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Medical fixation systems and methods of using the same

Abstract

A medical device that includes a clamp having a body defining a channel and a fixation member that is configured to move relative to the body from an unlocked position to a locked position. The medical device includes an actuator coupled to the fixation member and configured to move the fixation member from the unlocked position to the locked position. The fixation member extends at least partially into or radially outward from the channel in response to moving from the unlocked position to the locked position.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application claims the benefit of priority of U.S. Provisional Patent Application No. 63/039,220, filed Jun. 15, 2020, the entirety of which is incorporated herein by reference.

TECHNICAL FIELD

(1) Various aspects of the present disclosure relate generally to medical fastening systems, devices, and related methods. Examples of the present disclosure relate to systems, devices, and related methods for securing a position and/or orientation of a medical instrument relative to a subject, among other aspects.

BACKGROUND

(2) Technological developments have given users of medical systems, devices, and methods, the ability to conduct increasingly complex procedures on subjects. One challenge in the field of minimally invasive surgeries is associated with maintaining a stable position of one or more components of a medical instrument, such as, for example, an endoscope, relative to a subject (e.g., a patient) during a procedure. The limitations of medical instruments in providing a secured position and/or orientation of its components may require a user to manually maintain the device throughout the procedure. Requiring manual control of the medical instrument may prolong the procedure, limit its effectiveness, and/or cause injury to the patient when manipulating the instrument.

SUMMARY

(3) Aspects of the disclosure relate to, among other things, systems, devices, and methods for fastening a position and/or orientation of a medical instrument relative to a subject, among other aspects. Each of the aspects disclosed herein may include one or more of the features described in connection with any of the other disclosed aspects.

(4) According to an example, a medical device may include a clamp having a body defining a channel, a fixation member that is configured to move relative to the body from an unlocked

position to a locked position, and an actuator coupled to the fixation member and configured to move the fixation member from the unlocked position to the locked position. The fixation member extends at least partially into or radially outward from the channel in response to moving from the unlocked position to the locked position.

(5) Any of the medical devices described herein may include one or more of the following features. The clamp has a C-shaped body, and the fixation member includes a cam disposed within the body and positioned along an interior surface of the body. The actuator includes a lever that is disposed along an exterior surface of the body, the lever configured to engage the cam. The lever is configured to extend the cam into the channel. The clamp includes a mating feature configured to engage a corresponding mating feature of a coupling mechanism of a tube. The tube is configured to suspend the coupling mechanism at a fixed position. The clamp has a C-shaped body, and the fixation member includes one or more flexible membranes coupled to and positioned along an interior surface of the body. The actuator is configured to control delivery of a pressurized medium to the one or more flexible membranes. The one or more flexible membranes are configured to expand into the channel of the clamp. The one or more flexible membranes are configured to expand outwardly from an exterior surface of the body. The actuator includes an assembly configured to contain a pressurized medium, the assembly being fluidly coupled to the one or more flexible membranes via an inlet port of the body. The assembly includes a valve and a syringe each fluidly coupled to the inlet port. The actuator includes a compressible body that extends proximally from the body of the clamp, the actuator being fluidly coupled to the one or more flexible membranes. The compressible body is configured to contain a pressurized medium, the compressible body including a release valve configured to release the pressurized medium from the compressible body.

(6) According to another example, a medical device may include a body having a curved profile such that a distal-most end surface of the body extends transversely relative to a proximal-most end surface of the body. The proximal-most end surface is configured to flexibly deform to engage a medical instrument. The medical device may include a slot formed through the body and extending between the distal-most end surface and the proximal-most end surface. The slot is configured to receive a shaft of the medical instrument. The body is configured to maintain a bend in the shaft of the medical instrument in accordance with the curved profile of the body such that a distal portion of the shaft that extends outwardly from the slot at the distal-most end surface is oriented transversely relative to a proximal portion of the shaft received at the proximal-most end surface.

(7) Any of the medical devices described herein may include one or more of the following features. The medical device may include a protrusion formed along an exterior of the body and extending between the distal-most end surface and the proximal-most end surface. The protrusion includes a curved configuration in accordance with the curved profile of the body. The proximal-most end surface of the body defines a first opening, and the distal-most end surface of the body defines a second opening, the second opening having a cross-sectional dimension that is smaller than the first opening.

(8) According to another example, a medical device may include a body having a proximal portion and a distal portion configured to pivot relative to the proximal portion. The proximal portion defines a plurality of apertures. The medical device may include a locking assembly configured to transition the distal portion between a plurality of positions relative to the proximal portion and maintain the body in each position. The locking assembly includes a protrusion. An orientation of the distal portion relative to the proximal portion is fixed in response to the protrusion engaging at least one of the plurality of apertures to fix the body to at least one of the plurality of positions.

