Medeon Biodesign Cross-Seal™ System

Suture-Mediated Vascular Closure Device System

CAUTION: Federal (USA) law restricts this device to sale by or on the order of a physician.

INSTRUCTIONS FOR USE

Medeon Biodesign Cross-Seal System

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CAUTION: TO ENSURE PROPER USE OF THIS DEVICE AND TO PREVENT INJURY TO PATIENTS, READ ALL INFORMATION CONTAINED IN THESE INSTRUCTIONS FOR USE.

1.0 Description of Cross-Seal System

The Medeon Biodesign Cross-Seal Suture-Mediated Vascular Closure Device System (Cross-Seal System) is designed to deliver two pairs of monofilament polypropylene sutures simultaneously to close the femoral artery access sites of patients who have undergone diagnostic or interventional catheterization procedures. The Cross-Seal System includes the Cross-Seal Device and three accessories (Cross-Seal Knot Tyer, Cross-Seal Knot Pusher, and Cross-Seal Suture Trimmer).

1.1 Cross-Seal Device Description

The Cross-Seal Device (**Figure 1.1**) is composed of a Catheter, Suture Delivery System, and Handle.

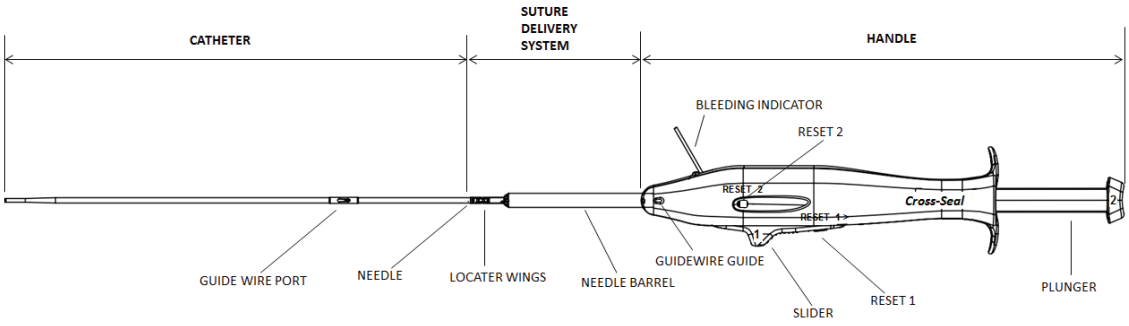


Figure 1.1 Cross-Seal Device

The Cross-Seal Device tracks over a standard 0.038” or 0.035” (minimum length 130 cm) guidewire. A hemostasis valve located in the middle of the CATHETER limits blood flow from the GUIDEWIRE PORT through the CATHETER with or without the guidewire in place. The SUTURE DELIVERY SYSTEM contains NEEDLES, LOCATOR WINGS, and the NEEDLE BARREL that control suture placement around the arteriotomy. The HANDLE contains the SLIDER, BLEEDING INDICATOR, PLUNGER, RESET 1 BUTTON (SLIDER RETRACTOR), and RESET 2 BUTTON (LOCATOR WINGS RETRACTOR). The SLIDER triggers a mechanism that opens the LOCATOR WINGS and creates a sandwich configuration to stabilize the delivery system within the vessel wall. The BLEEDING INDICATOR connects to a lumen that has an intraluminal port positioned at the distal end of the Suture Delivery System to allow bleeding back to ensure Suture Delivery System is positioned properly in the

femoral artery. The NEEDLE BARREL keeps the Cross-Seal Device from moving deeper inside the vessel, stabilizes the device once the LOCATOR WINGS are opened and retrieves the disengaged suture-carried NEEDLES. The PLUNGER triggers the NEEDLES to deploy sutures and simultaneously close the LOCATOR WINGS. The GUIDEWIRE GUIDE is the feature at distal handle portion which allows the physician to practice coaxial insertion of the device along the guidewire if necessary.

1.2 Cross-Seal Accessories Description

The Cross-Seal Accessories (Cross-Seal Knot Tyer, Cross-Seal Knot Pusher, and Cross-Seal Suture Trimmer) are designed to tie the knots, position the knot to the top of the arteriotomy and to trim the trailing limbs of suture, respectively. The Cross-Seal Accessories are depicted in **Figure 1.2**

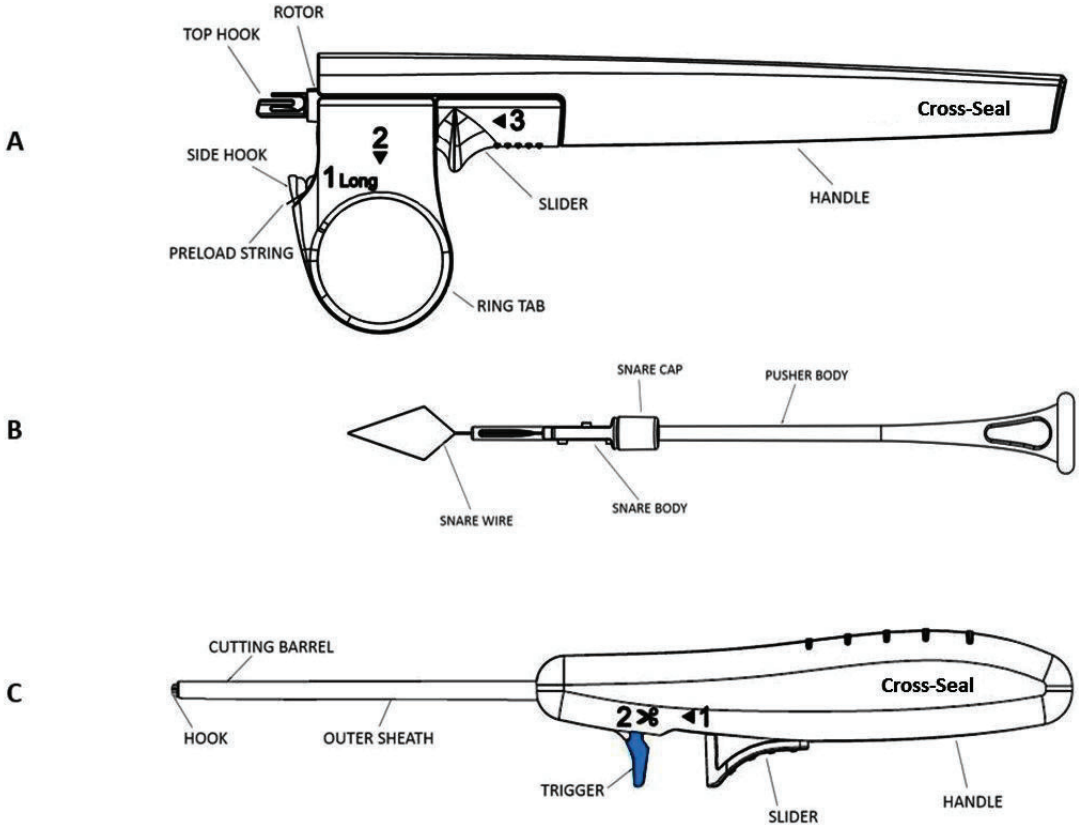


Figure 1.2 Cross-Seal Accessories

A. Cross-Seal Knot Tyer; **B**. Cross-Seal Knot Pusher; **C**. Cross-Seal Suture Trimmer

2.0 How Supplied

The Cross-Seal System is provided sterile and non-pyrogenic in an unopened, undamaged package. The Cross-Seal System is sterilized with ethylene oxide and intended for single use

only. Store in cool, dry place.

Cross-Seal System Includes:

One (1) Cross-Seal™ Device (packaged separately)
Three (3) Cross-Seal™ Knot Tyers
Two (2) Cross-Seal™ Knot Pushers
One (1) Cross-Seal™ Suture Trimmer

3.0 Indications for Use

The Cross-Seal Suture-Mediated Vascular Closure Device System is indicated for the percutaneous delivery of sutures for closing the common femoral artery access site while reducing time-to-hemostasis in patients who have undergone diagnostic or interventional catheterization procedures using 8F to 18F introducer sheaths. The Cross-Seal System is indicated for one access site per leg.

4.0 Contraindications

There are no known contraindications to the use of this device. Attention is drawn to the Warnings, Precautions, and Special Patient Populations sections below.

5.0 Warnings

DO NOT use the Cross-Seal System if the packaging or sterile barrier have been previously opened or damaged, or if the components appear to be damaged or defective.

DO NOT RESTERILIZE OR REUSE. The Cross-Seal System is intended for single use only.

DO NOT use the Cross-Seal System if the sterile field has been broken where bacterial contamination of the sheath or surrounding tissues may have occurred, since such a broken sterile field may result in infection.

DO NOT use the Cross-Seal System if the puncture site is located above the most inferior border of the inferior epigastric artery (IEA) and/or above the inguinal ligament based upon bony landmarks, since such a puncture site may result in a retroperitoneal hematoma. Perform a femoral angiogram to verify the location of the puncture site. NOTE: This may require both a Right Anterior Oblique (RAO) and Left Anterior Oblique (LAO) angiogram to adequately visualize where the sheath enters the femoral artery.

DO NOT use the Cross-Seal System if the puncture is through the posterior wall or if there are multiple punctures, since such punctures may result in a hematoma or retroperitoneal bleed.

DO NOT use the Cross-Seal System if the puncture site is located in the superficial femoral artery or the profunda femoris artery, or the bifurcation of these vessels, since such puncture sites may result in a pseudoaneurysm, intimal dissection, or an acute vessel closure (thrombosis of small artery lumen). Perform a femoral angiogram to verify the location of the puncture site. NOTE: This may require both a Right Anterior Oblique (RAO) and Left Anterior Oblique (LAO) angiogram to adequately visualize where the sheath enters the femoral artery.

DO NOT attempt to advance device with excessive force while (1) resistance or difficulty is encountered; (2) and/or bleeding back is not patent, which could cause severe vascular injury.

