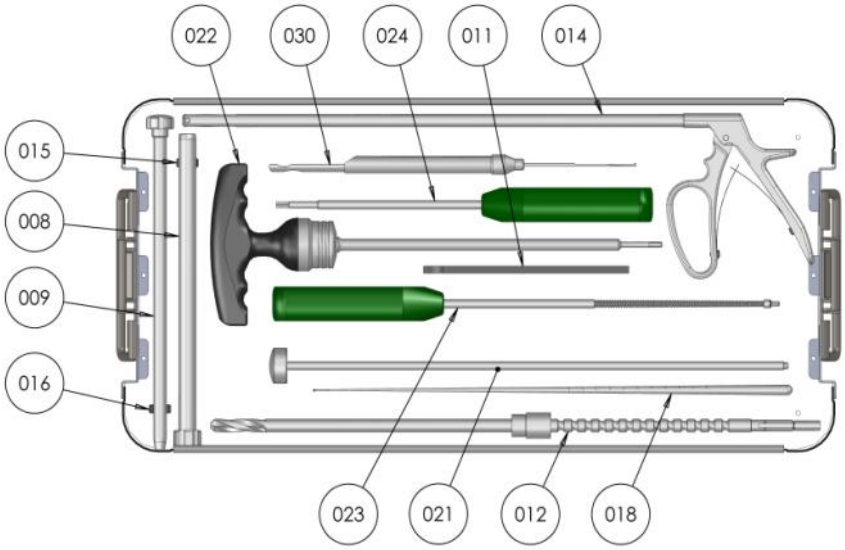
Single Sterile Packaged Consumables

XNI-001	Ø 2.4mm x 900mm long guidewire
XNI-010	Ø 3.2mm x 385mm femoral head guidewire
XNI-017	Ø 4.0mm x 305mm pilot drill bit, quick connect
XNI-029	Ø 4.0mm x 150mm pilot drill bit, quick connect
XNI-038	Parachute grasper guidewire



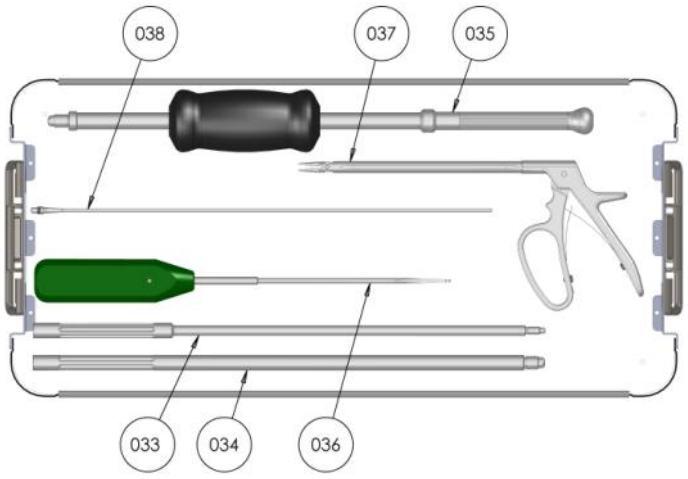
Set X

Description	Part Code
Curved Awl Cannulated	XNI-002
T-handle quick-fit Jacobs chuck	XNI-003
Outer proximal reamer sleeve	XNI-004
Inner proximal reamer sleeve	XNI-005
Rigid conical reamer	XNI-006
Flexi-drive for M-10 bolt	XNI-007
M-10 connector bolt	XNI-013
Alignment jig	XNI-019
Long nail measuring ruler	XNI-028



Set Y

Outer drill sleeve for X-Bolt	XNI-008
Inner drill sleeve for X-Bolt	XNI-009
Guidewire ruler for X-Bolt	XNI-011
Ø9.1mm X-Bolt drill-reamer	XNI-012
Bone crusher	XNI-014
Outer distal locking sleeve	XNI-015
Inner distal locking sleeve	XNI-016
Depth hook for locking screw	XNI-018
Compression screw rod	XNI-021
3.5mm-hex screwdriver (T-handle) (4.5Nm torque limit)	XNI-022
3.5mm-hex screwdriver (flexible)	XNI-023
4.0mm-hex screwdriver (cannulated)	XNI-024
Depth gauge for cortical screw	XNI-030



Set Z (Removal set)

X-Bolt extractor shaft	XNI-033
Nail extractor shaft	XNI-034
Slap hammer	XNI-035
Crochet hook removal tool	XNI-036
Parachute grasper	XNI-037
Guidewire for parachute grasper	XNI-038

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