(9) Any of the medical devices described herein may include one or more of the following features. The proximal portion is included on a handle of a device having a shaft extending distally from the handle. The distal portion receives at least a portion of the shaft therein. The body is configured to move the shaft relative to the handle when the distal portion pivots relative to the proximal portion.

(10) It may be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate exemplary aspects of the disclosure and together with the description, serve to explain the principles of the disclosure.

(2) FIG. **1** is a perspective view of an exemplary medical device including a clamp with a curved body, according to aspects of this disclosure;

(3) FIG. **2** is a side view of the medical device of FIG. **1** coupled to a medical instrument, according to aspects of this disclosure;

(4) FIG. **3**A is a perspective view of another exemplary medical device including an indexing mechanism in a first position, according to aspects of this disclosure;

(5) FIG. **3**B is a perspective view of the medical device of FIG. **3**A with the indexing mechanism in a second position, according to aspects of this disclosure;

(6) FIG. **4** is a side view of another exemplary medical device including a clamp, according to aspects of this disclosure;

(7) FIG. **5** is a perspective view of the medical device of FIG. **4** including a flexible tube coupled to the clamp, according to aspects of this disclosure;

(8) FIG. **6** is a perspective view of another exemplary medical device including a clamp and a valve assembly, according to aspects of this disclosure;

(9) FIG. **7** is a perspective view of the medical device of FIG. **6** including a syringe coupled to the valve assembly and a positioning device coupled to the clamp; according to aspects of this disclosure;

(10) FIG. **8** is a cross-sectional perspective view of the medical device of FIG. **6** with the clamp engaged to a medical instrument, according to aspects of this disclosure; and

(11) FIG. **9** is a perspective view of another exemplary medical device including a clamp engaged to a medical instrument, according to aspects of this disclosure.

DETAILED DESCRIPTION

(12) Examples of the disclosure include systems, devices, and methods for securing a proximal component of a medical instrument relative to a subject (e.g., a patient) to maintain a position and/or orientation of a distal component of the medical instrument relative to a target treatment site within the subject.

(13) As used herein, the term “distal” refers to a portion farthest away from a user when introducing a device into a patient and the term “proximal” refers to a portion closest to the user when placing the device into the subject. The terms “comprises,” “comprising,” or any other variation thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements does not necessarily include only those elements, but may include other elements not expressly listed or inherent to such process, method, article, or apparatus. The term “exemplary” is used in the sense of “example,” rather than “ideal.” As used herein, the terms “about,” “substantially,” and “approximately,” indicate a range of values within +/−10% of a stated value.

(14) Examples of the disclosure may relate to devices and methods for performing various medical procedures and/or treating portions of the large intestine (colon), small intestine, cecum, esophagus, any other portion of the gastrointestinal tract, and/or any other suitable patient anatomy (collectively referred to herein as a “target treatment site”). Various examples described herein include single-use or disposable medical devices. Reference will now be made in detail to

examples of the disclosure described above and illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

(15) FIG. **1** shows an exemplary medical device **100** in accordance with an example of this disclosure. Medical device **100** may include a clamp having a body **102** defined between a proximal end **104** and a distal end **108**. Body **102** may be generally curved and include a proximal opening **106** at proximal end **104** and a distal opening **110** at distal end **108**. In some examples, a curved configuration of body **102** may be defined as a portion of an arc, such as, for example, of a circle. By way of further example, body **102** may form an angle between proximal end **104** and distal end **108**. For example, a center axis of proximal opening **106** may be transverse, e.g., perpendicular, to a center axis of distal opening **110** and an angle formed between the respective center axes of openings **106**, **110** may range from about 10 degrees to about 145 degrees. In the example, body **102** may form an angle of about 80 degrees between proximal opening **106** and distal opening **110**.

(16) It should be appreciated that a distal portion of body **102**, adjacent to distal end **108**, may have a transverse orientation relative to a proximal portion of body **102** adjacent to proximal end **104**. Proximal end **104** may be offset from distal end **108** by a vertical height ranging from about 70 millimeters to about 90 millimeters, such as about 80 millimeters. Further, proximal end **104** may be offset from distal end **108** by a horizontal length ranging from about 80 millimeters to about 100 millimeters, such as about 90 millimeters.

(17) Body **102** further includes a slot **112** extending between proximal end **104** and distal end **108**. Slot **112** may be positioned along a sidewall of body **102** and may form a continuous opening with proximal opening **106** and distal opening **108** along a longitudinal length of body **102**. Stated differently, proximal opening **106**, distal opening **110**, and slot **112** may mutually define a single, longitudinal opening on body **102** with slot **112** extending between proximal opening **106** and distal opening **110**.