6.0 Precautions

1. The Cross-Seal system should only be used by a licensed physicians (or other healthcare professionals authorized by or under the direction of such physicians) after they have been trained.
2. Prior to use, inspect the Cross-Seal System to ensure that the sterile packaging has not been damaged during shipment. Examine all components prior to use to verify proper function. Exercise care during device handling to reduce the possibility of accidental device breakage.
3. As with all catheter-based procedures, infection is a possibility. Observe sterile technique at all times when using the Cross-Seal System. Employ appropriate groin management post procedure and post hospital discharge to prevent infection.
4. DO NOT use device if access site of target limb has stenosis, which could cause severe stenosis, and/or ipsilateral limb ischemia after closure.
5. Use a single wall puncture technique. DO NOT puncture the posterior wall of the artery.
6. DO NOT deploy the Cross-Seal Device into the femoral artery at an angle greater than 45 degrees to the longitudinal plane of the artery as this may cause a failure during needle and suture deployment.
7. DO NOT deploy PLUNGER if BLEEDING INDICATOR is not patent after SLIDER deployment.
8. During PLUNGER deployment, stabilize the Cross-Seal Device by maintaining the HANDLE in a neutral position with a steady hand to prevent the device from moving forward or backward (**Figure 6.0**). Moving the device excessively backward or forward during deployment could cause needle deflection or excessive tissue bite, respectively. The excessive tissue bite may cause stenosis after closure. Apply gentle but not excessive force to deploy the PLUNGER to avoid breakage of the device, which may necessitate

intervention and/or surgical removal of the device and vessel repair.

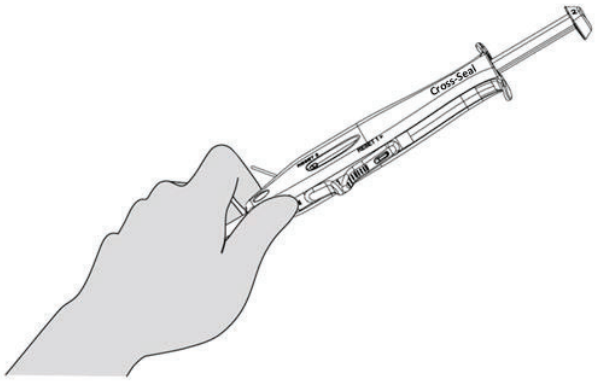


Figure 6.0 Stabilize Cross-Seal Device

9. DO NOT attempt to stop or pull PLUNGER back during PLUNGER deployment. Interrupting PLUNGER deployment can lead to malfunction of the Cross-Seal Device, which may result in partial NEEDLE deployment or inability to close LOCATOR WINGS. The situations may necessitate intervention and/or surgical removal of the device and vessel repair.
10. DO NOT attempt to remove the device while LOCATOR WINGS are opened, since this could result in device damage and/or lead to vessel trauma, which may necessitate intervention and/or surgical removal of the device and vessel repair.
11. DO NOT advance or withdraw the Cross-Seal Device against resistance until the cause of that resistance has been determined (*Refer to Section 10.0 Cross-Seal System Clinical Procedure*). Excessive force used to advance or torque the Cross-Seal Device should be avoided as it may lead to significant arterial damage and/or breakage of the device, which may necessitate intervention and/or surgical removal of the device and vessel repair.
12. If excessive resistance in advancing the Cross-Seal Device is encountered, after determining the cause of that resistance, withdraw the Cross-Seal Device over a 0.038" or 0.035" (minimum 130 cm length) guidewire and reinsert the introducer sheath. Flush the BLEEDING INDICATOR and CATHETER immediately after removal to avoid clot formation in the lumen.
13. Fisherman's knot is required to ensure suture knot stability. Tie and prepare two (2) Fisherman's knots (*Refer to Section 10.3.1 Use of Cross-Seal Knot Tyer*) prior to sheath dilation to diagnostic or interventional catheterization procedures to allow adequate knot tying time.
14. Pre-Tie Fisherman's knot with Cross-Seal Knot Tyer on an 8F sheath is required prior to dilation to diagnostic or interventional catheterization procedures. Post-tie Fisherman's knot with Cross-Seal Knot Tyer (after diagnostic or interventional catheterization

procedures) should not be attempted, as increased resistance caused by suture tension could lead to vessel wall tear.

15. When using the Cross-Seal Knot Tyer, keep Cross-Seal Knot Tyer as close to the vessel puncture site as possible while pulling the RING TAB to avoid tension generated during the use of Cross-Seal Knot Tyer.
16. While introducing a large bore sheath during the index procedure, avoid quick or jerky type movements to minimize vascular injury such as dissection.
17. Gently advance the knots to avoid vessel damage, as described in *Section 10.3.2 Use of Cross-Seal Knot Pusher*. Remove the guidewire before tightening the knots in order to avoid tying the knots onto the guidewire.
18. In using this or any other suture material, care should be taken to avoid damage from handling. Avoid crushing damage due to application of surgical instruments such as clamps, forceps or needle holders.
19. To prevent suture breakage, always pull on the suture limbs with slow, consistent, increasing tension. Avoid quick or jerky type movements with the suture limbs. If suture breakage occurs, discard suture material and based on the physician assessment of the amount of bleeding use manual compression, compression assisted devices, and/or a surgical repair to obtain hemostasis.
20. Do not apply excessive compressive force on groin while sliding the knot down with pusher, which could keep from knot delivery and cause failure of hemostasis.
21. In the event bleeding from the femoral access site persists after the use of the Cross-Seal System, the physician should assess the situation. Based on the physician's assessment of the amount of bleeding use manual compression, compression assisted devices, and/or a surgical repair to obtain hemostasis.
22. During closure of the arteriotomy sites in those cases where the implanting physician is not a vascular surgeon, it is recommended that a vascular surgeon or a surgeon with vascular training be available during the procedure to perform any necessary surgical intervention.
23. Do not apply excessive force for guidewire insertion while resistance is encountered, which can cause vessel injury such as dissection.
24. In the event that bleeding from the femoral access site persists after the use of the Cross-Seal device, the physician should assess the situation. Based on the physician assessment of the amount of bleeding, use manual or mechanical compression, application of a balloon press from a secondary access site, placement of a covered stent, and/or a surgical repair to obtain hemostasis.

7.0 Special Patient Populations

The safety and effectiveness of the Cross-Seal System has not been established in the following special patient populations:

1. Patients in whom the percutaneous transcatheter interventional procedures involve access through the femoral artery using < 8F or > 18 F introducer sheaths.
2. Patients with common femoral artery lumen diameter < 5 mm.
3. Patients with access site above the most inferior border of the inferior epigastric artery (IEA) and/or above the inguinal ligament based upon bony landmarks.
4. Patients having arterial access other than the common femoral artery.
5. Patients younger than 18 years old.
6. Patients with prior intra-aortic balloon pump at access site at any time prior.
7. Patients with severe claudication, severe inflow disease (iliac artery diameter stenosis > 50%) and/or severe peripheral arterial disease (Rutherford Classification 5 or 6), as confirmed with prior standard of care CT Imaging, duplex ultrasound, and/or intra-procedural fluoroscopy.
8. Patients with prior vascular surgery, bypass surgery, vascular graft, or stent placement in the vicinity of access site.
9. Patients receiving glycoprotein IIb/IIIa inhibitors before, during, or after the catheterization procedure.
10. Patients with significant anemia (Hgb < 10 g/dL, Hct < 30%).
11. Patients with potential drop of hemoglobin post-operation that requires transfusion.
12. Patients with bleeding diathesis or known bleeding disorder including thrombocytopenia (platelet count < 100,000), thrombasthenia, hemophilia, or Von Willebrand's disease.
13. Patients with renal insufficiency (serum creatinine level > 221µmol/L or 2.5 mg/dL), on dialysis therapy, or with renal transplant.
14. Patients with known severe allergy to contrast reagent that cannot be managed with premedication.
15. Patients with inability to tolerate aspirin and/or other anticoagulation/antiplatelet treatment.
16. Patients with planned anticoagulation therapy post-procedure such that ACT is expected to be elevated above 350 seconds for more than 24 hours after the procedure.
17. Patients with connective tissue disease (e.g., Marfan's Syndrome).
18. Patients with thrombolytics (e.g., t-PA, streptokinase, urokinase), Angiomax (bivalirudin), or other thrombin-specific anticoagulants ≤ 24 hours prior to the procedure.
19. Patients with recent (within 8 weeks) cerebrovascular accident or Q-wave myocardial infarction.
20. Patients who are morbidly obese (BMI > 40 kg/m^2).
21. Patients with planned major intervention or surgery, including planned endovascular

procedure in the target leg, within 30 days following the interventional procedure.

22. Patients with known allergy to any device component.
23. Patients who are pregnant or lactating.
24. Patients with active systemic, cutaneous, or local groin infection or inflammation.
25. Patients with New York Heart Association (NYHA) Class IV heart failure that is uncontrolled and requires treatment in the Intensive Care Unit within 24 hours prior to the index procedure.
26. Patients with left Ventricular Ejection Fraction (LVEF) < 20%.
27. Patients with unilateral or bilateral lower extremity amputation.
28. Patients with existing nerve damage in the target leg.
29. Patients with access site in the profunda femoris or superficial femoral arteries, or the bifurcation of these vessels.
30. Patients with ipsilateral femoral venous sheath during the catheterization procedure, or with ipsilateral arterial access site punctured and compressed within 48 hours of closure. NOTE: The previous / initial punctured site may have the potential to re-bleed due to an unstable clot and / or anticoagulants, even if the new puncture site is successfully closed with the Cross Seal System.
31. Patients with common femoral artery calcium at the arteriotomy site (i.e., target access site), which is visible with prior CT Imaging and/or duplex ultrasound.
32. Patient where there is difficulty inserting the introducer sheath or need for greater than 2 ipsilateral arterial punctures at the start of the catheterization procedure.
33. Patients with antegrade punctures.
34. Patients with intra-procedural bleeding around access site.
35. Patients with pre-existing hematoma (> 1.5 cm in diameter), arteriovenous fistula, pseudoaneurysm, or intraluminal thrombosis at the access site.
36. Patients with target arteriotomy > 18F ID sheath.

