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## Closure devices and methods


### Abstract

A method for closing a puncture in tissue that includes advancing a guide member into proximity with the tissue, the guide member having a needle guide, positioning a distal end of the guide member with the needle guide toward the tissue to present an opening of the needle guide toward the tissue the needle guide cooperating with a suture securing device that is slidably coupled to the guide member and a suture attached to the suture securing device, deploying the suture securing device, the suture securing device comprising a body with an anchor point for the suture and features that allow the suture securing device to pierce the tissue and resist retraction through the tissue, and establishing tension in the suture to move the suture securing device toward another suture securing device to thereby close the puncture in the tissue.



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## Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of U.S. patent application Ser. No. 16/737,604, titled CLOSURE DEVICES AND METHODS, filed Jan. 8, 2020, which is a continuation of U.S. patent application Ser. No. 15/344,978, titled CLOSURE DEVICES AND METHODS, filed Nov. 7, 2016, now U.S. Pat. No. 10,537,313, which is a divisional of U.S. patent application Ser. No. 13/112,618, titled CLOSURE DEVICES AND METHODS, filed May 20, 2011, now U.S. Pat. No. 9,486,191, which is a continuation-in-part of U.S. patent application Ser. No. 12/684,470, titled CLOSURE DEVICES, SYSTEMS, AND METHODS, filed Jan. 8, 2010, now U.S. Pat. No. 9,414,820, which claims the benefit of U.S. Provisional Application No. 61/143,751, titled VESSEL CLOSURE DEVICES AND METHODS, filed Jan. 9, 2009, which are incorporated herein by reference in their entireties.

BACKGROUND
1. Technical Field
(1) The present disclosure relates generally to medical devices and their methods of use. In particular, the present disclosure relates to vessel closure devices and corresponding methods of use.
2. The Technology
(2) Catheterization and interventional procedures, such as angioplasty or stenting, generally are performed by inserting a hollow needle through a patient's skin and tissue into the vascular system. A guidewire may be advanced through the needle and into the patient's blood vessel accessed by the needle. The needle is then removed, enabling an introducer sheath to be advanced over the guidewire into the vessel, e.g., in conjunction with or subsequent to a dilator.

(3) A catheter or other device may then be advanced through a lumen of the introducer sheath and over the guidewire into a position for performing a medical procedure. Thus, the introducer sheath may facilitate introducing various devices into the vessel, while minimizing trauma to the vessel wall and/or minimizing blood loss during a procedure.
(4) Upon completing the procedure, the devices and introducer sheath are removed, leaving a puncture site in the vessel wall. Traditionally, external pressure would be applied to the puncture site until clotting and wound sealing occur; however, the patient must remain bedridden for a substantial period after clotting to ensure closure of the wound. This procedure may also be time consuming and expensive, requiring as much as an hour of a physician's or nurse's time. It is also uncomfortable for the patient and requires that the patient remain immobilized in the operating room, catheter lab, or holding area. In addition, a risk of hematoma exists from bleeding before hemostasis occurs. Although some closure systems may be available, they provide limited control and flexibility to the operator, which may lead to improper or undesirable closure of the puncture site.

## BRIEF SUMMARY

(5) The present invention provides a vessel closure device that is both manageable and versatile. A vessel closure device is provided that may include a guide member and one or more needle guides disposed at least partially within the guide member. The needle guides may be configured to move between a first position wherein the needle guides are substantially straightened at least partially within the guide member and a second position wherein the needle guides at least partially extend radially and distally away from the guide member. The vessel closure device may further include an angle adjustment member movably attached to the guide member. The angle adjustment member may be configured to move between a first position and a second position wherein the angle adjustment member can selectively deflect the needle guides radially toward the guide member when the needle guides are in the second position.
(6) A vessel closure device is provided that may include a guide member and one or more needle guides moveably connected to the guide member. The needle guides may be configured to move between a first position wherein the needle guides are adjacent to the guide member and a second position wherein the needle guides at least partially extend distally away and radially outward from the guide member at a first angle. The vessel closure device may further include an angle adjustment member slidably attached to the guide member. The angle adjustment member may be configured to selectively reduce the first angle of the needle guides in the second position by selectively urging the needle guides toward the guide member.
(7) A suture securing device is provided that may include an elongated body having a proximal end, a distal end, and an inner cavity. The elongated body may further include a first opening in the proximal end that is in communication with the inner cavity. The elongated body may further include a cutout extending distally from the first opening. The cutout may include tissue-engaging elements. The elongated body may be attached to a suture. The elongated body may be moveable between a first position wherein the elongated body is substantially parallel with a longitudinal axis of the suture and a second position wherein the elongated body is substantially non-parallel with the longitudinal axis of the suture and at least a portion of the suture is received within the cutout such that the elongated body can resist proximal movement against a distal surface of a vessel wall.
(8) A suture securing device is provided that may include a body having a proximal end, a distal end, and an inner cavity. The body may further include a first opening in the proximal end and a second opening in the distal end, both in communication with the inner cavity. The body may further include elongated slots extending distally from the proximal end. The slots may define projections therebetween that have a fixed end connected to the body and a free end. The body may be attached to a suture extending through the inner cavity. The projections may be moveable between a first configuration wherein the projections are substantially parallel with a longitudinal axis of the body and a second configuration wherein the projections extend radially outwardly from

the body such that the body can resist proximal movement against a distal surface of a vessel wall.
(9) A vessel closure system is provided that may include a plurality of needle carriers having a distal end and a proximal end. The system may also include a plurality of detachable needles configured to resist proximal movement when deployed through a vessel wall. At least one of the detachable needles may be detachably coupled to the distal end of one of the needle carriers. The system may also include at least one suture secured to each of the detachable needles. A guide member can have a plurality of first lumens extending distally from a proximal end toward a distal end of the guide member. Each of the first lumens can be sized to receive one of the needle carriers and one of the detachable needles coupled to the needle carrier. The first lumens can also be configured to direct the needle carrier and the detachable needle radially outward and distally away from the guide member. The system may also include an outer housing that has a second lumen defined between a distal end and a proximal end of the outer housing. The second lumen can be configured to receive at least a portion of the guide member. The distal end of the outer housing may also include a tapered tip portion. The tapered tip portion can be configured to move between a first configuration and a second configuration. An anchor member can also be configured to be at least partially disposed within the second lumen. The anchor member can comprise an anchor portion and an elongate portion. The anchor member can be disposed in the inner lumen in an initial configuration and move to an expanded configuration once positioned distally from the distal end of the outer housing. Finally, the system may include an expandable plug positioned between the guide member and the anchor member.
(10) A method of closing a puncture in a vessel wall is provided that may include advancing a guide member into proximity with a puncture in a vessel wall, the guide member having openings near a distal end a plurality of needle guides disposed within. A distal end of an angle adjustment member, slidably coupled to the guide member, may then be positioned distal to the openings of the guide member. The needle guides and sutures and suture securing devices disposed within the needle guides may then be deployed distally and radially away from the guide member. The angle adjustment member may then deflect the needle guides toward a longitudinal axis of the guide member. The deflected needle guides and suture securing devices may then be advanced through the vessel wall. Thereafter, the needle guides may be retracted into the guide member to release the suture securing devices. Tension may then be established in the sutures to move the suture securing devices toward each other to thereby close the puncture.
(11) These and other advantages and features of the present disclosure will become more fully apparent from the following description and appended claims, or may be learned by the practice of the disclosure as set forth hereinafter.

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## Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) To further clarify at least some of the advantages and features of the present disclosure, a more particular description of the disclosure will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It is appreciated that these drawings depict only illustrated embodiments of the disclosure and are therefore not to be considered limiting of its scope. The disclosure will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:
(2) FIG. **1**A illustrates a side view of a closure device according to one example;
(3) FIG. **1**B illustrates an exploded view of the closure device of FIG. **1**A;
(4) FIG. **1**C illustrates a cross-sectional view of the guide member and associated first plunger of FIG. **1**B taken along section **1**C-**1**C of FIG. **1**B;
(5) FIG. **1**D illustrates a cross-sectional view of the closure device shown in FIG. **1**A taken along