(18) In some examples, body **102** may have a greater cross-sectional dimension at proximal end **104** than at distal end **108**. Accordingly, proximal opening **106** may have a greater cross-sectional dimension (e.g., diameter) relative to distal opening **110**. In some examples, proximal end **104** may have a size ranging from about 34 millimeters to about 38 millimeters, such as about 36 millimeters. Distal end **108** may have a size ranging from about 23 millimeters to about 27 millimeters, such as about 25 millimeters.

(19) Additionally or alternatively, slot **112** may have a varying cross-sectional dimension between proximal end **104** and distal end **108**. For example, an opening formed by slot **112** in body **102** may be relatively larger adjacent to proximal end **104** than at distal end **108**. As described in detail herein, proximal end **104** may define a fixation member and proximal opening **106** may be sized, shaped, and configured to receive a first component or portion of another medical device. Distal opening **108** may be sized, shaped, and configured to receive a second component or portion of the other medical device, with the second component or portion being relatively smaller than the first component or portion.

(20) Still referring to FIG. **1**, body **102** may include one or more protrusions **114** positioned between proximal end **104** and distal end **108**. Protrusion(s) **114** may extend laterally outward from, or form an integral part of a lateral surface of, an exterior surface of body **102**. Protrusion(s) **114** may include actuator(s) defining graspable feature(s) that is sized, shaped, and configured to be manually grasped by a user of medical device **100**. As described further herein, medical device **100** may be manually maneuverable and/or manipulated to secure body **102** to another medical device in response to selectively grasping the one or more protrusions **114**. In the example shown in FIG. **1**, medical device **100** includes a pair of protrusions **114** along opposing lateral sidewalls of body **102**. Protrusions **114** also may provide additional rigidity to device **100**.

(21) Body **102** may be formed of various rigid materials, including, but not limited to, plastic,

rubber, metal, etc. Medical device **100** optionally may further be configured and operable to selectively flex at proximal end **104**, such that a cross-sectional dimension (e.g., diameter) of proximal opening **106** may be adjustable. In some examples, body **102** may flex laterally outward at proximal end **104** in response to another medical device applying a force thereto when received through proximal opening **106**. In other words, a medical device having a greater cross-sectional dimension than proximal end **104** may apply a radial force onto body **102** when received through proximal opening **106**, thereby causing proximal end **104** to flex and/or move outward.

(22) Referring now to FIG. **2**, an exemplary method of using medical device **100** with another device is shown. In the example, medical device **110** is coupled to a medical instrument **10**, such as, for example, an endoscope, duodenoscope, gastroscope, colonoscope, ureteroscope, bronchoscope, catheter, or other delivery system. Medical instrument **10** may include a handle **12**, at least one actuator **14**, a device port **16**, and a shaft **18**. Handle **12** may be defined by a proximal end including actuator **14** and a distal end **13** including shaft **18** extending distally therefrom. Device port **16** may extend outwardly from an intermediate portion of handle **12**.

(23) Handle **12** may have one or more lumens (not shown) that communicate with lumen(s) of one or more other components of medical instrument **10**. Device port **16** opens into the one or more lumens of handle **12** and is sized and shaped to receive one or more devices therethrough, such as, for example, a catheter **20**. Catheter **20** may include a tube **22** that is received in a lumen of handle **12** via device port **16** and passed through shaft **18**. Shaft **18** may include a tube that is sufficiently flexible such that shaft **18** is configured to selectively bend, rotate, and/or twist when being inserted into and/or through a subject's tortuous anatomy to a target treatment site.

(24) Although not shown, it should be understood that shaft **18** may have one or more lumens extending therethrough that include, for example, a working lumen for receiving instruments, such as tube **22**. Shaft **18** may include one or more additional lumens, such as a control wire lumen for receiving one or more control wires for actuating one or more distal parts/tools (e.g., an articulation joint, an elevator, etc.), a fluid lumen for delivering a fluid, an illumination lumen for receiving at least a portion of an illumination assembly, and/or an imaging lumen for receiving at least a portion of an imaging assembly.

(25) Shaft **18** may be substantially flexible such that a longitudinal length of shaft **18** may include a minimal stiffness between a proximal end of shaft **18** secured to distal end **13** of handle **12**, and a distal end (not shown) positioned opposite of the proximal end. Shaft **18** may be formed of a material providing minimal resistance through a longitudinal length of shaft **18** such that shaft **18** may have a flexible configuration.

(26) When medical device **100** is omitted, shaft **18** may extend from distal end **13** of handle **12** in a generally downward orientation, and may be selectively maneuvered to various configurations. Movement of proximal end of shaft **18** may cause movement of a distal end of shaft **18** (e.g., proximate a target site of a patient), such that the distal end does not maintain a fixed position, orientation, and/or configuration relative to a proximal end of shaft **18**. Therefore, a user of medical instrument **10** may manually control, manipulate, and/or hold shaft **18** continuously during a procedure when inserting the distal end through a subject (e.g., patient) toward a target treatment site in order to fix the position, orientation, and/or configuration of the distal end of shaft **18**.