Before considering early discharge, assess the patient for the following clinical conditions:

- Conscious sedation
- Anticoagulation, thrombolytic, or antiplatelet therapy
- Unstable cardiac status
- Hematoma at the closure site
- Hypotension
- Pain while walking
- Bleeding at the closure site
- Any comorbid condition requiring observation

The presence of any of the above factors has generally led to the deferral of early discharge recommendations.

8.0 Potential Adverse Events

Potential and identified complications associated with the use of the Cross-Seal System as with all other suture-mediated closure devices may include, but are not limited to, the following:

- Allergic reaction or hypersensitivity to device components
- Anemia
- Arterial stenosis/occlusion
- Arteriovenous fistula
- Bleeding*/hemorrhage
- Bruising
- Death
- Deep vein thrombosis
- Device entrapment
- Device failure/malfunction/misplacement
- Diminished pulses distal to closure site
- Embolism
- Extended Hospitalization / Delayed time to ambulation
- Hypotension / hypertension
- Hematoma*
- Infection/sepsis
- Inflammation
- Intimal tear/dissection
- Ischemia distal to closure site
- Nerve injury
- Numbness
- Pain
- Perforation
- Pseudoaneurysm*
- Pulmonary embolism
- Retroperitoneal hematoma/bleeding
- Superficial vein thrombosis
- Surgical exposure/closure of common femoral artery
- Thrombus formation
- Vascular injury*
- Vasovagal episode
- Vasoconstriction/vasospasm
- Wound dehiscence

*indicates those complications reported within the IDE clinical study discussed below.

9.0 Cross-Seal System Clinical Trial

9.1 Study Design

The Cross-Seal System IDE Study was a prospective, multi-center, single arm, clinical study designed to investigate the safety and effectiveness of the Cross-Seal System for closure of the femoral artery access site of subjects who had undergone interventional catheterization procedures using 8-18Fr ID procedural sheaths. The study was conducted at 19 investigational sites all based within the United States. A total of 147 subjects were enrolled in the study, with 51 subjects in the roll-in cohort and 96 subjects in the pivotal cohort. Up to 2 roll-in patients per investigator were allowed to give investigators an opportunity to learn how to use the Cross-Seal device. Patient enrollment in the study was suspended and the study was then terminated earlier than planned due to the COVID-19 pandemic, since travel limitations as a result of the COVID-19 pandemic had adversely impacted study enrollment, patient follow-up, and ongoing data monitoring. This early termination was approved by the FDA, with there being a sufficient number of enrolled patients to evaluate the Cross-Seal device. For the roll-in patients, the first date of enrollment was 8/9/19, the last date of enrollment was 2/24/20, and the last follow-up completion date was 5/13/20. For the pivotal patients, the first date of enrollment was 9/5/19, the last date of enrollment was 3/12/20, and the last follow-up completion date was 10/8/20.

When enrollment of the study patients was suspended, the clinical protocol was accordingly revised to accommodate the challenges of patient follow-up during the COVID-19 pandemic. In order to address the potential for underpowered analyses of the primary safety and effectiveness endpoints due to the decrease in the number of enrolled study patients from the number originally planned, the statistical analysis plan was revised such that if the number of evaluable patients for the primary safety and effectiveness endpoints dropped below the estimated sample size for each, then the sample size would be augmented by adding the last 18 consecutively enrolled patients from the roll-in arm. The evaluable sample size for the primary safety endpoint was 88 which exceeded the 78 patients required from the sample size justification, so there was no need to add roll-in patients for this safety analysis. The term “pivotal safety cohort” was used to refer to the 96 pivotal-only patients for the safety analysis cohort and to refer in general to the 96 pivotal-only patients. For the primary effectiveness endpoint, the evaluable sample size was 85 which was just below the 86 patients required from the sample size justification. Therefore, the last 18 roll-in patients were added for this effectiveness analysis and the term “pivotal effectiveness cohort” was used to refer to the effectiveness analysis cohort of 114 patients consisting of 96 pivotal plus 18 roll-in patients.

The primary safety endpoint was the 30-day freedom from major complications of the target limb access site. The performance goal for the primary safety endpoint was established as 85.2% based upon the FDA Summary of Safety and Effectiveness Data (SSED) for the Abbott Vascular Perclose ProGlide™ VCD. The primary effectiveness endpoint was defined as the mean time-to-hemostasis (TTH) from procedural sheath (or introducer sheath) removal to first observed cessation of common femoral artery bleeding in the target limb for subjects not requiring adjunctive intervention. The statistical sample size and primary effectiveness endpoint were calculated based on a performance goal of 15 minutes based upon published literature on the Perclose ProGlide™ VCD with a TTH of 9.8 minutes and standard deviation of 17 minutes. The primary effectiveness endpoint analysis does not include patients who received adjunctive therapy.

The following secondary safety and effectiveness endpoints were evaluated and included:

- Freedom from minor complications of the target limb access site within 30 days post-procedure.
- Device- and procedural-related complications within 30 days post-procedure.
- Evaluation of Adverse Events within 30 days and 60 days of procedure including major and minor complications.
- Technical Success: defined as achievement of hemostasis with the investigational device without the need for any access site-related adjunctive surgical or endovascular intervention on the target limb.
- Access site closure success: defined as technical success and freedom from major complications within 48 hours of the index procedure or hospital discharge, whichever occurs first (target limb only).
- Treatment success: defined as technical success and freedom from major complications through 30-days follow-up.
- Subjects requiring adjunctive surgical or endovascular intervention to achieve hemostasis of the access site (target limb only).
- Subjects receiving adjunctive manual compression (e.g., light or firm) following use of the investigational device to achieve hemostasis of the access site.

- Time-to-Ambulation (TTA): defined as elapsed time from final procedural sheath removal to time when the subject stands and walks at least 20 feet without re-bleeding.
- Time-to-Discharge (TTD): defined as elapsed time between final procedural sheath removal and when the subject was discharged from the hospital.
- Occurrence of device failure: defined as the device is used per the IFU, but does not perform as described in the IFU, and negatively impacts treatment of the study subject.

Adjunctive intervention was defined as any use of surgical or endovascular intervention OR firm/occlusive manual pressure needed to achieve access site hemostasis (light/non-occlusive pressure to control cutaneous or subcutaneous oozing at the access site was excluded).

Patients were eligible for the Cross-Seal IDE clinical trial if they were undergoing a planned or elective TAVR/TAVI, TEVAR, EVAR, or BAV procedure with the use of 8-18Fr (ID) procedural sheath. They were to be candidates for emergent surgical intervention in the event of a vascular closure complication and had to meet all entrance criteria. Key entrance criteria included but were not limited to the following:

- Exclusion Criteria
  - Inflow disease (iliac artery diameter stenosis > 50%) and/or severe peripheral arterial disease (Rutherford Classification 5 or 6)
  - Common femoral artery lumen diameter < 5 mm
  - Significant anemia (Hgb < 10g/dL, Hct < 30%)
  - Bleeding disorder thrombocytopenia (platelet count < 100,000), thrombasthenia, hemophilia or Von Willebrand's disease
  - Renal insufficiency (serum creatinine level > 221 μmol/L or 2.5 mg/dL), on dialysis therapy, or with renal transplant
  - Morbidly obese (BMI > 40 kg/m^2)
  - Major intervention or surgery, including planned endovascular procedure in target leg within 30 days following the interventional procedure
  - Left Ventricular Ejection Fraction (LVEF) < 20%
  - Unilateral or bilateral lower extremity amputation

- Intra-Procedure Exclusion Criteria
    - CFA calcium
    - Multiple arterial punctures
    - Pre-existing hematoma (> 1.5 cm diameter), arteriovenous fistula, pseudoaneurysm, or intraluminal thrombosis at access site
    - Marked tortuosity of the femoral or external iliac artery in target leg based on prior CT, Fluoroscopy, and/or Duplex ultrasound
    - Target arteriotomy > 18Fr (ID) or < 8Fr (ID)

Data related to safety and effectiveness measures were collected pre-procedure, intra-procedure, immediately post-procedure, and prior to hospital discharge. Femoral artery angiography was performed to assess the femoral artery and puncture site prior to utilizing the investigational device and after procedure for assessment of major and/or minor complications. A follow-up visit was conducted at 30 days post-procedure which included a Femoral Duplex Ultrasound (DUS) for assessment of groin/access site related complications in the target limb. For subjects with an abnormal DUS finding at 30 days, an additional follow-up visit at 60 days post-procedure was performed which included a repeat DUS. Adverse events were recorded throughout the study, and an independent Core Laboratory was used to evaluate all ultrasound images. All potential major and minor complications were presented to an independent Clinical Events Committee (CEC) for adjudication.

9.2 Effectiveness Analysis

The study enrolled 114 patients into the primary effectiveness cohort, with a mean age of 76.4 ± 10.26 years. The patient demographics included 66.7% males and 33.3% females with a mean BMI of 28.2 ± 5.08. Procedural data reflected 43.9% EVAR, 53.5% TAVR/TAVI and 2.6% TEVAR. Approximately 1.1 Cross-Seal devices were used per patient.

The primary effectiveness endpoint of mean TTH was evaluable in 101/114 subjects in the pivotal effectiveness cohort. The mean TTH was 0.4 ± 1.4 minutes with an upper one-sided 97.5% confidence limit of 0.7 minutes against a performance goal of 15 minutes. Grouping TTH, approximately 92% of the subjects secured hemostasis within 1 minute or less. 76.2%, 15.8%, 0%, and 7.9% of the patients had hemostasis in < 10 seconds, between 10-30 seconds, 30-60 seconds, and > 60 seconds, respectively. The primary effectiveness endpoint results are

represented in **Table 1** below. The primary effectiveness endpoint analysis does not include patients who received adjunctive therapy. The outcomes of the secondary effectiveness endpoints are reported in **Table 2** below.