section **1**D-**1**D of FIG. **1**A;
(6) FIG. **2**A illustrates a closure device in a pre-deployed state according to one example;
(7) FIG. **2**B illustrates the closure device of FIG. **2**A in an intermediate state according to one example;
(8) FIG. **2**C illustrates the closure device of FIGS. **2**A-**2**B in a deployed state;
(9) FIG. **3**A illustrates steps for closing a puncture in a vessel wall in which a closure device is in a pre-deployed state and in proximity to an arteriotomy according to one example;
(10) FIG. **3**B illustrates steps for closing a puncture in a vessel wall in which the closure device of FIG. **3**A is located relative to a vessel wall;
(11) FIG. **3**C illustrates steps for closing a puncture in a vessel wall in which detachable needles are deployed through the vessel wall;
(12) FIG. **3**D illustrates a more detailed view of engagement between a detachable needle and the vessel wall of FIG. **3**A;
(13) FIG. **3**E illustrates steps for closing a puncture in a vessel wall in which the sutures and needles are secured in place to close the puncture in the vessel wall;
(14) FIG. **4** illustrates a detachable needle according to one example;
(15) FIG. **5**A illustrates a distal portion of a closure device according to one example;
(16) FIG. **5**B illustrates the closure device shown in FIG. **5**A in a deployed state;
(17) FIG. **6**A illustrates a cross-sectional view of the closure device shown in FIG. **5**A located relative to a vessel wall in a pre-deployed state;
(18) FIG. **6**B illustrates a cross-sectional view of the closure device shown in FIG. **5**A located relative to a vessel wall in a semi-deployed state;
(19) FIG. **7**A illustrates a side view of a closure device according to one example;
(20) FIG. **7**B illustrates a perspective view of needle guides removed from the closure device shown in FIG. **7**A;
(21) FIG. **8**A illustrates a cross-section view of the closure device taken along section **6**-**6** of FIG. **7**A with the needle guides in a pre-deployed state and an angle adjustment member in a retracted position;
(22) FIG. **8**B illustrates the closure device shown in FIG. **8**A with the needle guides deployed from the closure device and the angle adjustment member in the retracted position;
(23) FIG. **8**C illustrates the closure device shown in FIG. **8**A with the needle guides deployed from the closure device and the angle adjustment member in an extended position;
(24) FIG. **8**D illustrates the closure device shown in FIG. **8**A with the needle guides deployed from the vessel closure device and the angle adjustment member in an intermediate position;
(25) FIG. **9**A shows a perspective view of a suture securing device according to one example;
(26) FIG. **9**B shows the suture securing device shown in FIG. **9**A deployed through a vessel wall in a low-profile configuration within a needle guide;
(27) FIG. **9**C shows the suture securing device shown in FIG. **9**B released from the needle guide in an expanded configuration.
(28) FIG. **10**A shows a perspective view of a suture securing device according to one example;
(29) FIG. **10**B shows the suture securing device shown in FIG. **10**A deployed through a vessel wall in a collapsed configuration within a needle guide; and
(30) FIG. **10**C shows the suture securing device shown in FIG. **10**B released from the needle guide in an expanded configuration.
(31) It should be noted that the figures are not drawn to scale and that elements of similar structures or functions are generally represented by like reference numerals for illustrative purposes throughout the figures. It also should be noted that the figures are only intended to facilitate the description of example configurations of the present disclosure.

## DETAILED DESCRIPTION

(32) The present disclosure relates to devices and methods for closing an opening in a body lumen.

In one example embodiment, a closure device of the present disclosure may allow an operator to quickly and efficiently close a body lumen opening or puncture in a vessel wall while simultaneously providing the operator with a greater measure of control and flexibility in positioning and anchoring the closure device than previously available. For example, the closure device may allow an operator to achieve a more intimate securement of a suture securing device in the tissue surrounding a body lumen opening. In a further embodiment, the closure device may be compatible with a wider range of body lumen wall thicknesses, thereby taking into account the possibility of calcifications or scar tissue in the lumen wall. In yet a further embodiment, the closure device may be compatible with varying sizes of body lumen openings.

(33) FIG. **1**A illustrates a side view of a closure device **10** according to one example. The closure device **10** may include a handle **100**, an outer housing **110**, a first plunger **120** coupled to a guide member **130**, an optional plug **140**, a second plunger **150** coupled to a plurality of needle carriers **160**A, **160**B, a plurality of detachable needles **170**A, **170**B removably coupled to the needle carriers **160**A, **160**B respectively, an anchor member **180** and control members **190**A, **190**B coupled to the anchor member **180**.

(34) The anchor member **180** and control members **190**A, **190**B may cooperate to allow the closure device **10** to be located relative to a puncture in a vessel wall, such as an arteriotomy. Any type of locator having any configuration may be used as desired to position the closure device **10** in proximity to a vessel wall.

(35) In the illustrated example, the control members **190**A, **190**B can be manipulated to move the anchor member **180** between a pre-deployed state (not shown in FIG. **1**A) to the expanded or deployed state shown in FIG. **1**A. In particular, the control members **190**A, **190**B may be coupled to the anchor member **180** and extend proximally from the anchor member **180** through the plug **140**, the guide member **130**, the first plunger **120**, and the second plunger **150**. In the illustrated example, manipulation of the control members **190**A, **190**B may be performed manually, though it will be appreciated that any suitable device and/or method may be used to manipulate the control members **190**A, **190**B.

(36) As shown in FIG. **1**B, the control members **190**A, **190**B and the anchor member **180** may form a continuous member. In such an example, retracting the control members **190**A, **190**B may anchor the anchor member **180** against an inner surface of a vessel wall or any other surface against which the anchor member **180** is positioned. In one embodiment, retracting both control members **190**A, **190**B simultaneously may produce tension or some other force in the anchor member **180** which may increase the resistance of the anchor member **180** to contracting.

(37) For example, the tension of both control members **190**A, **190**B may be simultaneously transferred to the anchor member **180** thereby creating sufficient tension in the anchor member **180** to resist movement away from its expanded configuration. In addition, providing an opposing force against a proximal surface of the anchor member **180**, such as with a vessel wall, may also assist in creating sufficient tension in the anchor member **180** to resist contraction of the anchor member **180**. In a further implementation, the wires of the anchor member **180** may overlap or cross over each other in order to increase resistance.

(38) In at least one example, retracting only one of the control members **190**A, **190**B, may lessen the tension in the anchor member **180**, thereby allowing the anchor member **180** to move from its deployed, expanded configuration to a contracted configuration. As a result, by retracting only one of the control members **190**A or **190**B, without applying tension to the other control member **190**B or **190**A or by applying a distal force to the other control member **190**B or **190**A, the anchor member **180** may contract and be retracted into the outer housing **110**.

(39) Referring again to FIG. **1**A, the guide member **130** may be configured to house at least a portion of the control members **190**A, **190**B and to allow axial movement of the control members **190**A, **190**B relative to the guide member **130**. Such a configuration may allow the control members **190**A, **190**B to be manipulated at a proximal location to control the anchor member **180**

at a distal location.
(40) The guide member **130**, and thus the control members **190**A, **190**B that extend therethrough, may be at least partially housed within the outer housing **110** and/or within the handle **100**. As previously discussed, the guide member **130** may be coupled to the first plunger **120**. Such a configuration may cause actuation of the first plunger **120** to result in axial movement of the guide member **130**. In at least one example, axial movement of the first plunger **120** results in similar axial movement of the guide member **130**. Such a configuration may allow the first plunger **120** to extend and retract the guide member **130** from the outer housing **110** as desired. While actuation of the first plunger **120** may have been described with reference to axial movement of the first plunger **120** relative to the handle **100**, it will be appreciated that actuation of the first plunger **120** may include any type of action that results in desired movement of the guide member **130**.
(41) The optional plug **140** may be secured to the distal end of the guide member **130** in such a manner that axial movement of the first plunger **120** also results in a corresponding movement of the plug **140**. Such a configuration may thereby allow axial movement of the first plunger **120** to also extend and retract the plug **140** from the outer housing **110** as desired by extending and retracting the guide member **130**. Although the guide member **130** and the plug **140** are shown as moving together, it will be appreciated that the plug **140** may also be independently controlled and moved, such as by the use of additional plungers and/or shafts.
(42) In addition to serving as a mandrel to thereby move the plug, the guide member **130** may also be configured to house the needle carriers **160**A, **160**B and the detachable needles **170**A, **170**B. More specifically, the guide member **130** may be configured to allow the needle carriers **160**A, **160**B and the detachable needles **170**A, **170**B to move between a pre-deployed state (not shown in FIG. **1**A) and the deployed state shown in FIG. **1**A. In a pre-deployed state (not shown in FIG. **1**A), the needle carriers **160**A, **160**B and/or the detachable needles **170**A, **170**B are retracted within the guide member **130**. In the deployed state shown in FIG. **1**A, the detachable needles **170**A, **170**B and/or the needle carriers **160**A, **160**B extend radially and/or distally from the guide member **130**.
(43) The needle carriers **160**A, **160**B are coupled to the second plunger **150** in such a way that actuation of the second plunger **150** causes the needle carriers **160**A, **160**B to move between the pre-deployed and deployed states described above. In at least one example, axial movement of the second plunger **150** relative to the first plunger **120** moves the needle carriers **160**A, **160**B between the pre-deployed and deployed states. While actuation of the second plunger **150** may be provided by axial movement of the second plunger **150** relative to the first plunger **120**, it will be appreciated that actuation of the second plunger **150** may include any type of action that results in desired movement of the needle carriers **160**A, **160**B.
(44) As will be described in more detail, the actions described above allow the closure device **10** to deploy the detachable needles **170**A, **170**B into a vessel wall as part of a method for closing a puncture in the vessel wall. Exemplary structure of each of the components introduced above will first be introduced briefly followed by a discussion of the assembly and interaction of adjacent components. Thereafter, function of an exemplary closure device will be discussed, followed by a discussion of an exemplary method of closing a puncture in a vessel wall.
(45) FIG. **1**B illustrates an exploded view of the closure device **10**. As illustrated in FIG. **1**B, the handle **100** includes a distal end **100**A and a proximal end **100**B. A guide member receiving lumen **102** extends proximally from the distal end **100**A. A first plunger receiving lumen **104** extends distally from the proximal end **100**B and is in communication with the guide member receiving lumen **102**. In the illustrated example, a shoulder **106** is formed at a transition between the guide member receiving lumen **102** and the first plunger receiving lumen **104**.
(46) The outer housing **110** may be coupled to the distal end **100**A of the handle **100**. In particular, the outer housing **110** may include a distal end **110**A and a proximal end **110**B. A guide member receiving lumen **112** may be formed therein that extends through the distal end **110**A and the proximal end **110**B. The guide member receiving lumen **112** may be configured to allow the guide