(27) Still referring to FIG. **2**, medical device **100** may be attached to medical instrument **10** in response to a user grasping protrusions **114** and engaging proximal end **104** to handle **12** and/or a portion of shaft **18** proximate distal end **13** of handle **12**. In the example illustrated in FIG. **2**, body **102** may be mounted onto handle **12** by snapping proximal end **104** to distal end **13**, thereby forming a snap-fit connection between medical device **100** and medical instrument **10**. In some embodiments, distal end **13** may have a greater cross-sectional dimension than proximal opening **106** such that a configuration of proximal end **104** may be adjusted (e.g., laterally expanded) to accommodate receipt of distal end **13** in proximal opening **106**. In at least one example, body **102** may be mounted onto a proximal portion of shaft **18** adjacent to or otherwise proximate distal end

13 of handle **12**, rather than mounted to handle **12** directly.
(28) As described above, body **102** may be sufficiently flexible to allow it to flex at proximal end **104** in response to a user attaching medical device **100** to medical instrument **10** (or inserting medical instrument **10** into slot **112** of medical device **100**). For example, proximal end **104** may at least partially deform and/or move to receive at least a portion of distal end **13** of handle **12** (or a portion of shaft **18**) through proximal opening **106**. Medical device **100** may clip onto medical instrument **10** in response to proximal end **106** snapping onto distal end **13** of handle **12** (or a portion of shaft **18**), thereby securely fastening body **102** to medical instrument **10**. Accordingly, proximal end **104** may move radially outward relative to slot **112** when receiving and locking onto distal end **13**.
(29) Still referring to FIG. **2**, with medical device **100** fixed to medical instrument **10**, shaft **18** may be received through slot **112** and oriented in a transverse alignment relative to handle **12**, with the transverse alignment corresponding to a curved configuration of body **102**. Shaft **18** may form a bend and be held in a fixed position when received in body **102**, and the distal end of shaft **18** may extend outwardly from slot **112**, and distally from distal end **108**, via distal opening **110**.
(30) During a procedure, medical device **100** may fix a position and/or orientation of a proximal end of shaft **18** relative to medical instrument **10**. Medical device **100** may further minimize a slackness of shaft **18** by increasing a resistance and/or stiffness through shaft **18**. By fixing a position and/or orientation of a proximal end of shaft **18**, medical device **100** may further maintain a position and/or orientation of a distal end of shaft **18** relative to a target treatment site within the subject. Medical device **100** may further minimize a slippage of the distal end of shaft **18** when shaft **18** is received within the subject, thereby reducing a need for a user to manually hold shaft **18** during the procedure.
(31) Referring now to FIGS. **3**A-**3**B, an exemplary medical device **200** is shown in accordance with another example of this disclosure. Medical device **200** may include a body **202** defined by a proximal portion **204** and a distal portion **206**. Body **202** may be integral with and/or integrated onto handle **12**, e.g., distal end **13** of handle **12**, such that medical device **200** forms a unitary structure with medical instrument **10**. Proximal portion **204** may be generally circular and positioned on distal end **13** of handle **12**. Further, for example, distal portion **206** may be generally cylindrical and extend distally from distal end **13** of handle **12**. Body **202** may further include a rotation axis extending through a center **203** of proximal portion **204**, with proximal portion **204** being configured to rotate about rotation axis (e.g., in a clockwise and/or counter clockwise direction). The rotation axis may be transverse, e.g., perpendicular, to a longitudinal axis of handle **12**.
(32) It should be appreciated that proximal portion **104** and distal portion **106** are coupled together, e.g., fixedly secured to one another, such that movement of proximal portion **204** may cause a simultaneous movement of distal portion **206**, and vice versa. As described in further detail herein, body **202** may be configured to move (e.g., rotate, pivot, etc.) relative to handle **12** to transition medical device **200** to one or more positions. Distal portion **206** may have a hollow interior that is sized and shaped to receive a proximal end of shaft **18** therein. Accordingly, movement of body **202** may provide a corresponding movement of shaft **18** relative to handle **12**.
(33) Still referring to FIGS. **3**A-**3**B, body **202** may further include one or more apertures disposed along proximal portion **204**, including, for example, a plurality of apertures. In the example, body **202** may include a first aperture **208** and a second aperture **210** formed on, or defined by, proximal portion **204**. Medical device **200** may further include a detent mechanism **212** disposed within body **202**, e.g., within proximal portion **204**. Detent mechanism **212** may include a locking assembly, e.g., including a protrusion (shown as a solid circle in FIGS. **3**A and **3**B) that is biased by a spring (not shown) to an extended state. Thus, for example, detent mechanism **212** may be configured to extend radially outward from proximal portion **204** and into one of the apertures **208**, **210** absent a counter force applied thereto.