Table 1: Primary Effectiveness Endpoint

Effectiveness Parameters	Pivotal Effectiveness (N=114)
Primary Effectiveness Endpoint - Time-to-Hemostasis (minutes)	
N	101
Mean ± SD	0.4 ± 1.40
Median (IQR)	0.05 (0.017 - 0.15)
Min, Max	0, 12.1
Upper One-Sided 97.5% Confidence Limit†	0.7

Table 2: Secondary Effectiveness Endpoints

Secondary Effectiveness Endpoint	Result
Technical Success	92.7% (102/110)
Access Site Closure Success	88.4% (99/112)
Treatment Success	88.4% (99/112)
Adjunctive Surgical/ Endovascular Intervention	7.3% (8/110)
Surgical	25.0% (2/8)
Endovascular	75.0% (6/8)
Manual Compression Used	27.9% (31/111)
Firm (occlusive)	16.1% (5/31)
Light (non-occlusive)	83.9% (26/31)
Device Failures	0.9% (1/114)
Time to Ambulation	
N	108
Mean ± SD	15.9 ± 14.65
Median (IQR)	10.5 (7 - 21)
Min, Max	2, 90
Time to Discharge (hours)	
N	110
Mean ± SD	44.8 ± 36.99

Secondary Effectiveness Endpoint	Result
Median (IQR)	27 (25 - 51)
Min, Max	18, 246

For sex, age and race subgroup analysis, the primary effectiveness endpoint excluded patients that received adjunctive therapy while the secondary effectiveness endpoints analyzed all patients including those that received adjunctive therapy.

9.3 Safety Analysis

The primary safety cohort was comprised of a total of 96 subjects with a mean age of 76.3 ± 10.59 years. The patient demographics included 67.7% males and 32.3% females with a mean BMI of 28.0 ± 5.17. Procedural data reflected 44.8% EVAR, 53.1% TAVR/TAVI and 2.1% TEVAR. A mean of 1.1 Cross-Seal devices were used per patient.

Among the 96 subjects in the pivotal safety cohort, 8.3% (8/96) exited from the study prior to the 30-day follow-up window, leaving 88 subjects evaluable for the primary and secondary safety endpoints. The primary safety endpoint of 30-day freedom from major complications was 94.3% (83/88) with a lower one-sided 95% confidence limit of 88.4% compared to the performance goal of 85.2%. Thus, the primary safety endpoint for the study was met. There were six major complications in five subjects; one subject had two major complications. The results are summarized in **Table 3** below.

Table 3: Primary Safety Endpoint

Endpoint	Pivotal Safety
Freedom from Major Complications through 30-days	94.3% (83/88)
Lower one-sided 95% confidence limit (Performance Goal > 85.2%)	88.4%
Types of Major Complications: [1]	
Vascular injury that requires surgical repair, stent-graft, or balloon angioplasty	4.5% (4/88)
Access site-related bleeding that requires transfusion	1.1% (1/88)
Ipsilateral lower extremity ischemia documented by subject symptoms, physical exam, and/or decreased or absent blood flow on lower extremity angiogram	1.1% (1/88)

Endpoint	Pivotal Safety
Access site-related nerve injury that requires surgery	0.0% (0/88)
Permanent (lasting > 30 days) access site-related nerve injury	0.0% (0/88)
Access site infection requiring intravenous antibiotics and/or extended hospitalization	0.0% (0/88)

[1]For major complications, the event-free rate of 94.3% (83/88) was for 6 events in 5 patients in the pivotal safety cohort.

The results for the secondary safety endpoints are summarized in **Table 4** below. There was no performance goal, hypothesis, or clinical acceptance criterion associated with the secondary endpoints. Freedom from minor complications at target limb access site within 30 days was reported at 95.5% (84/88) of the pivotal safety cohort. Among the individual components of the minor access site complication composite endpoint, treated pseudoaneurysms were reported in 2.3% (2/88), hematomas were reported in 1.1% (1/88), and "other complication" was reported in 1.1% (1/88). There were four device-related complications within 30 days, which were also considered to be procedure-related, as adjudicated by the CEC. No minor complications were observed at the 60-day time period.

Table 4: Secondary Safety Endpoints: Minor Complications

Minor Complications (30 Day) [1]	Pivotal Safety Cohort
Freedom from Minor Access Site Complications	95.5% (84/88)
Pseudoaneurysm - Not Treated	0.0% (0/88)
Pseudoaneurysm - Treated with ultrasound-guided compression, ultrasound-guided thrombin injection, or ultrasound-guided fibrin adhesive injection	2.3% (2/88)
Non-treated or treated AV Fistula	0.0% (0/88)
Access Site Hematoma ≥ 10 cm	1.1% (1/88)
Late (following hospital discharge) access site-related bleeding	0.0% (0/88)
Lower extremity arterial emboli	0.0% (0/88)
Vein Thrombosis	0.0% (0/88)

Minor Complications (30 Day) [1]	Pivotal Safety Cohort
Transient access site-related nerve injury	0.0% (0/88)
Access site infection treated with intramuscular or oral antibiotics	0.0% (0/88)
Other Complication [2]	1.1% (1/88)
Device-Related Complications	4.5% (4/88)
Procedure-Related Complications	4.5% (4/88)

1 For minor complications, the rate of 4.5% (4/88) was for 4 events in 4 patients in the pivotal safety cohort.

2 Persistent access site-related bleeding at the time of attempted Cross-Seal deployment that required surgical cut-down to stop the bleeding and close the access site.

The findings that were noted during the ultrasound examinations of the study patients were complications that are expected with large-bore interventional procedures like TAVR/TAVI, EVAR, and TEVAR which the study patients underwent. In the pivotal effectiveness cohort, there were 3 abnormalities noted on the 30-day ultrasounds as reported by the Core Laboratory which evaluated the ultrasound images. These abnormalities were a visible intraluminal thrombus, a pseudoaneurysm, and a dissection. In the pivotal effectiveness cohort, there was 1 abnormality noted on the 60-day ultrasounds as reported by the Core Laboratory, which was a pseudoaneurysm.

Overall in the pivotal safety cohort:

- 64.6% (62/96) of subjects experienced one or more adverse events (AE)
- 19.8% (19/96) of subjects experienced an AE which was determined to be device-related
- 30.2% (29/96) of subjects experienced a procedure-related AE
- 29.2% (28/96) of subjects experienced one or more serious adverse events (SAE)
- 6.3% (6/96) of subjects experienced one or more device-related SAE
- 10.4% (10/96) of subjects experienced one or more procedure-related SAE

One patient death occurred, and this event was not related to the device as adjudicated by the CEC.

9.4 Conclusion

The study's primary safety endpoint of 30-day freedom from major complications was met: 94.3% (83/88) with a lower one-sided 95% confidence limit of 88.4% compared to the performance goal of 85.2%. The primary effectiveness endpoint of time-to-hemostasis (TTH)

was also achieved: TTH was 0.4 ± 1.4 minutes with an upper one-sided 97.5% confidence limit of 0.7 minutes compared to a performance goal of 15 minutes. The data collected in relation to the secondary endpoints were also favorable. Overall, the clinical data provided strong evidence in support of the device's safety and effectiveness when used in accordance with its indications.

10.0 Cross-Seal System Clinical Procedure

The following instructions provide technical direction but do not obviate the necessity of formal training in the use of the Cross-Seal System. The techniques and procedures described are not intended as a substitute for the physician's experience and judgment in treating any specific patients. Patients treated with the Cross-Seal™ Device must receive anticoagulation or antiplatelet medication during the index procedure. Cross-Seal is to be used only by a licensed physician (or other health care professional authorized by or under the direction of such physician) possessing adequate instruction in the use of the device, e.g., participation in a Cross-Seal physician instruction program or equivalent.

10.1 Arterial Puncture Considerations

1. Before inserting the access needle, it is strongly recommended to use ultrasound guidance to visualize the common femoral artery or fluoroscopy to visualize the femoral head. It is recommended to puncture at 12 o'clock as possible to obtain optimum closure. When using the femoral head as a reference point, target the middle of the femoral head as the puncture site. Performing a femoral angiogram through the introducer sheath (or procedural sheath) to verify that the access site is in the common femoral artery is recommended before anticoagulants are given.
2. Puncture the anterior wall of the common femoral artery at an angle of approximately 45 degrees. Avoid sidewall or posterior wall femoral artery punctures.
3. Prior to deployment of the Cross-Seal Device, perform a femoral angiogram to evaluate the femoral artery site for vessel size, calcium deposits, tortuosity, and for disease or dissections of the arterial wall to avoid NEEDLE deflection (NEEDLE not caught by NEEDLE BARREL). Angiographically verify that the puncture is on the anterior wall of the common femoral artery. The puncture should be proximal to the bifurcation of the superficial femoral artery and the profunda femoris branch and distal to the inferior margin of the inferior epigastric artery.

CAUTION: Evaluate the angiogram for femoral artery size, calcium deposits, tortuosity, disease, and for location of the puncture (ensure the Cross-Seal Device is not in a bifurcation or side branch). DO NOT deploy Cross-Seal Device in vessels with moderate or severely

calcified deposition located on anterior wall of femoral artery that close to arteriotomy.

10.2 Cross-Seal Device Procedure as Pre-Close Technique

1. Select the Cross-Seal System for closure of 8F to 18F introducer sheath access sites.
2. After carefully inspecting the packaging of the Cross-Seal Device and Cross-Seal Accessories for damage to the sterile barrier, remove the devices from their package.
3. Exercise care when using additional instruments, such as clamps, forceps or needle holders during device handling, to reduce the possibility of accidental device breakage or damage to the suture.
4. Verify CATHETER patency by flushing the CATHETER from the tip with heparinized saline until the saline exits the GUIDEWIRE PORT. Verify BLEEDING INDICATOR patency by flushing the BLEEDING INDICATOR with heparinized saline until the saline exits the bleeding inlet. **DO NOT use the Cross-Seal Device if the BLEEDING INDICATOR or CATHETER is not patent.**
5. Perform a standard femoral puncture and insert a 0.038” or 0.035” guidewire at least 130 cm in length through the introducer sheath. Remove the introducer sheath while applying pressure on the groin to maintain hemostasis.
6. Insert an 8F dilator over the guidewire and perform blunt dissection to create a tissue track over the 8F dilator. The adequate tissue track is approximately 1 cm incision on skin with wider and deeper track to the top of artery.
7. Remove the 8F dilator. Introduce the Cross-Seal Device over the guidewire, with the logo facing up. Keep the catheter coaxial with the guidewire while slowly advancing the Cross-Seal Device. If kinking or bending of the catheter is observed during the Cross-Seal advancement, carefully remove the Cross-Seal Device. The procedure may be repeated with a new Cross-Seal Device starting with Step 1 above.
8. Advance the Cross-Seal Device at a 45-degree angle until the GUIDEWIRE PORT is just above the skin line and remove the guidewire.
9. Confirm correct Cross-Seal Device insertion orientation with the logo facing up and device positioned at a 45-degree angle (**Figure 10.2-1**).