member **130** to move axially within the outer housing **110** as will be described in more detail hereinafter. In at least one example, the guide member receiving lumen **112** may have approximately the same size as the guide member receiving lumen **102** defined in the handle **102**.
(47) As shown in FIG. **1**B, the proximal end **110**B of the outer housing **110**A may be coupled to the distal end **100**A of the handle **100** in such a manner that the guide member receiving lumens **102**, **112** are aligned to thereby form a single lumen that is in communication with the distal end **110**A of the outer housing **110** and the first plunger receiving lumen **104** in the handle **100**. Such a configuration may allow the first plunger **120** to move axially relative to the handle **100** while moving the guide member **130** axially relative to outer housing **110** and the handle **100**.
(48) More specifically, the first plunger **120** may include a distal end **120**A and a proximal end **120**B. The distal end **120**A may be sized to fit within the first plunger receiving lumen **104**. In the example shown, proximal translation of the first plunger **120** relative to the handle **100** may be limited by engagement between the distal end **120**A of the first plunger **120** and the shoulder **106** in the handle **100**.
(49) As previously introduced, the first plunger **120** may be coupled to the guide member **130**. In particular, the distal end **120**A of the first plunger **120** may be coupled to a proximal end **130**B of the guide member **130**. Accordingly, as the first plunger **120** moves proximally relative to the handle **100**, the proximal end **130**B of the guide member **130** also moves proximally relative to the handle **100** as well as to the outer housing **110**. In at least one example, axial movement of the proximal end **130**B of the guide member **130** results in a proportional or similar movement of a distal end **130**A. This may allow an operator to move the first plunger **120** axially to cause the distal end **130**A of the guide member **130** to move between a first position, in which the distal end **130**A is retracted within the distal end **110**A of the outer housing **110**, and various other positions, in which the distal end **130**A extends beyond the distal end **110**A of the outer housing **110** to varying extents. The distal end **130**A of the guide member **130** can be extended distally beyond the distal end **110**A of the outer housing **110** to deploy the plug **140** and/or position the needle carriers **160**A, **160**B for deployment. Deployment of the plug **140** will first be discussed, followed by a discussion of the deployment of the needle carriers **160**A, **160**B.
(50) As previously introduced, the plug **140** may be coupled to the distal end of the guide member **130**. As a result, the plug **140** may be retracted within and extended from the distal end **110**A of the outer housing **110** by axial movement of the first plunger **120**.
(51) In at least one example, the plug **140** may be formed of an expandable material. Suitable materials can include, without limitation, collagen and/or one or more polymers such as PEG. When the plug **140** is moved out of the outer housing **110**, the plug **140** may move toward an expanded state. Similarly, when the plug **140** is retracted back into the outer housing **110**, the plug **140** may be compressed to fit within the outer housing **110**. Accordingly, the distal end **130**A of the guide member **130** can be extended beyond the distal end **110**A of the outer housing **110** to deploy the plug **140** and/or retracted within the outer housing **110** to retrieve the plug **140**.
(52) The distal end **130**A of the guide member **130** can also be extended beyond the distal end **110**A to allow for deployment of the needle carrier **160**A, **160**B. In particular, relative movement between the second plunger **150** and the first plunger **120** may move the needle carriers **160**A, **160**B between retracted and extended positions relative to the guide member **130**. The configuration of the guide member **130** will first be discussed in more detail, followed by a discussion of the interaction of the guide member **130** and the needle carriers **160**A, **160**B.
(53) FIG. **1**C illustrates a cross-sectional view of the first plunger **120** and the guide member **130**. As shown in FIG. **1**C, the first plunger **120** has a second plunger receiving recess **124** defined therein that extends distally from a proximal end **120**B. The first plunger **120** also has needle carrier lumens **126**A, **126**B defined therein that extend proximally from the distal end **120**A and into communication with the second plunger receiving recess **124**. A shoulder **128** is formed at a junction of the needle carrier lumens **126**A, **126**B and the second plunger receiving recess **124**.

(54) The guide member **130** may also have needle carrier lumens **132**A, **132**B defined therein that extend distally from the proximal end **130**B. In the illustrated example, the needle carrier lumens **132**A, **132**B include parallel or axially aligned portions **134**A, **134**B and curved, angled portions **136**A, **136**B that are in communication with openings **138**A, **138**B in the guide member **130**. The axially aligned portions **134**A, **134**B are aligned with the needle carrier lumens **126**A, **126**B defined in the first plunger **120** to thereby form continuous lumens that extend from near the distal end **130**A of the guide member **130** to the second plunger receiving recess **124** in the first plunger member **120**. The configuration of the guide member **130** can allow the guide member **130** to house the needle carriers **160**A, **160**B (FIG. **1**B) therein prior to deployment and to guide the needle carriers **160**A, **160**B radially outward and distally away from the guide member **130**. An exemplary configuration of the needle carriers **160**A, **160**B will first be discussed, followed by the interaction between the needle carriers **160**A, **160**B and the guide member **130** with reference to FIG. **1**B.

(55) As shown in FIG. **1**B, proximal ends **162**A, **162**B of the needle carriers **160**A, **160**B may be coupled to a distal end **150**A of the second plunger **150** in such a way that axial movement of the second plunger **150** results in similar movement of the needle carriers **160**A, **160**B, including distal ends **164**A, **164**B. As a result, when the second plunger **150** is positioned at least partially within the second plunger receiving lumen **124**, the needle carriers **160**A, **160**B extend through the first plunger **120** by way of the needle carrier lumens **126**A, **126**B and into the guide member **130** by way of needle carrier lumens **132**A, **132**B.

(56) The distal ends **164**A, **164**B of the needle carriers **160** A, **160**B may be positioned such that axial movement of the second plunger **150** relative to the first plunger **120** moves the needle carriers **160**A, **160**B between retracted and extended positions relative to the guide member **130**. When the needle carriers **160**A, **160**B are retracted, the distal ends **164**A, **164**B of the needle carriers **160**A, **160**B may be positioned proximally and/or radially inward relative to the openings **138**A, **138**B. When the needle carriers **160**A, **160**B are extended, the distal ends **164**A, **164**B extend both radially outward and distally away from the openings **138**A, **138**B in the guide member **130**. Accordingly, the guide member **130** is configured to house the needle carriers **160**A, **160**B and to guide the needle carriers **160**A, **160**B between the retracted and extended positions described above.

(57) In at least one example, guide member **130** can be used to initially position the anchor member **180**. Further, the guide member **130** may be configured to house the control members **190**A, **190**B in addition to the needle carriers **160**A, **160**B. FIG. **1**D illustrates a cross-sectional view of the closure device **10** taken along section **1**D-**1**D of FIG. **1**A. As shown in FIG. **1**D, the control member lumens **139**A, **139**B may be defined in the guide member **139**A, **139**B to pass through the guide member **130**. The control member lumens **139**A, **139**B may be positioned at any location and orientation desired. FIG. **1**D also illustrates that the needle carriers **160**A, **160**B may have suture lumens **166**A, **166**B defined therein. The suture lumens **166**A, **166**B may house sutures (not shown), which may be coupled to the detachable needles **170**A, **170**B (FIG. **1**B). As will be discussed in more detail below, the closure device **10** may be configured to deploy the detachable needles **170**A, **170**B (FIG. **1**B) through a vessel wall as part of a method for closing a puncture in a vessel wall. The function of the closure device **10** will first be described in isolation, followed by a discussion of the method for closing a puncture in a vessel wall using the closure device.

(58) FIGS. **2**A-**2**C are cross-sectional views of the closure device **10** at various positions taken along section **2**-**2** of FIG. **1**A. In particular, FIG. **2**C is a cross-section view of the closure device **10** in the deployed state shown in FIG. **1**A while FIGS. **2**A and **2**B show the closure device in a pre-deployed state and a location state according to one example. For ease of reference, various components will be described in which one component is being moved toward a second component. It will be appreciated that a second member can also be moved toward the first member or some combination of movement of the two can also be used to accomplish the same