(34) In other embodiments, proximal portion **204** may include depressions along a wall of proximal portion **204** in lieu of apertures **208**, **210**. In this example, the depressions may be located along an interior of the wall at the respective locations of apertures **208**, **210**. Thus, detent mechanism **212** may be configured to extend radially outward towards the wall of proximal portion **204** and received in the depressions absent a counter force applied thereto.
(35) Apertures **208**, **210** may be sized, shaped, and configured to receive detent mechanism **212** in response to at least one aperture **208**, **210** being in alignment with a position of detent mechanism **212**. In other words, detent mechanism **212** may be positioned relative to proximal portion **204** such that at least one of the first aperture **208** or the second aperture **210** may be aligned with detent mechanism **212** (e.g., protrusion of detent mechanism **212**) in response to a rotation of proximal portion **204** about rotation axis extending through center **203**. As described in detail below, apertures **208**, **210** and detent mechanism **212** may provide an indexing mechanism of medical device **200** for moving and locking shaft **18** to a plurality of rotative positions relative to handle **12**.
(36) Still referring to FIGS. **3**A-**3**B, medical device **200** may be configured to transition shaft **18** to a first position when detent mechanism **212** (e.g., protrusion of detent mechanism **212**) is received through first aperture **208**, and to a second position when detent mechanism **212** is received through second aperture **210**. Accordingly, it should be appreciated that each aperture **208**, **210** may define at least one of a plurality of rotative positions for moving and locking shaft **18** relative to handle **12**.
(37) According to an exemplary method of using medical device **200** during a procedure, medical device **200** may be transitioned to one or more positions for fixing a position and/or orientation of shaft **18** relative to a subject and a target treatment site. For example, medical device **200** may be moved from a first position, with detent mechanism **212** (e.g., protrusion of detent mechanism **212**) received in first aperture **208**, to a second position by rotating body **202** relative to handle **12**. In this instance, rotation of proximal end **204** about center **203** of rotation axis may apply an inward force against detent mechanism **212** that is greater than an outward bias of detent mechanism **212**, thereby causing detent mechanism **212** to compress inwardly.
(38) With detent mechanism **212** (e.g., protrusion of detent mechanism **212**) removed from first aperture **208**, medical device **200** may transition to a second position. Body **202** may move relative to handle **12** until detent mechanism **212** aligns with second aperture **210**. It should be appreciated that distal portion **206** may pivot relative to distal end **13** during movement of proximal portion **204** until detent mechanism **212** (e.g., protrusion of detent mechanism **212**) extends through second aperture **210**. With at least a proximal portion of shaft **18** received within distal portion **206** of medical device **200**, movement of proximal portion **204** relative to handle **12** may simultaneously provide movement of shaft **18** relative to distal end **13**. In this way, shaft **18** is moved to and locked in the second position, thereby forming a different angle between handle **12** and shaft **18** than when in the first position.
(39) Referring now to FIG. **3**B, a position and/or orientation of body **202** may be fixed relative to handle **12** when detent mechanism **212** (e.g., protrusion of detent mechanism **212**) is aligned with, and received through, second aperture **210**. In this instance, medical device **200** may fix a position of shaft **18** relative to medical instrument **10**, minimize a slackness, and increase a stiffness of shaft **18** when medical device **200** is locked in the second position. By fixing a position of shaft **18**, medical device **200** may further maintain a position of shaft **18** relative to a target treatment site within the subject, minimize a slippage of shaft **18** when shaft **18** is received within the subject, and reduce a need for a user to manually hold shaft **18** during the procedure.
(40) Referring to FIG. **4**, an exemplary medical device **300** is shown in accordance with another example of this disclosure. Medical device **300** may include a clamp including a body **302** having a C-shaped (or O-shaped) configuration defined by a pair of terminal ends **304**. Body **302** may form a slot or channel **306** between the pair of terminal ends **304**, and channel **306** may be defined by an

inner surface **305** of body **302**. Medical device **300** may further include a lever **310** coupled to body **302** at a pivot joint **308**. It should be appreciated that at least a portion of lever **310** may be disposed within body **302** and movably coupled thereto at pivot joint **308**. In the example, lever **310** may extend outwardly from a portion of body **302** adjacent to at least one of the pair of terminal ends **304**.

(41) Medical device **300** may include a fixation member in the form of a cam **312** that is at least partially disposed within body **302** and positioned adjacent to lever **310**. Inner surface **305** may include an opening with cam **312** positioned therein. As described further below, cam **312** may be at least partially extendable from the opening and into channel **306** when in an actuated state. In the example, the portion of lever **310** disposed within body **302** may be positioned proximate to, and in alignment with, the opening housing cam **312**. Lever **310** may be configured to contact and/or abut against cam **312** when actuating lever **310**. Cam **312** may be configured to move relative to inner surface **305**, and into channel **306**, in response to movement of lever **310** relative to body **302**.