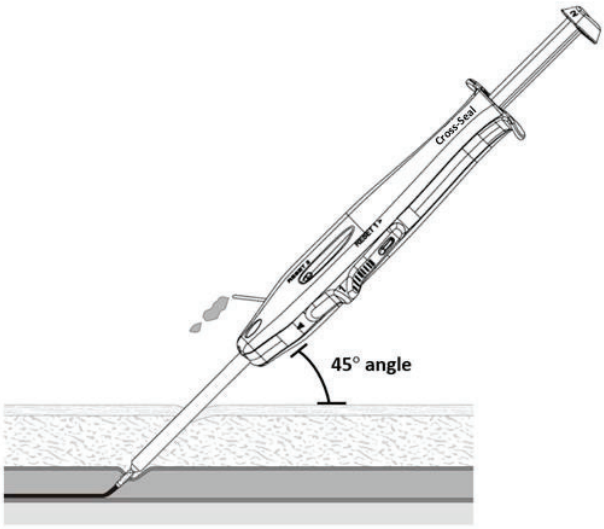


Figure 10.2-1 Cross-Seal Device Insertion Orientation

10. Advance the Cross-Seal Device gently until brisk pulsatile flow of blood is evident from the BLEEDING INDICATOR (**Figure 10.2-1**). If resistance is felt or no blood flow is observed from the BLEEDING INDICATOR, reinsert the guidewire and withdraw the Cross-Seal Device. Flush the BLEEDING INDICATOR and CATHETER with heparinized saline immediately after removal to check for patency. Do not use the Cross-Seal Device if the BLEEDING INDICATOR or CATHETER is not patent. If patency cannot be restored, get a new Cross-Seal Device and start with Step 1 above. Perform another deeper blunt dissection and reinsert the Cross-Seal Device (Steps 4-9) and confirm brisk pulsatile flow of blood from the BLEEDING INDICATOR. DO NOT proceed to next step or deploy SLIDER (Step 11) unless brisk pulsatile flow of blood is evident from the BLEEDING INDICATOR.

    CAUTION: Check the tip of the NEEDLE BARREL is fully inserted into the tissue track before proceeding to the next step or deploy SLIDER (Step 11) to avoid sandwiching the skin surface

11. Gently advance the Cross-Seal Device SLIDER forward (**Figure 10.2-2**) until a distinct click is heard or until the SLIDER fully covers the black arrow (◀) which confirms deployment of the LOCATOR WINGS.

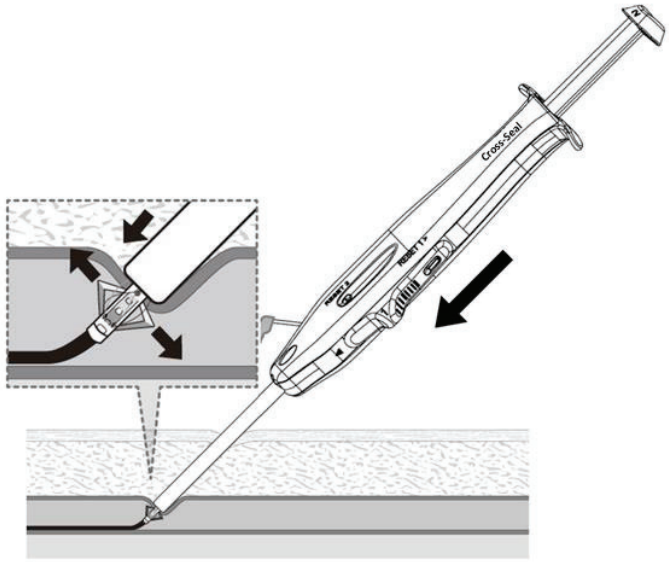


Figure 10.2-2 Push SLIDER forward to deploy LOCATOR WINGS

12. Gently pull back on the device to confirm the LOCATOR WINGS are deployed in the correct position within the vessel. If proper positioning has been achieved, tactile sensation should be felt, and pulsatile flow of blood from the BLEEDING INDICATOR should be observed. If no pulsatile blood flow is observed, close the LOCATOR WINGS using the RESET 1 BUTTON (*Refer to Section 11.1 Technique for Reset Slider*). Reinsert the guidewire and withdraw the Cross-Seal Device. Flush the BLEEDING INDICATOR and CATHETER with heparinized saline immediately after removal to check for patency. Perform another deeper dissection (Step 6) and repeat Steps 7-11 above and confirm brisk pulsatile flow of blood from the BLEEDING INDICATOR.

NOTE: Pulsatile flow of blood indicates the LOCATOR WINGS are deployed inside the vessel and ready for the PLUNGER deployment. No pulsatile flow of blood indicates that the LOCATOR WINGS may be deployed outside the vessel.

13. Prepare to deploy PLUNGER.

CAUTION: DO NOT deploy PLUNGER without observing pulsatile flow of blood from the BLEEDING INDICATOR.

CAUTION: Make sure the skin is not sandwich between the LOCATOR WING and NEEDLE BARREL to avoid needle penetrating the skin surface. If the skin is caught, close the LOCATOR WINGS using the RESET 1 BUTTON and check the tip of the NEEDLE BARREL is fully inserted into the tissue track before redeployment of the SLIDER.

14. Maintain the device in neutral position, stabilize the device with left hand. Use the other hand to push the PLUNGER all the way down until a distinct click is heard which confirms suture deployment (**Figure 10.2-3**). DO NOT advance or retract the Cross-Seal Device while activating the PLUNGER. Advancing or retracting the Cross-Seal Device during this step can result in incomplete suture deployment.

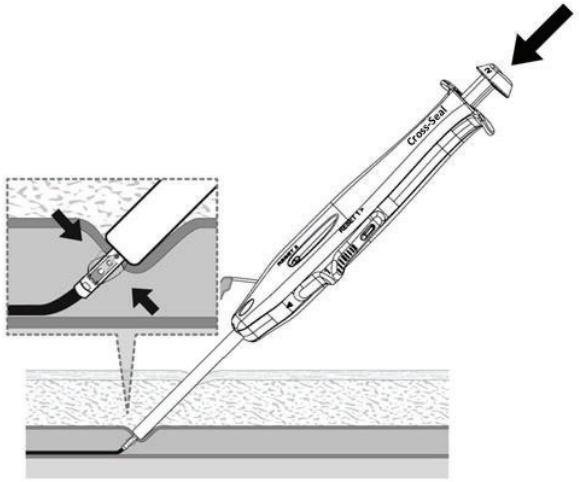


Figure 10.2-3 Deploy PLUNGER

15. Gently withdraw the Cross-Seal Device until the GUIDEWIRE PORT is exposed just above the skin line. Reinsert a 0.038” or 0.035” (minimum length 130 cm) guidewire into the GUIDEWIRE PORT. Continuously withdraw the Cross-Seal Device until the 4 sutures (two suture pairs) are tensioned or felt resistance

CAUTION: DO NOT grab or touch sutures during Cross-Seal Device withdrawal. Interference with sutures during device withdrawal could result in vessel damage or suture breakage.

CAUTION: If resistance is encountered while withdrawing the Cross-Seal Device, check the RESET 2 BUTTON as an indication of LOCATOR WING position. If RESET 2 BUTTON is not returned to the original position (the far right position), the LOCATOR WINGS are open. Do not withdraw the device as open LOCATOR WINGS could cause vessel damage. Manually push the RESET 2 BUTTON to the far right position to close the LOCATOR WINGS (Refer to Section 10.2 Technique for manual closure of the locator wings).

CAUTION: If not all of the four (4) sutures are present and connected to the distal end of the NEEDLE BARREL (defined as fail-safe) after withdrawing the Cross-Seal Device, remove the sutures by pulling out one end of the suture pair and then repeat Steps 2-15 above using a new Cross-Seal Device.

16. Disengage the catheter and guidewire, and reinsert 8F dilator over guidewire.
17. Continue to withdraw the Cross-Seal Device until all 4 sutures are tensioned. Cut all 4 sutures at once at the proximal end next to the NEEDLE BARREL.

CAUTION: DO NOT cut the sutures until all 4 sutures are tensioned to avoid suture entanglement.

18. Gently clamp the two blue sutures together with a hemostat. Gently pull on the clamp until the sutures are taut to remove any suture slack from the tissue track. Place the clamped blue sutures on the **right side** of the patient under a sterile towel.
19. Clamp the two white sutures together with a hemostat and gently pull on the clamp until the suture are taut to remove any suture slack from the tissue track. Place the clamped white sutures on the **left side** of the patient under a sterile towel.
20. Pre-tie the Fisherman's knot with Cross-Seal Knot Tyer before diagnostic or interventional procedure as a pre-close technique. Please refer to Steps 1-2 in *Section 10.3 Suture Management and Section 10.3.1 Use of Cross-Seal Knot Tyer.*
21. Proceed to diagnostic or interventional procedure after Fisherman's knots are pre-tied on blue and white sutures, respectively.
22. The use of accessories to advance and cut sutures are described in steps 4-14 in *Section 10.3 Suture Management.*

CAUTION: To prevent suture breakage, always pull on the suture limbs with slow, consistent increasing tension. Avoid quick or jerky type movements with the suture limbs. If suture breakage occurs, discard suture material and based on the physician assessment of the amount of bleeding use manual compression, compression assisted devices and/or a surgical repair to obtain hemostasis.

CAUTION: Exercise care when using additional instruments, such as clamps, forceps or needle holders during device handling, to reduce the possibility of accidental device breakage or damage to the sutures.