function.
(59) As shown in FIG. **2**A, while in a pre-deployed state the first plunger **120** is drawn proximally from the handle **100** to thereby position the distal end **130**A of the guide member **130** as well as the plug **140** within the outer housing **110**. While the plug **140** is thus positioned within the outer housing **110**, the plug **140** may be compressed (FIG. **1**B). Further, the second plunger **150** may be positioned proximally from the first plunger **120** to thereby position the distal ends **160**A, **160**B of the needle carriers **160**A, **160**B within the guide member **130**. As also shown in FIG. **2**A, the control members **190**A, **190**B may be manipulated and positioned to move the anchor member **180** to a pre-deployed position within the outer housing **110**.
(60) The closure device **10** may be moved from the pre-deployed state shown in FIG. **2**A to the locator state shown in FIG. **2**B by manipulating the control members **190**A, **190**B and moving the first plunger **120** toward the handle **100**. In at least one example the second plunger **150** may move with the first plunger **120** as the first plunger **120** moves toward the handle **100**. Such a configuration may allow the second plunger **150** to deploy the needle carriers **160**A, **160**B separately from movement of the first plunger **120**.
(61) As shown in FIG. **2**B, as the first plunger **120** moves toward the handle **100**, the anchor member **180**, the plug **140** and/or the distal end **130**A of the guide member **130** move distally from the distal end of the outer housing **110**. The anchor member **180** may then be manipulated by the control members **190**A, **190**B to move to the deployed state shown in FIG. **2**B.
(62) More specifically, the anchor member **180** may be configured to move from an initial, contracted configuration within the outer housing **110** to a deployed, expanded configuration once deployed from the outer housing **110**. To facilitate movement from an initial, contracted configuration to a deployed, expanded configuration, the anchor member **180** may include one or more superelastic or shape memory materials such as shape memory alloys.
(63) For example, the anchor member **180** may be heat set in a deployed, expanded configuration. The anchor member **180** may then be elastically deformed into an initial, contracted configuration contracted and disposed within the outer housing **110**. In its initial, contracted configuration shown in FIG. **2**A, the anchor member **180** may store sufficient energy to return to its deployed, expanded configuration once released from the outer housing **110** shown in FIG. **2**B.
(64) Retracting the handle **100** in a proximal direction may position and/or anchor the anchor member **180** against a distal or inner surface of a vessel wall. In a further embodiment, further retracting the plunger member **130** in a proximal direction may retract the anchor member **180** from the vessel and/or into the outer housing **110**.
(65) Once the anchor member **180** is at a desired position, the first plunger **120** can be moved toward the handle **100** while holding the control members **190**A, **190**B stationary to thereby the advance the plug **140** toward the anchor member **180**. The plug **140**, which may have expanded from the compressed state described above upon exiting the outer housing **110**, can thus be positioned relative to the anchor member **180**. Such a configuration can allow the closure device **10** to engage a proximal or outer surface of the vessel's walls of varying thicknesses as the plug **140** can be advanced until it engages a vessel wall since the anchor member **180** is positioned on an opposing side of the vessel wall. Such a configuration can also place the distal end **130**A of the guide member **130** in position to deploy the needle carriers **160**A, **160**B.
(66) As shown in FIG. **2**C, the needle carriers **160**A, **160**B can be deployed by moving the second plunger **150** toward the first plunger **120**. As the second plunger **150** moves toward the first plunger **120**, the needle carriers **160**A, **160**B, and the distal ends **164**A, **164**B in particular, move the detachable needles **170**A, **170**B distally and radially away from the distal end **130**A of the guide member **130**. Such a configuration can allow the detachable needles **170**A, **170**B to be moved into engagement with a vessel wall, as part of an exemplary method for closing a puncture in a vessel wall, which will now be discussed in more detail with reference to FIG. **3**A-**3**D.
(67) FIG. **3**A illustrates first steps of a method for closing a puncture **300** in a vessel wall **310**. For

ease of reference, only the distal portion of the closure device **10** is shown and described. It will be appreciated that the distal components can be manipulated by proximal components in a similar manner as described above with reference to FIGS. **1**A-**2**C.

(68) Referring now to FIG. **3**A, the method can begin by positioning a distal end **110**A of the outer housing **110** in proximity with the puncture **300** while the closure device **10** is in a pre-deployed state. With the distal end **110**A of the outer housing **110** in proximity with the puncture **300**, the anchor member **180** can be passed through the puncture **300** and moved to the deployed, expanded position as shown in FIG. **3**B.

(69) As shown in FIG. **3**C, the anchor member **180** can then be drawn proximally into engagement with an inner surface or posterior side **310**A of the vessel wall **310** adjacent the puncture **300** and the distal end **130**A of the guide member **130** can be urged distally toward the outer surface or anterior side **310**B of the vessel wall **310**, thereby positioning the vessel wall **310** adjacent the puncture **300** between the plug **140** and the anchor member **180**. With the vessel wall **310** positioned between the anchor member **180** and the plug **140**, the vessel wall **310** can be described as being located by the closure device **10** since the position of vessel wall **310** is established as being between the plug **140** and the anchor member **180**. In at least one example, the expanded plug **140** can cover the puncture **300** while pressure between the plug **140** and the anchor member can provide sufficient contact between the plug **140** and the vessel wall **310** to limit the flow of fluid from the puncture **300**.

(70) As also shown in FIG. **3**C, when the guide member **130** is in position with respect to the vessel wall **310**, the distal end **130**A of the guide member **130** can be positioned distally of the distal end **110**A of the outer housing **110** to thereby expose the openings **138**A, **138**B (FIG. **1**C) from within the outer housing **110**. With the openings **138**A, **138**B (FIG. **1**C) thus exposed, the needle carriers **160**A, **160**B and detachable needles **170**A, **170**B can be moved distally beyond and radially outward from the distal end **130**A of the guide member **130** to move the detachable needles **170**A, **170**B at least partially through the vessel wall **310** on opposing sides of the puncture **300**. As shown, the anchor member **180** in the expanded state can extend beyond the position of the detachable needles **170**A, **170**B in the vessel wall **310**. Such a configuration can improve the ability of the anchor member **180** to support user pullback by increasing the area over which the anchor member **180** engages the inner surface of the vessel wall **300**. In addition, the loop-type configuration of the anchor member **180** in the expanded state can allow the anchor member **180** to locate the vessel wall **310** without substantial interference from the detachable needles **170**A, **170**B. While the anchor member **180** in the expanded state is shown extending beyond the position of the detachable needle **170**A, **170**B, any size and/or configuration of the anchor member **180** that is suitable to support user pullback against the vessel wall **310** is possible. In one embodiment, the anchor member **180** in the expanded state can extend between the position of the detachable needles **170**A, **170**B and the sides of the puncture **300**. In other embodiments, the anchor member **180** in the expanded state can extend considerably beyond the position of the detachable needles **170**A, **170**B.

(71) FIG. **3**D shows the detachable needle **170**A in more detail. While a single detachable needle **170**A is shown in FIG. **3**D, it will be appreciated that the discussion of the detachable needle **170**A can be equally applicable to the detachable needle **170**B (FIG. **3**C) as well as any number of other detachable needles. As shown in FIG. **3**D, the detachable needle **170**A may include features that allow it to readily pierce the vessel wall **310** while resisting retraction therefrom. In particular, the detachable needle **170**A includes a generally conical body **172** having a tip **174** and a base **176**. The detachable needle **170**A may also include a shaft **178** coupled to the base **178**.

(72) In at least one example, the shaft **178** is configured to have a suture **320** coupled thereto. The shaft **178** can be further configured to be positioned within the suture lumen **166**A to provide a slip fit between the needle carrier **160**A and the shaft **178**. The shaft **178** may also have a narrower aspect than the base **176**. Such a configuration allows the needle carrier **160**A to exert a distally

acting force on the detachable needle **170**A by way of the base **176**. Such a distally acting force can cause the tip **174** to pierce the vessel wall **310** while the width of the base **176** anchors the detachable needle **170**A to the vessel wall **310** and resists proximal retraction.

(73) Referring again to FIG. **3**C, once the detachable needles **170**A, **170**B are anchored in the vessel wall **310**, the needle carriers **160**A, **160**B can be drawn proximally into the guide member **130**. The engagement between the detachable needles **170**A, **170**B and the vessel wall **310** can be sufficient to detach the detachable needles **170**A, **170**B from the needle carriers **160**A, **160**B as the needle carriers **160**A, **160**B are withdrawn.

(74) After the needle carriers **160**A, **160**B are drawn into the guide member **130**, one of the control members **190**A, **190**B can be moved in one direction more than the other of the control members **190**A, **190**B to move the anchor member **180** into a contracted or collapsed state. The guide member **130**, the plug **140**, and the control member **180** can then be drawn into the outer housing **110**. Thereafter, the closure device **10** can be withdrawn, leaving the detachable needles **170**A, **170**B engaged in the vessel wall **310** with the sutures **320** extending proximally from the detachable needles **170**A, **170**B as shown in FIG. **3**E.

(75) As also shown in FIG. **3**E, a constrictor **330** can be passed over the sutures **320**. The constrictor **330** can have a smaller diameter than the distance between the detachable needles **170**A, **170**B. As a result, moving the constrictor **330** over the sutures **320** while maintaining tension on the sutures **320** can act to draw the detachable needles **170**A, **170**B toward each other, thereby pulling the puncture **300** closed, as shown in FIG. **3**E.

(76) Once the puncture **300** is sufficiently closed, the constrictor **330** can be secured to maintain tension in the sutures **320** between the detachable needles **170**A, **170**B and the constrictor **330**. For example, in one embodiment the constrictor **330** can be an annular member that can be crimped to maintain the tension in the sutures **320**. While an annular member can be used, it will be appreciated that any constrictor can be used to establish tension in the sutures **170**A, **170**B. It will also be appreciated that any suitable means may also be used to maintain the tension in the sutures **170**A, **170**B. Thereafter, the sutures **170**A, **170**B can be trimmed as desired using any appropriate method and/or device.

(77) Accordingly, as shown in FIGS. **1**A-**3**E, the closure device **10** can be configured to deploy detachable needles **170**A, **170**B in a vessel wall **310**. A constrictor **330** can then be used to establish tension in suture extending away from the detachable needles **170**A, **170**B to thereby close the puncture **300** in the vessel wall **310**. In the illustrated example, two needle carriers **160**A, **160**B and detachable needles **170**A, **170**B have been described. It will be appreciated that in other examples, any number of needle carriers and detachable needles can be used, include four or more needle carriers and detachable needles.

(78) In the example shown above, the detachable needles included a conical shape in which the sutures are anchored in a vessel wall by engagement with a proximal portion of the detachable needle. FIG. **4** illustrates one configuration for a detachable needle **340**. The detachable needle **340** can have a body **350** having a tapered point **360**. A suture **320** can be positioned in a manner that causes the detachable needle **340** to rotate when tension is applied to the suture **320** to thereby cause a lateral portion of the detachable needle **340** to engage a vessel wall to thereby anchor the detachable needle **340** thereto. For example, the suture **320** can be offset either radially from a center axis **370** of the detachable needle **340** and/or distally from a proximal end **380** of the body **350**.