(42) Still referring to FIG. **4**, lever **310** may include one or more protrusions (e.g., gripping features) along an exterior surface that may facilitate manually grasping lever **310**. Medical device **300** may further include a coupling mechanism **314** attached to body **302** along a proximal end **311** positioned opposite of terminal ends **304** and channel **306**. Proximal end **311** may include a threaded portion **313** that is configured to mate with a corresponding threaded portion (not shown) of coupling mechanism **314**. Accordingly, coupling mechanism **314** may be selectively coupled to body **302** in response to rotating relative to proximal end **311** to engage threaded portion **311**. While FIG. **4** illustrates threads, other suitable mating features such as clips, friction fit, etc., may be used.

(43) In some embodiments, medical device **300** may include a ball joint disposed within proximal end **311**. Body **302** may be configured to rotate about the ball joint to a plurality of rotative positions and/or orientations. Thus, for example, body **302** may be rotatable relative to coupling mechanism **314**. Accordingly, it should be appreciated that a user of medical device **300** may selectively orient body **302** relative to coupling mechanism **314** to align channel **306** with one or more other devices, including, for example, shaft **18** (see FIG. **5**).

(44) Still referring to FIG. **4**, coupling mechanism **314** may be secured to a tube **316** extending proximally therefrom. Tube **316** may be formed of a material having a preformed stiffness and/or resistance such that tube **316** may be configured to retain a particular shape and/or configuration. As described further herein, tube **316** may be flexible, e.g., malleable, but configured to maintain (i.e., hold, suspend, etc.) body **302** at a fixed position and/or orientation relative to a subject during a procedure. Tube **316** may be formed of various materials, including, but not limited to, plastic, rubber, metal, etc.

(45) Referring now to FIG. **5**, a proximal end **318** of tube **316** may be secured to a clamp **320**, and a distal end **319** of tube **316** may be secured to coupling mechanism **314** of medical device **300**. Clamp **320** may be configured to engage a support (e.g., a table, a bed, etc.) by one or more locking systems, such as, for example, a cam, a magnet, a suction device, a screw, or the like. Clamp **320** may include an actuator **322** that is selectively actuatable to secure clamp **320** to the support. For example, actuator **322** may include a button, a switch, a lever, a knob, etc.

(46) According to an exemplary method of using medical device **300** during a procedure, clamp **320** may engage a bed **30** that is positioned adjacent to a subject **50**. Distal end **319** of tube **316** may be maneuvered relative to subject **50** to position body **302** of medical device **300** at an opening **52** of subject **50**, such as, a mouth or nose. As described above, tube **316** may have a relative stiffness such that a position of distal end **319**, and body **302** coupled thereto via coupling mechanism **314**, may be maintained in a fixed position upon adjusting a configuration of tube **316**.

(47) Body **302** may receive an intermediate portion of shaft **18** of medical instrument **10** between terminal ends **304** and within channel **306**. Medical device **300** may be configured to lock shaft **18** within channel **306** in response to actuating lever **310**. For example, with shaft **18** positioned in