CAUTION: The monofilament suture can be damaged by opening and closing the clamp. If you want to attach the suture to the drape, it is recommended that you use a second clamp with the tip placed through the handle of the first clamp and attach the second clamp to the drape.

10.3 Suture Management

1. While 8F dilator is in place, make knots with Cross-Seal Knot Tyers (Please refer to Steps

1-10 *Section 10.3.1 Use of Cross-Seal Knot Tyer*).

2. Load Cross-Seal Knot Pusher to the rail suture (Please refer to *Section 10.3.2 Use of Cross-Seal Knot Pusher*). Compact the knot by pulling gently and coaxially on the non-rail suture. Advance the knot with the Cross-Seal Knot Pusher to next to the skin surface.
3. Knot advancement will be placed on hold at this point and the sutures set aside under sterile towels while the operator proceeds with the procedure.
4. Following the diagnostic or interventional catheterization procedures, heavily irrigate the tissue tract and sutures with heparinized saline to remove any dried blood.
5. Use Cross-Seal Knot Pusher to advance the knot to the top of the arteriotomy (Refer to *Steps 4-11 in Section 10.3.2 Use of Cross-Seal Knot Pusher*)
6. Gently and coaxially advance the knot on **BLUE** suture with Cross-Seal Knot Pusher into tissue track. Stop advancing the Knot when resistance is felt.
7. Gently and coaxially advance the knot on **WHITE** suture with Cross-Seal Knot Pusher into tissue track. Stop advancing the Knot when resistance is felt.
8. Wrap the rail suture limb of **BLUE** suture securely around your left forefinger and prepare to further advance the knot to the top of arteriotomy. While maintaining guidewire access, carefully remove the sheath and advance the knot with Cross-Seal Knot Pusher. **Avoid quick or jerky type movements with the suture limbs**.
9. Wrap the rail suture limb of **WHITE** suture securely around your left forefinger and further advance the knot with Knot Pusher coaxially to tissue track. **Avoid quick or jerky type movements with the suture limbs**.

CAUTION: To prevent suture breakage, always pull on the suture limbs with slow, consistent increasing tension. **Avoid quick or jerky type movements with the suture limbs**. If suture breakage occurs, discard suture material and based on the physician assessment of the amount of bleeding use manual compression, compression assisted devices and/or a surgical repair to obtain hemostasis.

10. **Assess the site for adequate hemostasis.** If brisk bleeding is observed, advance the blue suture again and then advance the white suture again. Multiple knot advancements are common when closing larger arteriotomies. However, DO NOT lock or excessively tighten the knot while the guidewire is still in the vessel. Until the guidewire is removed, some bleeding will be visible but it should not be pulsatile blood flow.
11. If bleeding is controlled, the operator should then remove the guidewire. **DO NOT secure the knot while guidewire is within the arteriotomy.**
12. With the rail suture limb securely wrapped around the left forefinger, again advance the **BLUE** suture, place the Cross-Seal Knot Pusher under the left thumb to assume a single-handed position and complete knot advancement with slow, consistent increasing tension

until the suture is taut. With the Knot Pusher in place and the suture taut, tighten the knot by gently pulling the non-rail suture limb keeping it coaxial to the tissue tract.

13. Follow the same step to advance and secure the **WHITE** suture knot.
14. Visually confirm that hemostasis is achieved. Apply manual compression if slight bleeding is observed.
15. If hemostasis is deemed adequate, cut the suture ends below the surface of the skin using a sterile scalpel, scissors, or Cross-Seal Suture Trimmer (Refer to *Section 10.3.3 Use of Cross-Seal Suture Trimmer*).

CAUTION: In the event of bleeding from the femoral access site persists after the use of the Cross-Seal System, the physician should assess the situation. Based on the physician assessment of the amount of bleeding use manual compression, compression assisted devices and/or a surgical repair to obtain hemostasis.

10.3.1 Use of Cross-Seal Knot Tyer

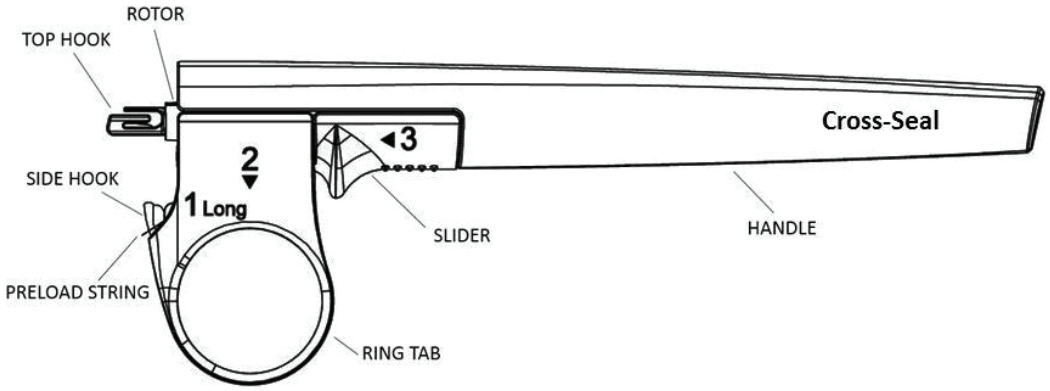


Figure 10.3.1-1 Cross-Seal Knot Tyer

1. While 8F dilator is in place, remove the clamp from the **BLUE** sutures (patient's right side).
2. Adjust the two limbs of the **BLUE** suture so that one limb is approximately two times the length of the other limb while checking the anchorage of suture.
3. Create a loop with the shorter limb of the **BLUE** suture and load it to the TOP HOOK at the front of Cross-Seal Knot Tyer (leave 3-5 cm suture limb), making sure the logo is facing upwards.
4. Create another loop with the longer limb of the **BLUE** suture and fix it to the SIDE HOOK on the RING TAB (leave 3-5 cm suture limb).

CAUTION: Please make sure the length of suture loaded to the SIDE HOOK is double the length of suture loaded to the TOP HOOK, otherwise suture breakage may occur.

5. Place the Cross-Seal Knot Tyer close to the puncture site, making sure the RING TAB is facing the operator. Pull the RING TAB at a 90-degree angle away from the HANDLE (toward operator) until the SUTURE CLIP detaches. Continue pulling until the double strands of suture become a single strand (See **Figure 10.3.1-2**).

CAUTION: When pulling the RING TAB, DO NOT hold on the suture limb loaded in Step 4. The suture limbs need to be free to automatically create suture loops. Holding the suture will cause the device to function improperly or lead to suture breakage. If suture loops did not form on the ROTOR, release the suture limbs from the hooks, get a new Cross-Seal Knot Tyer and repeat Steps 2-5 above.

CAUTION: DO NOT continually pull the RING TAB after the single strand is presented. If the user pulls the RING TAB too far, the SUTURE CLIP will detach from the non-rail suture, and the non-rail suture must be clipped with a clamp.

CAUTION: When pulling the RING TAB, make sure the Cross-Seal Knot Tyer is held close to the tissue track to avoid creating tension on the blood vessel or suture breakage. DO NOT pull suture with excessive force when using Cross-Seal Knot Tyer. Pulling suture against resistance may lead to significant arterial damage, which may necessitate vessel repair.

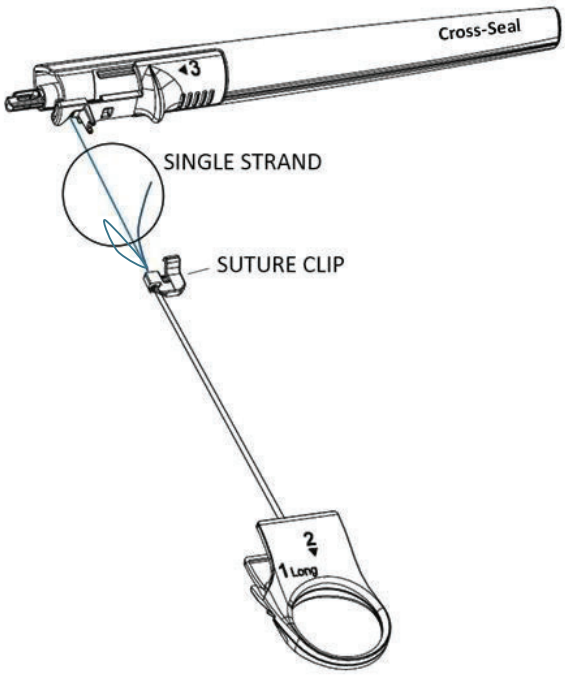


Figure 10.3.1-2 Pull the RING TAB until the suture clip dislodges, and then until a single strand is present.

6. Place the RING TAB to the side. If the suture length is too short to be placed on the patient, gently pull on the RING TAB until sufficient suture length is acquired. **Avoid quick or jerky type movements when pulling on the suture.**
7. Push the SLIDER to release the suture loops.
8. Hold the Cross-Seal Knot Tyer coaxially to the tissue track. Gently pull back the Knot Tyer coaxially to slide down the knot to approximately halfway between the Cross-Seal Knot Tyer and the incision site. The knot should slide onto the suture easily. Gently pull on the non-rail suture limb coaxially while keeping rail suture tension with slow, consistent tension until the loops of knot become compact. DO NOT lock the knot at this point. DO NOT further pull on the non-rail suture after the knot is formed.

CAUTION: DO NOT continually pull back the Cross-Seal Knot Tyer if significant resistance is felt or if the knot did not form as expected. Pull back the slider, disengage the suture from the TOP HOOK, get a new Cross-Seal Knot Tyer, and repeat Steps 2-8 above.

CAUTION: After compacting the knot, STOP pulling the Cross-Seal™ Knot Tyer when resistance is encountered and use the Cross-Seal™ Knot Pusher as needed.

9. Load the Cross-Seal Knot Pusher to the rail suture limb (Refer to *Steps 1-3 in Section 10.3.2 Use of Cross-Seal Knot Pusher*), clamp the two blue suture limbs together and place them at the **right side** of the patient. To prevent knot advancement or locking of the knot, care must be taken not to pull on the individual sutures until the clamp is securely holding the two suture ends together.

CAUTION: The monofilament suture can be damaged by opening and closing the clamp. If you want to attach the suture to the drape, it is recommended that you use a second clamp with the tip placed through the handle of the first clamp and attach the second clamp to the drape.