(79) FIGS. **5**A-**6**B illustrate a vessel closure device **40** according to one example. The closure device **40** may be similar in many respects to the closure device **10** previously described above in FIGS. **1**A-**4**, wherein certain features will not be described in relation to this configuration wherein those components may function in the manner as described above and are hereby incorporated into this additional configuration described below. As shown in FIG. **5**A, the closure device **40** may include an outer sheath **410** having a distal end with a tapered tip portion **420**. The tapered tip

portion **420** may be formed of a polymer or any other suitable biocompatible material. The tapered tip portion **420** may be coupled to the outer sheath **410** or may be integrally formed on the outer sheath **410**. In one embodiment, the tapered tip portion **420** may include slits radially spaced about the tapered tip portion **420** and extending proximally from a distal end of the tapered tip portion **420**. The slits **430** may define intermediate portions of the tapered tip portion **420**, each intermediate portion having a free end and a fixed end. The slits **430** may be elongated, triangular, diamond shaped, oval, or any other configuration and/or shape suitable to define the intermediate portions of the tapered tip portion **420**. As shown in FIG. **5**B, the slits **430** may allow the intermediate portions of the tapered tip portion **420** to expand or open up as a guide member **490**, a plug **440**, an anchor member **480**, or needle guides **460**A, **460**B and detachable needles **470**A, **470**B are advanced from within the outer sheath **410**. Such a configuration can help protect the guide member **490**, the plug **440**, the anchor member **480**, the needle guides **460**A, **460**B and the detachable needles **470**A, **470**B, and/or the access tract. For example, the tapered tip portion **420** may help protect the access tract from damage that may be caused by the guide member **490**, the plug **440**, the anchor member **480**, the needle guides **460**A, **460**B and the detachable needles **470**A, **470**B by enclosing them within the outer sheath **410** up until immediately adjacent a puncture **300**. In addition, enclosing the same components within the outer sheath **410** up until immediately adjacent the puncture may help protect and improve the implementation of the guide member **490**, the plug **440**, the anchor member **480**, the needle guides **460**A, **460**B and the detachable needles **470**A, **470**B by limiting interference from the access tract and/or other biological materials. Moreover, the conical shape of the tapered tip portion **420** can help ease advancement of the outer sheath **410** through the access tract.

(80) FIGS. **6**A and **6**B illustrate the tapered tip portion **420** in a first configuration and an expanded or open configuration over a puncture in a vessel wall **310**. As shown in FIG. **6**A, the distal portion of the outer sheath **410** may be advanced through the access tract and the tapered tip portion **420** may be positioned slightly within the puncture **300**. With the tapered tip portion **420** positioned in the puncture **300**, the anchor member **480** can be passed directly into the puncture **300**. The anchor member **480** can then be moved to a deployed expanded position as shown in FIG. **6**B. The guide member **490** and plug **440** can then be urged through the tapered tip portion **420** and distally toward an outer surface of a vessel wall **310**. As shown in FIG. **6**B, urging the guide member **490** and the plug **440** through the tapered tip portion **420** can rotate the intermediate portions of the tapered tip portion **420** about pivot points **495** which in turn can cause the tapered tip portion **420** to expand or open up. In other embodiments, the intermediate portions of the tapered tip portion **420** can be flexed outward by the plug **440** and/or the guide member **490** to cause the tapered tip portion to expand or open up. In one embodiment, once the plug **440** and the anchor member **480** are positioned on opposite sides of the vessel wall **310**, the outer housing **410** may be retracted distally a predetermined distance to allow for deployment of the needle guides **460**A, **460**B and the detachable needles **470**A, **470**B from the guide member **490**.

(81) Accordingly, as shown in FIGS. **5**A-**6**B, the tapered tip portion **420** of the closure device may be configured to ease the advancement of the closure device **40** through an access tract; aid in the protection of the access tract, the closure device **40** and components thereof; and improve implementation of the closure device's components within the access tract.

(82) Embodiments of the anchor, detachable needles and the like may include a material made from any of a variety of known suitable biocompatible materials, such as a biocompatible shape memory material (SMM). For example, the SMM may be shaped in a manner that allows for a delivery orientation while within the tube set, but may automatically retain the memory shape of the detachable needles once deployed into the tissue to close the opening. SMMs have a shape memory effect in which they may be made to remember a particular shape. Once a shape has been remembered, the SMM may be bent out of shape or deformed and then returned to its original shape by unloading from strain or heating. Typically, SMMs may be shape memory alloys (SMA)

comprised of metal alloys, or shape memory plastics (SMP) comprised of polymers. The materials may also be referred to as being superelastic.

(83) Usually, an SMA may have an initial shape that may then be configured into a memory shape by heating the SMA and conforming the SMA into the desired memory shape. After the SMA is cooled, the desired memory shape may be retained. This allows for the SMA to be bent, straightened, twisted, compacted, and placed into various contortions by the application of requisite forces; however, after the forces are released, the SMA may be capable of returning to the memory shape. The main types of SMAs are as follows: copper-zinc-aluminum; copper-aluminum-nickel; nickel-titanium (NiTi) alloys known as nitinol; nickel-titanium platinum; nickel-titanium palladium; and cobalt-chromium-nickel alloys or cobalt-chromium-nickel-molybdenum alloys known as elgiloy alloys. The temperatures at which the SMA changes its crystallographic structure are characteristic of the alloy, and may be tuned by varying the elemental ratios or by the conditions of manufacture. This may be used to tune the detachable needles so that it reverts to the memory shape to close the arteriotomy when deployed at body temperature and when being released from the tube set.

(84) For example, the primary material of an anchor, detachable needles, and/or ring may be of a NiTi alloy that forms superelastic nitinol. In the present case, nitinol materials may be trained to remember a certain shape, retained within the tube set, and then deployed from the tube set so that the tines penetrate the tissue as it returns to its trained shape and closes the opening. Also, additional materials may be added to the nitinol depending on the desired characteristic. The alloy may be utilized having linear elastic properties or non-linear elastic properties.

(85) An SMP is a shape-shifting plastic that may be fashioned into a detachable needles in accordance with the present disclosure. Also, it may be beneficial to include at least one layer of an SMA and at least one layer of an SMP to form a multilayered body; however, any appropriate combination of materials may be used to form a multilayered device. When an SMP encounters a temperature above the lowest melting point of the individual polymers, the blend makes a transition to a rubbery state. The elastic modulus may change more than two orders of magnitude across the transition temperature (Ttr). As such, an SMP may be formed into a desired shape of an endoprosthesis by heating it above the Ttr, fixing the SMP into the new shape, and cooling the material below Ttr. The SMP may then be arranged into a temporary shape by force and then resume the memory shape once the force has been released. Examples of SMPs include, but are not limited to, biodegradable polymers, such as oligo(ϵ-caprolactone)diol, oligo(ρ-dioxanone)diol, and non-biodegradable polymers such as, polynorborene, polyisoprene, styrene butadiene, polyurethane-based materials, vinyl acetate-polyester-based compounds, and others yet to be determined. As such, any SMP may be used in accordance with the present disclosure.

(86) An anchor, detachable needles, ring and the like may have at least one layer made of an SMM or suitable superelastic material and other suitable layers may be compressed or restrained in its delivery configuration within the garage tube or inner lumen, and then deployed into the tissue so that it transforms to the trained shape. For example, a detachable needles transitions to close the opening in the body lumen while an anchor may expand to anchor the closure device.

(87) Also, the anchor, detachable needles, ring, or other aspects or components of the closure device may be comprised of a variety of known suitable deformable materials, including stainless steel, silver, platinum, tantalum, palladium, nickel, titanium, nitinol, nitinol having tertiary materials (U.S. 2005/0038500, which is incorporated herein by reference, in its entirety), niobium-tantalum alloy optionally doped with a tertiary material (U.S. 2004/0158309, 2007/0276488, and 2008/0312740, which are each incorporated herein by reference, in their entireties) cobalt-chromium alloys, or other known biocompatible materials. Such biocompatible materials may include a suitable biocompatible polymer in addition to or in place of a suitable metal. The polymeric detachable needles may include biodegradable or bioabsorbable materials, which may be either plastically deformable or capable of being set in the deployed configuration.