channel **306** and in proximity to inner surface **305** (FIG. **4**), a distal movement of lever **310** (e.g., away from coupling mechanism **314**) may cause cam **312** to extend into channel **306**, thereby engaging shaft **18**. Accordingly, shaft **18** may be effectively locked to body **302** and a position of shaft **18** relative to medical device **300** may be fixed. In this instance, a position and/or orientation of shaft **18** may be selectively adjusted in response to moving flexible tube **316** relative to bed **30**.
(48) Still referring to FIG. **5**, medical device **300** may further include a positioning device **330** for facilitating alignment of shaft **18** with opening **52**. Positioning device **330** may include a receiving aperture **332** that is sized and shaped in accordance with a profile of shaft **18**, such that receiving aperture **332** may be configured to receive a distal end of shaft **18** therethrough. For example, positioning device **330** may be a mouth guard positioned over a head of subject **50** with receiving aperture **332** aligned with opening **52**. A distal end of shaft **18** may be received through receiving aperture **332** and into opening **52** for insertion into subject **50**.
(49) By locking shaft **18** within channel **306**, medical device **300** may fix a position of shaft **18** relative to medical instrument **10**, minimize a slackness, and increase a stiffness of shaft **18** when engaged by medical device **300**. Medical device **300** may further maintain a position of shaft **18** relative to a target treatment site within subject **50**, minimize a slippage of shaft **18**, and reduce a need to manually hold shaft **18** during the procedure.
(50) Upon completion of the procedure, shaft **18** may be decoupled from medical device **300** in response to actuating lever **310** in a second, opposite direction to retract cam **312** into the opening within body **302**. In this instance, cam **312** may disengage an exterior surface of shaft **18**. Stated differently, a proximal movement of lever **310** (e.g., toward coupling mechanism **314**) may remove an exerting force applied to cam **312** by lever **310**, thereby allowing cam **312** to retract into body **302**. Cam **312** may disengage shaft **18** within channel **306**, thereby allowing shaft **18** to be removed from between terminal ends **304**.
(51) FIG. **6** shows an exemplary medical device **400** in accordance with another example of this disclosure. Medical device **400** may include a body **402** and a valve assembly **420**. Body **402** may be configured as a clamp having a C-shaped (or O-shaped) configuration forming a slot or channel **408** between a pair of terminal ends. Body **402** may include an exterior layer **404** and an interior layer **406** with a gap **405** (e.g., a space, a void, a cavity, etc.) formed therebetween.
(52) Exterior layer **404** and interior layer **406** may each include corresponding apertures (e.g., cutouts) formed therethrough and in alignment with one another, with the apertures extending into gap **405** positioned therebetween. Medical device **400** may further include a fixation member in the form of at least one, e.g., a plurality of flexible membranes **410** disposed on body **402**, e.g., in an annular array. In this example, body **402** is shown with three flexible membranes **410**, however, it should be appreciated that additional and/or fewer flexible membranes **410** may be included on body **402**. It should be understood that a location and/or position of flexible membranes **410** along body **402** may vary from that shown and described herein without departing from a scope of this disclosure.
(53) Flexible membranes **410** may be disposed over the apertures on exterior layer **404** and interior layer **406** such that gap **405** may be sealed at the apertures (and between layers **404**, **406**) by flexible membranes **410**. In some embodiments, flexible membranes **410** may be molded onto the layers **404**, **406**. Flexible membranes **410** may be formed of a flexible material that is selectively expandable relative to body **402**. For example, flexible membranes **410** may expand radially outwardly from body **402** and relative to exterior layer **404**, and may further expand radially inward relative to interior layer **406** and into channel **408**. As described in further detail herein, flexible membranes **410** may be in fluid communication with gap **405** such that a pressurized medium (e.g., air, liquid, gas, etc.) received in gap **405** may be delivered to flexible membranes **410**.
(54) Still referring to FIG. **6**, medical device **400** may further include an inlet **412** extending outwardly from body **402**. Inlet **402** may define a channel **416** that is in fluid communication with gap **405** such that inlet **402** may be configured to deliver a pressurized medium into gap **405** via

channel **416**. It should be appreciated that a location and/or position of inlet **412** along body **402** may vary from that shown and described herein without departing from a scope of this disclosure. Inlet **412** may include a suitable connection such as a luer **414** at a terminal end opposite of body **402**. Luer **414** may be configured to engage inlet **412** to valve assembly **420**.

(55) Valve assembly **420** may be configured as a 3-way valve including an inlet valve **422**, an outlet valve **424**, a release valve **426**, and an actuator **428**. Each of the valves **422**, **424**, **426** may define an inner channel interconnected with the other channels of valves **422**, **424**, **426**. Actuator **428** may be movable (e.g., rotatable) relative to the valves **422**, **424**, **426** and configured to fluidly couple the inner channels of the valves **422**, **424**, **426** to one another in response to an actuation (e.g., movement) of actuator **428**. In some examples, actuator **428** may be a knob, a switch, a lever, a button, etc. In other embodiments, valve assembly **320** may include additional and/or fewer valves, such as, for example, a two-way valve.

(56) Still referring to FIG. **6**, inlet valve **422** may be configured to couple valve assembly **420** to one or more other components of medical device **400**, such as, for example, a delivery device **430** (FIG. **7**). Outlet valve **424** may be configured to couple valve assembly **420** to body **402** in response to engaging luer **414** with a corresponding threaded portion (or other suitable complementary mating feature) of outlet valve **424**. It should be understood that the corresponding threaded portion may be positioned along an interior surface of outlet valve **424** such that outlet valve **424** may be disposed over inlet **412** when coupling valve assembly **420** to body **402**.

(57) As described herein, valve assembly **420** may be configured to receive a pressurized medium (a fluid such as a compressed gas or compressed liquid) from delivery device **430** via inlet valve **422** when delivery device is coupled to valve assembly **420**. Further, outlet valve **424** may be configured to transmit the pressurized medium into gap **405** via inlet **412** when valve assembly **420** is coupled to body **402**. Release valve **426** may be configured to receive the pressurized medium from body **402**, such as, for example, via channel **416** and outlet valve **424**, for atmospheric release from medical device **400**.