10. Repeat Steps 1-9 for the pair of **WHITE** sutures, and place the clamped **WHITE** sutures at the **left side** of the patient. Again, DO NOT lock or excessively tighten the knot while the guidewire is still in the vessel.

CAUTION: If the Cross-Seal Knot Tyers do not create the knot as expected after at least 3 tries for each suture pair, visually check the suture condition. If there is no suture entanglement, reorganize and clamp the same color suture limbs together. Consider using additional Knot Tyers or prepare for manual tie. (Refer to *Section 11.3 Technique for Manual Tie of Fisherman's Knot*).

10.3.2 Use of Cross-Seal Knot Pusher

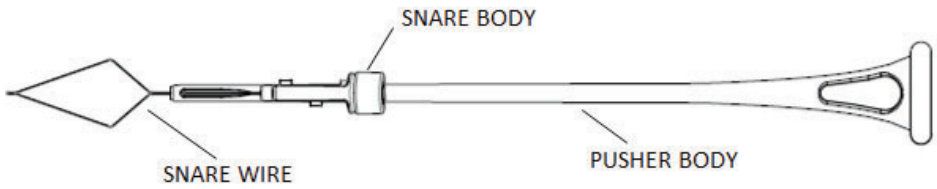


Figure 10.3.2 Cross-Seal Knot Pusher

BEFORE dilation to diagnostic or interventional catheterization procedures

1. Thread approximately 3-5 cm of the rail suture limb through the SNARE WIRE at the distal end of the Cross-Seal Knot Pusher.
2. Load the suture into the Cross-Seal Knot Pusher by pulling the SNARE BODY gently and coaxially toward the proximal end of the Cross-Seal Knot Pusher.
3. Once loaded, the Cross-Seal Knot Pusher should slide easily on the suture.

AFTER completion of diagnostic or interventional catheterization procedures

4. Replace sheath dilator and wire.
5. Gently and coaxially advance the knot with the Cross-Seal Knot Pusher from skin level into tissue track. Stop advancing the Knot when resistance is felt. Advance blue knot first, and followed by white knot.
6. Securely wrap the rail suture around your left forefinger, close to skin level. Place the Cross-Seal Knot Pusher under your left thumb to assume a single-handed position. Apply tension on the rail suture by gently pulling your left forefinger while advancing the pusher with your left thumb. Do not pull non-rail suture during the tension, which will lock the knot.
7. Continue to keep tension on the rail limb and DO NOT tighten the suture around the sheath. Slowly remove the sheath and dilator while maintaining guidewire position and tension on the rail limb by pulling gently on the rail limb. Always keep the suture coaxial to the tissue track.
8. With the rail suture securely wrapped around your left forefinger and held coaxial to the tissue tract, gently pull the suture with a slow, consistent increasing of tension while advancing Cross-Seal Knot Pusher into the tissue track with your right hand until the knot reaches the arterial surface. **Avoid quick or jerky type movements with the suture limbs**.
9. Complete blue knot advancement by slow, consistent increasing of tension on the left

forefinger and thumb until the blue rail suture is taut on the left forefinger. After completion of knot advancement on the blue suture, advance the knot on the white suture again by repeating step 6 to step 9.

10. With the Cross-Seal Knot Pusher held in position while keeping the rail suture taut, withdraw the guidewire and tighten the knot by gently pulling coaxially on the non-rail suture end.

    NOTE: If bleeding has not stopped once the guidewire is removed, the physician should assess the amount of bleeding and use manual compression, a cover stent and/or a surgical repair to obtain hemostasis.

11. Remove the Cross-Seal Knot Pusher from the tissue tract, relax tension on the suture, and visually confirm hemostasis. Use the Cross-Seal Suture Trimmer (Refer to *Section 10.3.3 Use of Cross-Seal Suture Trimmer*) or a new, sterile scalpel or scissor to cut the suture below the skin.
12. If hemostasis cannot be achieved, apply manual compression until hemostasis is achieved.

10.3.3 Use of Cross-Seal Suture Trimmer

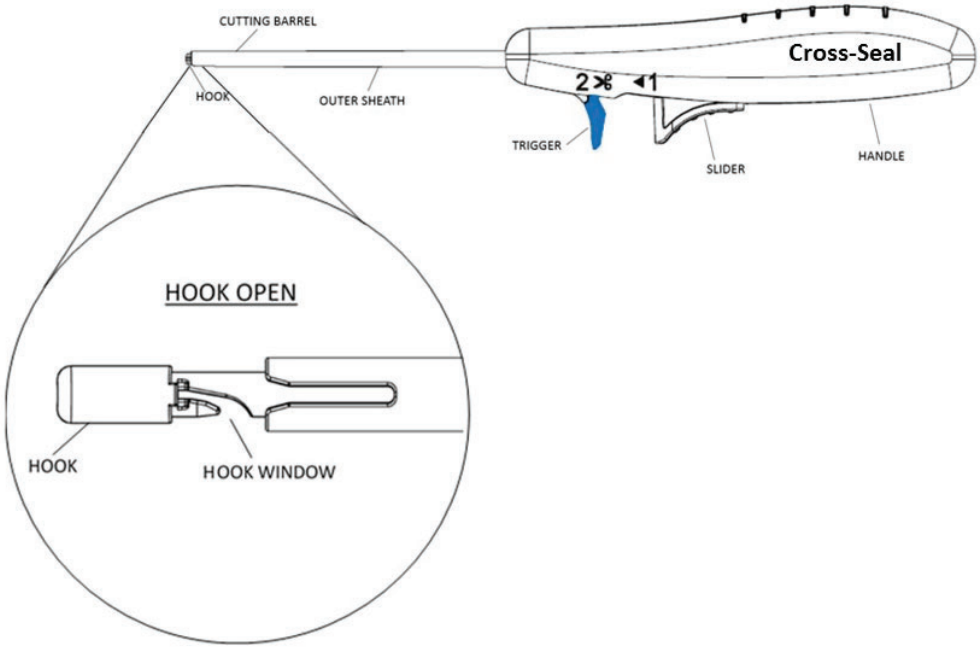


Figure 10.3.3 Cross-Seal Suture Trimmer

1. Securely wrap the pair of blue sutures around your left forefinger, low and close to the skin. Always keep the suture coaxial to the tissue tract.
2. Place the two blue sutures into the Cross-Seal Suture Trimmer following the steps below:
   i. Pull the blue suture pair toward yourself until tensioned with your left hand.
   ii. Hold the Cross-Seal Suture Trimmer with right hand, and make sure the logo is facing up. Push the SLIDER of the Cross-Seal Suture Trimmer with right thumb to open HOOK WINDOW.
   iii. Place the Cross-Seal Suture Trimmer on top of the suture pair, with hook window facing down. With a 90-degree angle formed between the suture pair and the Cross-Seal Suture Trimmer, move the Cross-Seal Suture Trimmer from left to right to hook the suture pair with the HOOK WINDOW.
   iv. Release the SLIDER to load the suture into the HOOK.
   v. Turn the Cross-Seal Suture Trimmer coaxial to the suture and verify that the Trimmer slides along the suture pair. If the Suture Trimmer does not slide along the sutures, release the suture and repeat steps i-iv.
   vi. Once the suture is loaded correctly, the Cross-Seal Suture Trimmer should slide easily.
3. With the suture and Cross-Seal Suture Trimmer coaxial to the tissue tract, advance Cross-Seal Suture Trimmer to the arterial surface. Trim the sutures by pressing on the TRIGGER. Keep the TRIGGER pressed while removing Cross-Seal Suture Trimmer and trimmed suture limbs from the tissue tract. If only one suture limb has been loaded and trimmed, repeat the same technique on the other suture limb.
4. Repeated Steps 1-3 for the white suture pair.
5. If hemostasis cannot be achieved, apply manual compression until hemostasis is achieved.

CAUTION: DO NOT trim 4 sutures at once. A maximum of up to 2 sutures can be trimmed at once.

10.4 Post-Procedure Patient Management

1. Apply an appropriate dressing to the access site.
2. Assess the access site as per hospital standard of care.
3. For patients who have undergone an interventional catheterization procedure using 8–18F sheaths, post-procedure ambulation is at the discretion of the physician.
4. In determining whether to ambulate or discharge an individual patient, it is important to consider all clinical factors including, but not limited to, anticoagulation regimen, antiplatelet and thrombolytic agents administered, oozing or bleeding from the access site, venous access site hemostasis, the general cardiovascular condition of the patient, anesthetic levels, and the overall clinical condition of the patient.

11.0 Troubleshooting

11.1 Technique for Closing LOCATOR WINGS

RESET 1 BUTTON can be used to close the LOCATOR WINGS after the SLIDER is deployed and prior to the PLUNGER deployment. The LOCATOR WINGS can be redeployed a maximum of two (2) times, if needed.

RESET 1 BUTTON is required if the following situations occur:

- The SLIDER is deployed, BUT pulsatile flow of blood is not observed through the BLEEDING INDICATOR
- The SLIDER is deployed but the Cross-Seal Device is not in the correct position inside the vessel

Procedure:

1. Press RESET 1 BUTTON using your right hand thumb/fingernail and push the SLIDER all the way back using your left hand thumb, until the black arrow (◀) is fully visible again.