(88) In one embodiment, the detachable needles, anchor, and/or ring may be made from a superelastic alloy such as nickel-titanium or nitinol, and includes a ternary element selected from the group of chemical elements consisting of iridium, platinum, gold, rhenium, tungsten, palladium, rhodium, tantalum, silver, ruthenium, or hafnium. The added ternary element improves the radiopacity of the nitinol detachable needles. The nitinol detachable needles has improved radiopacity yet retains its superelastic and shape memory behavior and further maintains a thin body thickness for high flexibility.
(89) In one embodiment, the anchor, detachable needles, and/or ring may be made at least in part of a high strength, low modulus metal alloy comprising Niobium, Tantalum, and at least one element selected from the group consisting of Zirconium, Tungsten, and Molybdenum.
(90) In further embodiments, the detachable needles, anchor, and/or ring may be made from or be coated with a biocompatible polymer. Examples of such biocompatible polymeric materials may include hydrophilic polymer, hydrophobic polymer biodegradable polymers, bioabsorbable polymers, and monomers thereof. Examples of such polymers may include nylons, poly(alpha-hydroxy esters), polylactic acids, polylactides, poly-L-lactide, poly-DL-lactide, poly-L-lactide-co-DL-lactide, polyglycolic acids, polyglycolide, polylactic-co-glycolic acids, polyglycolide-co-lactide, polyglycolide-co-DL-lactide, polyglycolide-co-L-lactide, polyanhydrides, polyanhydride-co-imides, polyesters, polyorthoesters, polycaprolactones, polyesters, polyanydrides, polyphosphazenes, polyester amides, polyester urethanes, polycarbonates, polytrimethylene carbonates, polyglycolide-co-trimethylene carbonates, poly(PBA-carbonates), polyfumarates, polypropylene fumarate, poly(p-dioxanone), polyhydroxyalkanoates, polyamino acids, poly-L-tyrosines, poly(beta-hydroxybutyrate), polyhydroxybutyrate-hydroxyvaleric acids, polyethylenes, polypropylenes, polyaliphatics, polyvinylalcohols, polyvinylacetates, hydrophobic/hydrophilic copolymers, alkylvinylalcohol copolymers, ethylenevinylalcohol copolymers (EVAL), propylenevinylalcohol copolymers, polyvinylpyrrolidone (PVP), combinations thereof, polymers having monomers thereof, or the like.
(91) In yet a further embodiment, a closure device **50** may include needle guides that can be deployed from the closure device **50** at varying angles. The closure device **50** may be similar in many respects to the closure devices **10** and **40** previously described above in FIGS. **1**A-**6**B, wherein certain features will not be described in relation to this configuration wherein those components may function in the manner as described above and are hereby incorporated into this additional configuration described below.
(92) FIG. **7**A shows a side view of the closure device **50**. As shown, the closure device **50** may include a guide member **520**, needle guides **510**A, **510**B deployable from the guide member **520**, a needle guide activation handle **620** coupled to the needle guides **510**A, **510**B, and an angle adjustment member **630** movably attached to the guide member **520**. FIG. **7**B shows the needle guides **510**A, **510**B removed from the closure device **50**. While features of a single needle guide **510**A are discussed, it will be appreciated that any discussion of the features of the needle guide **510**A can be equally applicable to the features of the needle guide **510**B as well as any number of other needle guides.
(93) The needle guides **510**A, **510**B may comprise a substantially flexible or semi-rigid body **530** having a proximal portion **540** and a distal portion **550**. The proximal portions **540** are substantially parallel to or axially aligned with one another, whereas the distal portions **550** of the needle guides **510**A, **510**B may be angled or curved to extend laterally outward from the proximal portions **540**. In one embodiment, the distal portions **550** of the needle guides **510**A, **510**B may be self-biased to extend laterally outward from the proximal portions **540**. In another embodiment, the needle guides **510**A, **510**B may have a memory shape where the distal portions **550** extend laterally outward from the proximal portions **540**. The needle guides **510**A, **510**B can be configured such that the needle guides **510**A, **510**B can be forcibly straightened but return to their curved or angled shape upon release from external forces.

(94) As discussed in more detail below, the design of the needle guides **510**A, **510**B allows the angle adjustment member **630** to be configured to adjust a deployment angle "α" of the needle guides **510**A, **510**B. The deployment angle "α" is defined as the greatest acute angle between the needle guides **510**A, **510**B and a longitudinal axis of the guide member **520**. In one configuration, the deployment angle "α" is in a range between about 20 degrees and about 60 degrees, while in another configuration the deployment angle "α" is between about 30 degrees and 50 degrees. One skilled in the art will understand that the deployment angle "α" can range between any puncture angle commonly used to suture an body lumen opening. Adjusting the deployment angle "α" allows the closure device **50** to be used on body lumen openings of varying sizes.
(95) It will be understood by those skilled in the art that various other configurations of the needle guides **510**A, **510**B are possible. For example, although the needle guides **510**A, **510**B have at least an angled or curved portion **545**, the body **530** of the needle guides **510**A, **510**B being entirely curved or substantially angled is possible. Moreover, the needle guides **510**A, **510**B may include a substantially rigid portion, a flexible portion and/or a semi-rigid portion. The needle guides **510**A, **510**B may be comprised of a biocompatible material such as one or more polymers, elastomers, plastics, metals, composites, other similar materials, or any combination thereof. The needle guides **510**A, **510**B may also include one or more superelastic or shape memory materials such as shape memory alloys. The needle guides **510**A, **510**B may have a cross-sectional configuration that is rectangular, circular, elliptical, triangular, uniform, varying, substantially solid, substantially hollow, or any other cross-sectional configuration suitable for deployment through a vessel wall (not shown in FIG. **7**A). In one embodiment, the needle guides **510**A, **510**B may be configured to hold a suture (not shown) and/or a suture securing device (not shown). For example, the needle guides **510**A, **510**B can include a suture lumen **560** defined between the proximal portion **540** and the distal portion **550**. The suture lumens **560** can be sized, shaped and/or configured to hold the suture and/or the suture securing device. Further, although two needle guides **510**A, **510**B are shown, one needle guide or a plurality of needle guides is possible. The needle guides **510**A, **510**B can also be configured to form a penetration path though a vessel wall **570** immediately surrounding a body lumen opening. As shown, the distal portion **550** of the needle guides **510**A, **510**B may include a penetrator tip **580**. In another embodiment, the needle guides **510**A, **510**B may include a detachable penetrator tip disposed on the distal portion **550**. In a further example, the penetrator tip **580** may comprise one or more sharpened edges on the distal portion **550** of the needle guides **510**A, **510**B.
(96) As illustrated in FIG. **7**A, the needle guides **510**A, **510**B can extend longitudinally along the length of the guide member **520** toward openings **610**A, **610**B near the distal end **670** of the guide member **520** (as shown by hidden lines in FIG. **7**A). While the needle guides **510**A, **510**B are shown disposed within the guide member **520**, the needle guides **510**A, **510**B disposed on the guide member **520** are possible. For example, the needle guides **510**A, **510**B may be positioned in between the outer surface of the guide member **520** and the inner surface of the angle adjustment member **630** in longitudinal grooves (not shown) formed on the outer surface of the guide member **520**.
(97) The needle guide activation plunger or handle **620** can be coupled to the needle guides **510**A, **510**B such that movement of the needle guide activation handle **620** can deploy the needle guides **510**A, **510**B though openings the **610**A, **610**B and distally of the guide member **520**. While a needle activation plunger or handle is shown, any number of mechanisms can deploy the needle guides **510**A, **510**B distally of the guide member **520** such as a release button, a trigger, an actuator, or other mechanisms capable of deploying the needle guides **510**A, **510**B.
(98) The angle adjustment member **630** may include a proximal end **640** and a distal end **650** and concentrically surround the guide member **520**. The angle adjustment member **630** can be configured to support the needle guide activation handle **620** and move relative to the length of the guide member **520**. In another embodiment, the guide member **520** may move relative to the angle

adjustment member **630**. The angle adjustment member **630** may be further configured so that the angle adjustment member **630** can adjust the deployment angle "α" of the needle guides **510**A, **510**B. While the angle adjustment member **630** is shown as a sheath, the angle adjustment member **630** may comprise elongate members moveably attached to opposing sides of the guide member **520**, or an annular member moveably attached to the guide member **520** having one or more deflector rods aligned with the openings **610**A, **610**B, or any other configuration suitable to adjust the deployment angle "α" of the needle guides **510**A.

(99) FIGS. **8**A-**8**D are cross-sectional views of the closure device **50** taken at various positions along section **6-6** of FIG. **7**A to illustrate adjustment of the deployment angle "α" by the angle adjustment member **630**. As shown in FIG. **8**A, while in a pre-deployed state the needle guides **510**A, **510**B may be positioned within the guide member **520**. Again, while the needle guides **510**A, **510**B are shown disposed within the guide member **520**, needle guides **510**A, **510**B disposed on the guide member **520** are possible. As shown, the guide member **520** may include a plurality of lumens **660**A, **660**B extending distally toward the openings **610**A, **610**B of the guide member **520**. The lumens **660**A, **660**B may be sized to receive at least one of the needle guides **510**A, **510**B. The lumens **660**A, **660**B may extend parallel to the longitudinal axis of the guide member **520**. The needle guides **510**A, **510**B may be forcibly straightened within the lumens **660**A, **660**B. This facilitates low-profile storage of the needle guides **510**A, **510**B and the closure device **10** generally. Moreover, storage of the needle guides **510**A, **510**B within the lumens **660**A, **660**B can help prevent contamination of the needle guides **510**A, **510**B.

(100) The openings **610**A, **610**B may be aligned along the longitudinal axis of the guide member **520** and be in fluid communication with the lumens **660**A, **660**B. As shown, the openings **610**A, **610**B may be located near a distal end **670** of the guide member **520**. Although the openings **610**A, **610**B in the guide member **520** are shown parallel to the longitudinal axis of the guide member **520**, the openings **610**A, **610**B can be oriented at any desirable angle relative to the guide member **520**. For example, the openings **610**A, **610**B may be oriented substantially non-parallel to the longitudinal axis of the guide member **520** such that the openings **610**A, **610**B direct the needle guides **510**A, **510**B radially away from the guide member **520**. Moreover, while the openings **610**A, **610**B are shown formed on the end of the guide member **520**, the openings **610**A, **610**B may be formed on the sidewalls of the guide member **520**. The needle guides **510**A, **510**B can be advanced through the openings **610**A, **610**B by manipulation of the needle guide activation handle **620** (not shown).

(101) FIG. **8**B shows the needle guides **510**A, **510**B deployed from the guide member **520** with the angle adjustment member **630** in a retracted position. As shown, the angle adjustment member **630** can be advanced along and relative to the guide member **520** such that the distal end **650** of the angle adjustment member **630** is positioned proximal to the openings **610**A, **610**B in the guide member **520**. Consequently, the needle guides **510**A, **510**B may form a penetration path through the vessel wall **570** without being biased toward the longitudinal axis of the guide member **520** by the angle adjustment member **630**. With the angle adjustment member **630** in the retracted position, the primary deployment angle "α" of the needle guides **510**A, **510**B may be approximately 60 degrees relative to the longitudinal axis of the guide member **520**, as determined primarily by the configuration of the needle guides **510**A, **510**B. The primary deployment angle "α" minimizes the deployment depth, thereby minimizing the possibility of overshooting the vessel. Moreover, the primary deployment angle "α" maximizes the radial span of the needle guides **510**A, **510**B, thereby maximizing the size of the body lumen opening the needle guides **510**A, **510**B can close.

(102) FIG. **8**C shows the needle guides **510**A, **510**B deployed from the guide member **520** with the angle adjustment member **630** positioned in an extended position. As shown, the angle adjustment member **630** can be advanced along and relative to the guide member **520** until the distal end **650** of the angle adjustment member **630** is distal of the openings **610**A, **610**B. The angle adjustment member **630** may be substantially aligned or proximal to the distal end **670** of the guide member

**520**. In the extended position, the angle adjustment member **630** may deflect the needle guides **510**A, **510**B toward the deployment angle "α" of approximately 20 degrees relative to the guide member **520**. With the angle adjustment member **630** in the extended position, the needle guides **510**A, **510**B can close a smaller body lumen opening.

(103) FIG. **8**D shows the needle guides **510**A, **510**B deployed from the guide member **520** with the angle adjustment member **630** positioned in an intermediate position. The intermediate position is defined between the retracted position and the extended position. In the intermediate position, the angle adjustment member **630** may be advanced along and relative to the guide member **520** such that the distal end **650** of the angle adjustment member **630** is positioned distal to the openings **610**A, **610**B but proximal to the position of the angle adjustment member **630** in the extended position. With the angle adjustment member **630** in the intermediate position, the angle adjustment member **630** may deflect the needle guides **510**A, **510**B toward the deployment angle "α" between about 20 degrees and about 60 degrees. Distal movement of the angle adjustment member **630** beyond the openings **610**A, **610**B will reduce the deployment angle "α" toward about 20 degrees until the angle adjustment member **630** reaches the extended position. Proximal movement of the angle adjustment member **630** beyond the openings **610**A, **610**B will increase the deployment angle "α" toward about 60 degrees until the angle adjustment member **630** reaches the retracted position. Thus, a user can adjust the deployment angle of the needle guides **510**A, **510**B anywhere between about 20 degrees and about 60 degrees by moving the angle adjustment member **630** between the retracted position and the extended position.

(104) In another embodiment, the closure device **10**, closure device **40**, or closure device **50** may employ an articulating suture securing device having a low-profile configuration and an expanded configuration. FIG. **9**A shows a perspective view of a suture securing device **705** according to one example. As shown, the suture securing device **705** may comprise a tubular body **710**, a cutout **730** formed in the tubular body **710**, and a suture **740** attached to the tubular body **710**.

(105) The tubular body **710** may be elongated and have a proximal end **715**, an intermediate portion **720**, and a distal end **725**. The tubular body **710** can include a first opening **735** at the proximal end **715** for receiving an end of the suture **740**. The suture **740** may extend into the interior of the tubular body **710** along its length. The suture **740** may exit the tubular body **710** through a second opening **745** located near the distal end **725**. While the suture **740** is shown exiting the tubular body through the second opening **745** located near the distal end **725**, the suture **740** may exit the tubular body **710** at any number of locations. For example, a second opening may be located near the intermediate portion **720** of the tubular body **710** such that the suture may exit the tubular body **710** near the intermediate portion **720**. In another example, a third opening (not shown) may be located between the intermediate portion **720** and the distal end **725** such that the suture **740** may exit through the third opening.

(106) The tubular body **710** may be crimped, as shown at **780**, about the suture **740** to mechanically affix the suture **740** to the suture securing device **705**. In other embodiments, the tubular body **710** can be crimped in a plurality of locations. In addition and or instead to mechanical crimping, the suture **740** may be bonded to the suture securing device **705** using an adhesive, heat, fasteners, knots or the like. The tubular body **710** may also include a swaged portion **750** adjacent the second opening **745** to help retain the suture **740** in the tubular body **710**. The tubular body **710** may include any number of rigid or semi-rigid materials. For example, the tubular body **710** may include one or more polymers, elastomers, plastics, metals, composites, other similar materials, or combinations thereof. The tubular body **710** may also include one or more superelastic or shape memory materials such as shape memory alloys.

(107) The cutout **730** may extend distally from the proximal end **715** of the tubular body **120**. In other embodiments, more than one cutout **730** is possible. While the cutout **730** is shown having being u-shaped, a rectangular, triangular, elliptical, oval, or any other suitable shape is possible. The cutout **730** may include a plurality of tissue-engaging elements **755** extending along each side

of the cutout **730**. In other embodiments, the tissue-engaging elements **755** may also be formed on other portions of the tubular body **710**. For example, the tissue-engaging elements **755** may be formed over the entire outer surface of the tubular body. In a further example, the tissue-engaging elements **755** may be formed between the proximal end **715** and the intermediate portion **720** of the tubular body **710**. In yet a further example, the tissue-engaging elements **755** may be formed between the proximal end **715** and the distal end **725** on the same surface as the cutout **730**. In other embodiments, the cutout **730** may include one or more tissue-engaging elements.

(108) The tissue-engaging elements **755** extend from opposing sides of the cutout **730** and may comprise teeth, serrations, tilted trapezoidal bodies, or any other shape or configuration suitable to increase friction when engaged against a vessel wall. It will be apparent to one skilled in the art that a variety of tissue-engaging element configurations may be possible. For example, the tissue-engaging elements **755** may have tapered bodies. The tissue-engaging elements **755** may have generally circular disc-shaped bodies. The tissue-engaging elements **755** may have setaceous bodies. The tissue-engaging elements **755** may have hook shaped bodies. The tissue-engaging elements **755** may have tine shaped bodies. The tissue-engaging elements **755** may comprise notches formed in the tubular body **710**. The orientation of the tissue-engaging elements **755** may also vary. For example, the tissue-engaging elements **755** may be angled toward or away from the cutout **730**. The tissue-engaging elements **755** may be curved inwardly or outwardly relative to the cutout **730**. The tissue-engaging elements **755** may alternate between extending inward and outward from the cutout **730**.

(109) In another embodiment, at least a portion of the suture **740** may include friction producing structures **760**. The friction producing structures **760** may include a plurality of annular vanes formed in the outer surface of the suture **740**. In another embodiment, the friction producing structures **760** may include raised helically formed or threaded portions on or in the suture **740**. In another embodiment, the friction producing structures **760** may include one or more annular grooves formed in the suture **740**. In another embodiment, the friction producing structures **760** may be formed on a substantially rigid portion of the suture **740**. In a further embodiment, the friction producing structures **760** may be non-uniformly distributed on the suture **740**. In yet a further embodiment, the friction producing structures **760** may include a plurality of raised portions and a plurality of recessed portions.

(110) FIGS. **9**B and **9**C show the suture securing device **705** in a low-profile configuration (FIG. **9**B) and an expanded configuration (FIG. **9**C). As shown in FIG. **9**B, the suture securing device **705** may have a low-profile configuration in which the tubular body **710** is substantially aligned along the axis of the suture **740**. The low-profile configuration shown in FIG. **9**B facilitates storage and delivery of the suture securing device **705**. For example, a needle guide **765** may hold the suture securing device **705** and the suture **740** as the needle guide **765** forms a penetration path through the vessel wall **770** immediately adjacent a body lumen opening. In another embodiment, the suture securing device **705** can be configured to penetrate the vessel wall **770** rather than the needle guide **765**. For example, the suture securing device **705** can be disposed on the needle guide **765** with a penetrator tip (not shown) attached to the distal end **725** of the suture securing device **705**.

(111) As shown in FIG. **9**C, the suture securing device **705** may have an expanded configuration. In one embodiment, the needle guide **765** may be retracted depositing or releasing the suture securing device **705** distally of the vessel wall **770**. The tubular body **710** may then rotate relative to the suture **740** such that the suture **740** is received within the cutout **730** and the tubular body **710** is positioned substantially non-parallel to the suture **740** and substantially parallel to the vessel wall **770**. In another embodiment, the tubular body **710** may include more than one cutout configured to receive the suture **740** such that the tubular body **710** may rotate relative to the suture **740** in a plurality of directions. For example, the tubular body **710** may include a second cutout (not shown) formed opposing the cutout **730** such that the tubular body **710** may rotate clockwise or

counterclockwise about the suture **740**. In a further embodiment, the cutout **730** may include a receptacle (not shown) configured to fix the orientation of the suture **740** relative to the tubular body **710** once the suture securing device **705** moves into the expanded configuration. In yet a further embodiment, the cutout **730** may include a locking clip (not shown) to fix the orientation of the suture **740** relative to the tubular body **710** once the suture securing device **705** moves into the expanded configuration. In yet a further embodiment, the cutout **730** may include a catch member (not shown) to fix the orientation of the suture **740** relative to the tubular body **710** once the suture securing device **705** moves into the expanded configuration.

(112) Reference is now made to FIGS. **10**A-**10**C which illustrates an additional example suture securing device **805**. The suture securing device **805** may be similar in many respects to the suture securing device **705** previously described above in FIGS. **9**A-**9**C. To the extent features or components of this configuration function in a manner similar to that as described above, such disclosure is hereby incorporated into the following additional configuration. Like structures and/or components are given like reference numerals. Additionally, the suture securing device **805** may incorporate at least one component of the suture securing device **705** described in FIGS. **9**A-**9**C.