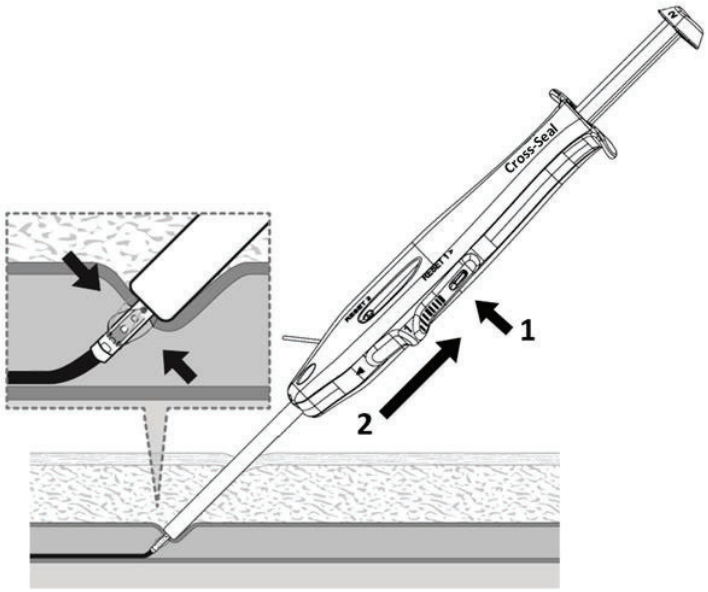


Figure 11.1-1 Pressing the RESET 1 BUTTON

Figure 11.1-2A shows the LOCATOR WINGS deployed and **Figure 11.1-2B** shows the LOCATOR WINGS closed after using the **RESET 1 BUTTON**.

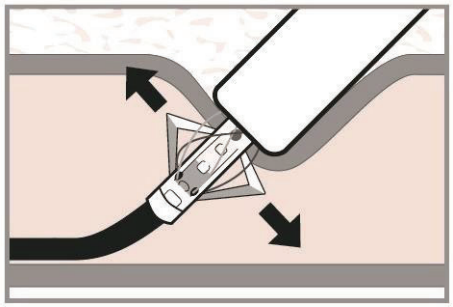


Figure 11.1-2A: LOCATOR WINGS deployed

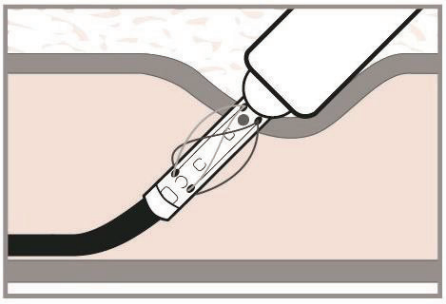


Figure 11.1-2B: LOCATOR WINGS returned to original closed position after using RESET 1 BUTTON

CAUTION: DO NOT withdraw the Device System when the LOCATOR WINGS are DEPLOYED. This may lead to significant arterial damage and/or breakage of the device, which may necessitate intervention and/or surgical removal of the device and vessel repair.

2. Remove the Cross-Seal Device from the patient. Flush the BLEEDING INDICATOR and CATHETER immediately after removal to avoid clot formation in the lumen.

11.2 Technique for Manual Closure of the Locator Wings

RESET 2 BUTTON (LOCATOR WINGS RETRACTOR) is a safety feature (containing an indicator) used to close the LOCATOR WINGS ***after*** the PLUNGER has been deployed.

Procedure:

1. If the RESET 2 BUTTON indicator is at the distal position, the LOCATOR WINGS are not closed. Push the **RESET 2 BUTTON** toward the PLUNGER (**Figure 11.2**).

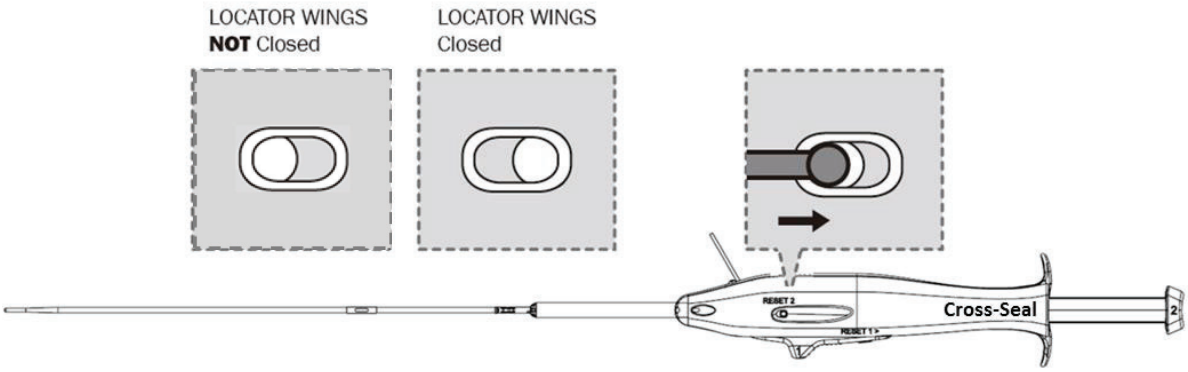


Figure 11.2 Push the RESET 2 BUTTTON toward the PLUNGER

2. Withdraw the Cross-Seal Device. If resistance is felt during withdrawal, surgical removal is required.

CAUTION: DO NOT withdraw the Cross-Seal Device when the LOCATOR WINGS are DEPLOYED. This may lead to significant arterial damage and/or breakage of the device, which may necessitate intervention and/or surgical removal of the device and vessel repair.

CAUTION: DO NOT attempt to redeploy the Cross-Seal Device after using the **RESET 2 BUTTON**. Replace with a new Cross-Seal Device and follow *Section 9.2 Cross-Seal Device Procedure.*

11.3 Technique for Manual Tying of the Fisherman's Knot

1. After the procedure, heavily irrigate the tissue tract and sutures with heparinized saline to remove any dried blood.
2. Keep the main procedural sheath in place and start to make knots.
3. Remove the clamp from the blue sutures (patient's right side). Manually tie the Fisherman's knot with the blue sutures (*Refer to* ***Figure 11.3 Manual Tie of Fisherman's Knot***). Gently pull the rail suture limb with slow, consistent tension to slide the knot into tissue tract. DO NOT lock the knot at this point.
4. Load the rail suture limb of the blue suture pair into one Cross-Seal Knot Pusher (Refer to *Section 10.3.2 Use of Cross-Seal Knot Pusher*).
5. Remove the clamp from the white sutures (patient's left side). Manually tie the Fisherman's knot with the white sutures (*Refer to* ***Figure 11.3 Manual Tie of Fisherman's Knot***). Gently pull the rail suture limb with slow, consistent tension to slide the knot into tissue track. DO NOT lock the knot at this point.

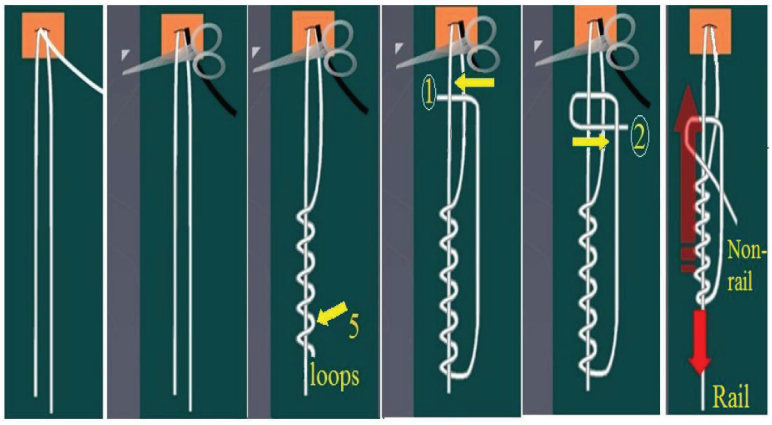


Figure 11.3 Manual Tie of Fisherman's Knot

6. Load the rail suture of the white suture pairs into the other Cross-Seal Knot Pusher (Refer to *Section 10.3.2 Use of Cross-Seal Knot Pusher*).

7. Wrap the rail suture limb of the blue suture securely around your left forefinger and prepare to advance the knot with the Cross-Seal Knot Pusher coaxially to the tissue tract. While maintaining guidewire access, carefully remove the sheath and advance the knot with the Cross-Seal Knot Pusher. **Avoid quick or jerky type movements with the suture limbs**.
8. Wrap the rail suture limb of the white suture securely around your left forefinger and advance the knot with the Knot Pusher coaxially to the tissue tract. **Avoid quick or jerky type movements with the suture limbs**.

CAUTION: To prevent suture breakage, always pull on the suture limbs with slow, consistent increasing tension. **Avoid quick or jerky type movements with the suture limbs**. If suture breakage occurs, discard suture material. Based upon the physician assessment of the amount of bleeding, use manual compression, compression-assisted devices, and/or a surgical repair to obtain hemostasis.

9. **Assess the site for adequate hemostasis.** If brisk bleeding is observed, advance the blue suture again, and then advance the white suture again. Multiple knot advancements are common when closing larger arteriotomies. However, DO NOT lock or excessively tighten the knot while the guidewire is still in the vessel. Until the guidewire is removed, some bleeding will be visible but it should not be pulsatile blood flow.
10. If bleeding is controlled, the operator should then remove the guidewire. DO NOT secure the knot while guidewire is within the arteriotomy.
11. With the rail suture limb securely wrapped around the left forefinger, again advance the blue suture, place the Cross-Seal Knot Pusher under the left thumb to assume a single-handed position and complete knot advancement with slow, consistent increasing tension until the suture is taut. With the Cross-Seal Knot Pusher in place and the suture taut, tighten the knot by gently pulling the non-rail suture limb keeping it coaxial to the tissue tract.
12. Follow to same step to advance the white suture and to secure the knot.
13. Visually confirm hemostasis is achieved. Apply manual compression if slight bleeding is observed.
14. If hemostasis is deemed adequate, cut suture ends below the surface of the skin using a sterile scalpel, scissors, or the Cross-Seal Suture Trimmer (refer to *Section 10.3.3 Use of Cross-Seal Suture Trimmer*)

CAUTION: In the event bleeding from the femoral access site persists after the use of the Cross-Seal System, the physician should assess the situation. Based on the physician assessment of the amount of bleeding use manual compression, compression assisted devices and/or a surgical repair to obtain hemostasis.

Graphical Symbols for Medical Device Labeling

LOT	Batch code/lot number	REF	Catalog number	SN	Serial number
	Consult instructions for use	STERILE EO	Sterilized using ethylene oxide		Do not use if package is damaged
	Do not re-sterilize		Do not re-use		Use-by date
	Keep dry	**Rx Only**	CAUTION: Federal (USA) law restricts this device to sale by or on the order of a physician.		Non-pyrogenic
	Keep away from sunlight		Upper limit of temperature		Humidity limitation
	Caution		Manufacturer		

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