(113) As shown in FIG. **10**A, the suture securing device **805** may include a tubular body **810** having a proximal end **815**, a mid-point **820**, and a distal end **825**. The tubular body **810** can include a first opening **835** at the proximal end **815** for receiving an end of a suture **840**. The suture **840** may extend distally within the tubular body **810** along its length. The suture **840** can also exit the tubular body **810** through a second opening **845** located near the distal end **825**. As shown, the tubular body **810** may be crimped **880** about the suture **840** near the distal end **825** to mechanically affix the suture **840** to the suture securing device **805**. In other embodiments, the tubular body **810** can be crimped in a plurality of locations. In addition and or instead to mechanical crimping, the suture **840** may be bonded to the suture securing device **805** using an adhesive, heat, fasteners, knots or the like. The tubular body **810** may also include a swaged portion **850** adjacent the second opening **845** to help retain the suture **840** in the tubular body **710**.

(114) The tubular body **810** may include a plurality of elongated slots **897** radially spaced about the tubular body, and extending distally from the proximal end **815**. The slots **897** may define a plurality of projections **875** therebetween. In one embodiment, each projection **875** may have a wire, strip-like, or ribbon like shape with a fixed end **885** and a free end **890**. The projections **875** of the tubular body **810** may be formed by one of more strips of material. In one embodiment, the projections **875** may include notches **895** formed near the free end **890**. The notches **895** may be sized, shaped, and configured to help anchor the projections **875** against a vessel wall **870**. In another embodiment, the projections **875** may include tissue-engaging elements formed near the free end **890**. For example, the projections **875** may include one or more teeth shaped elements, tines, and/or barbs that are oriented to engage the vessel wall **870**. The free end **890** of the projections **875** may also be forked such that the free end **890** can penetrate the vessel wall **870**.

(115) In one embodiment, the tubular body **810** may have four projections **875**. In another embodiment, the tubular body **810** may have six projections **875**. In a further embodiment, the projections **875** may be spaced evenly about the tubular body **810**. In a further embodiment, the projections **875** may form a shape similar to an ‘x’. In yet further embodiment, the tubular body **810** may have multiple layers of projections **875**. For example, the tubular body **810** may include a first set of projections **875***a* and a second set of projections **875***b*. Each set may include any number of projections **875** desired for a particular application. In further embodiments, each projection **875** may have any shape, size, or configuration desired for a particular application.

(116) As shown in FIG. **10**B, the suture securing device **805** may have a collapsed configuration in which the projections **875** are substantially parallel with a longitudinal axis of the tubular body **810**. The collapsed configuration shown in FIG. **10**B may facilitate storage and delivery of the suture securing device **805**. A needle carrier **865** may hold the suture securing device **805** in the collapsed configuration as the needle carrier **865** forms a penetration path through the vessel wall

**870** immediately adjacent a body lumen opening. In another embodiment, the suture securing device **805** can be configured to penetrate the vessel wall **870** rather than the needle guide **865**. For example, the suture securing device **805** can be disposed on the needle guide **865** with a penetrator tip (not shown) attached to the distal end **825** of the suture securing device **805**.
(117) As shown in FIG. **10**C, the suture securing device **805** may have an expanded configuration. In one embodiment, the needle guide **865** may be retracted from the penetration path depositing or releasing the suture securing device **805** distally of the vessel wall **870**. The projections **875** may then move to the expanded configuration wherein the projections **875** are substantially non-parallel with the longitudinal axis of the tubular body **810**. In one embodiment, the projections **875** may include one or more elastic or shape memory materials, such as spring steel, nitinol, and/or other shape memory alloys, and may be heat set to have a memory shape. For example, the projections **875** may be heat set in their expanded configuration. As a result, when the suture securing device **805** is deployed, it may superelastically move to an expanded configuration. A user may apply a force to the suture securing device **805** to deform the projections **875** away from their memory shape and move the suture securing device **805** into a collapsed configuration, as shown in FIG. **10**B. Alternatively, the projections **875** may be resiliently biased towards the expanded configuration. As a result, when the suture securing device **805** is released from an external force such as the needle guide **865**, the projections **875** may move to their expanded configuration. In another embodiment, the projections **875** may be pivotally connected to the tubular body **810**. In a further embodiment, the projections **875** may be pivotally connected to the proximal end **815** of the tubular body **810**. When the suture securing device **805** is stored within the needle guide **865**, the projections **875** may be rotated to the collapsed configuration. As shown, when the suture securing device **810** is deployed from the needle guide **865**, the projections **875** can rotate to the expanded configuration.
(118) The present disclosure may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the disclosure is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

## Claims

1. A method for closing a puncture in tissue, the method comprising: advancing a guide member into proximity with the tissue, the guide member having a guide for a suture securing device; positioning a distal end of the guide member in contact with tissue adjacent to the puncture with the guide toward the tissue to present an opening of the guide toward a proximal side of the tissue, the guide cooperating with the suture securing device that is slidably coupled to the guide member and a suture attached to the suture securing device; deploying the suture securing device through the tissue with the opening toward the proximal side of the tissue, the suture securing device comprising a body with an anchor point for the suture and features that allow the suture securing device to pierce the tissue and resist retraction through the tissue, the suture being attached to the body, the features comprising a plurality of projections configured to extend laterally beyond a deployment location of the suture securing device in the tissue, the plurality of projections being disposed circumferentially about a longitudinal axis of the body, the body having a proximal end, a distal end, and an inner cavity, a notch being formed at the proximal end of each projection of the plurality of projections, the notch being sized and shaped to aid with anchoring the projections into the tissue; and establishing tension in the suture to move the suture securing device toward another suture securing device to thereby close the puncture in the tissue.
2. The method of claim 1, wherein the guide is deployed distally from the guide member and advanced through the tissue by moving an activation handle relative to the guide member.

3. The method of claim 1, wherein each projection of the plurality of projections comprises a forked proximal end.
4. The method of claim 1, wherein each of the plurality of projections comprising one or more teeth-shaped elements, tines or barbs.
5. The method of claim 1, further comprising moving the body between a first position wherein the body is substantially parallel with a longitudinal axis of the suture and a second position where the plurality of projections extend laterally to be substantially non-parallel with the longitudinal axis of the suture and at least a portion of the suture.
6. The method of claim 1, further comprising engaging the plurality of projections against the tissue.
7. The method of claim 1, wherein the suture securing device comprises a tapered body.
8. A method for closing a puncture in tissue, the method comprising: advancing a guide member into proximity with a puncture in tissue; positioning a distal end of a guide in contact with tissue adjacent to the puncture and toward the tissue to present an opening of the guide toward a proximal side of the tissue, the guide cooperating with an anchor; deploying the anchor through the tissue with the opening toward the proximal side of the tissue, the anchor comprising a body with an anchor point for a suture and features that allow the anchor to pierce the tissue and resist retraction through the tissue, the anchor point being at a location proximal an intermediate location of the anchor, the suture being attached to the body, the features comprising a plurality of tissue-engaging elements that are configured to extend laterally beyond a deployment location of the anchor in the tissue, the plurality of tissue-engaging elements being disposed circumferentially about a longitudinal axis of the body with a projection of the plurality of tissue-engaging elements comprising a fixed end and a free end, the body having a proximal end, a distal end, and an inner cavity, and a notch being formed at the proximal end of each tissue-engaging element of the plurality of tissue-engaging elements, the notch being sized and shaped to aid with anchoring the tissue-engaging element into the tissue; and moving the anchor toward a longitudinal axis of the guide member to close the puncture in the tissue.
9. The method of claim 8, further comprising actuating a handle relative to the guide member to deploy the guide distally.
10. The method of claim 8, further comprising advancing the anchor through the guide member to the deployment location.
11. The method of claim 10, further comprising expanding the anchor to laterally extend beyond the deployment location.
12. The method of claim 8, further comprising positioning a plug against the tissue.
13. The method of claim 8, wherein the anchor comprises a conical body.
14. A method for closing a puncture in tissue, the method comprising: advancing a distal end of a guide member into contact with tissue adjacent to the puncture to position openings near the distal end of the guide member into proximity with a proximal side of the tissue and a puncture in tissue; deploying a plurality of anchors through the tissue with the openings toward the proximal side of the tissue, each of the plurality of anchors comprising a body with an anchor point for a suture and features that allow the anchors to pierce the tissue and resist retraction through the tissue, the anchor point being at a location proximal an intermediate location of the anchor, the suture being attached to the body, the features comprising a plurality of tissue-engaging elements that are configured to extend laterally beyond a deployment location of the anchor in the tissue, the plurality of tissue-engaging elements being disposed circumferentially about a longitudinal axis of the body with each tissue-engaging element of the plurality of tissue-engaging elements comprising a fixed end and a free end, the fixed end being integral with a distal portion of the anchor, the body having a proximal end, a distal end, and an inner cavity, a notch being formed at the proximal end of each tissue-engaging element of the plurality of tissue-engaging elements, the notch being sized and shaped to aid with anchoring the tissue-engaging element into the tissue; and moving the

plurality of anchors toward the longitudinal axis of the guide member to close the puncture in the tissue.

15. The method of claim 14, further comprising actuating a handle relative to the guide member to deploy the plurality of anchors.

16. The method of claim 14, further comprising advancing a locator through the guide member to the deployment location.

17. The method of claim 16, further comprising expanding the locator to laterally extend beyond the deployment location.

18. The method of claim 14, further comprising positioning a plug against the tissue.

19. The method of claim 14, wherein the anchor comprises a conical body.