(58) As shown in FIG. **7**, medical device **400** may further include a pneumatic system in the form of delivery device **430**. In the example, delivery device **430** may include a syringe having a body **432** defining an inner cavity **434** that is configured to store a pressurized medium (e.g., compressed fluid such as air or other gas, liquid, etc.) therein. Delivery device **430** may include a plunger **436** disposed within cavity **434** and selectively movable therein in response to actuation of an actuator **438**. In some examples, body **432** may include a transparent exterior wall such that cavity **434** and a pressurized medium stored therein may be visible to a user of medical device **400**.

(59) Delivery device **430** may further include a distal end **440** positioned along body **432** opposite of actuator **438**. Distal end **440** may be sized, shaped, and configured to engage inlet valve **422** and fluidly couple valve assembly **420** to delivery device **430**. With valve assembly **420** coupled to delivery device **430**, body **432** may be in fluid communication with gap **405** such that a pressurized medium disposed within cavity **434** may be delivered to body **402** via valve assembly **420**.

(60) According to an exemplary method of using medical device **400** during a procedure, body **402** may be disposed about shaft **18** such that shaft **18** is received through channel **408**. Body **402** may be positioned within receiving aperture **332** such that positioning device **330** is disposed about exterior layer **404**. Although not shown, it should be appreciated that positioning device **330** may be located along opening **52** of subject **50** (see FIG. **5**) such that a distal end of shaft **18** may be received into opening **52** when positioned through receiver aperture **332**.

(61) Still referring to FIG. **7**, distal end **440** may be engaged to inlet valve **422** and outlet valve **424** may be engaged to inlet **412**. For example, valve assembly **420** may be fluidly coupled to both body **402** and delivery device **430**. A user of medical device **400** may engage actuator **438** to move plunger **436** distally relative to body **432**, thereby pushing a pressurized medium disposed within cavity **434** toward distal end **440**. The pressurized medium may be received at inlet valve **422** and transmitted to outlet valve **424** upon actuating actuator **428** to fluidly couple the corresponding

inner channels of inlet valve **422** and outlet valve **424**. The pressurized medium may be received through inlet **412** and delivered to gap **405** via channel **416**.

(62) FIG. **8** shows medical device **400** with valve assembly **420** and delivery device **430** omitted, and at least a portion of body **402** and shaft **18** removed for illustrative purposes only. As the pressurized medium is received into gap **405** via channel **416**, each of the plurality of flexible membranes **410** may receive a portion of the pressurized medium. In this instance, flexible membranes **410** may expand radially outward relative to outer layer **404**, and radially inward relative to inner layer **406**, as additional quantities of the pressurized medium accumulates within gap **405**. It should be appreciated that, when in the inflated (expanded) state, flexible membranes **410** may engage an exterior of shaft **18** due to a presence of shaft **18** within channel **408**. Additionally, flexible membranes **410** may engage positioning device **330** due to a presence of body **402** within receiving aperture **332** (see FIG. **7**).

(63) Accordingly, medical device **400** may be configured to secure shaft **18** to positioning device **330** in response to delivery system **430** delivering the pressurized medium to body **402** via valve assembly **420**. In this instance, medical device **400** may fix a position of shaft **18** relative to medical instrument **10**, minimize a slackness, and increase a stiffness of shaft **18** when engaged by medical device **400**. Medical device **400** may further maintain a position of shaft **18** relative to a target treatment site, minimize a slippage of shaft **18** when received within the subject, and reduce or eliminate a need to manually hold shaft **18** during the procedure.

(64) Upon completion of the procedure, shaft **18** may be decoupled from medical device **400** in response to engaging actuator **428** to align the corresponding inner channels of outlet valve **424** and release valve **426**, thereby generating a negative pressure through medical device **400**. In this instance, the pressurized medium received in gap **405** may be transmitted (e.g., suctioned) toward release valve **426** via inlet **412** and outlet valve **426**, thereby releasing the pressurized medium into a surrounding atmosphere of medical device **400**. In some examples, a pressure regulator configured to generate a negative pressure may be fluidly coupled to valve assembly **420** at release valve **426** such that the activation of the pressure regulator may provide a vacuum through medical device **400** for removal of the pressurized medium.

(65) Removal of the pressurized medium from within gap **405** may cause the plurality of flexible membranes **410** to deflate, thereby disengaging medical device **400** from shaft **18** and positioning device **330**. Stated differently, the pressurized medium stored within gap **405** applies an outward force onto flexible membranes **410**, causing flexible membranes **410** to extend outwardly and engage shaft **18** and positioning device **330**. The pressurized medium removal may terminate the exerting force applied to flexible membranes **410**, thereby allowing flexible membranes **410** to deflate inwardly toward body **402**.

(66) Flexible membranes **410** may disengage shaft **18** within channel **408**, allowing shaft **18** to be removed from within body **402**. Flexible membranes **410** may further disengage positioning device **330** along outer layer **404**, allowing body **402** to be removed from within receiving aperture **332**.

(67) Referring now to FIG. **9**, an exemplary medical device **500** is shown in accordance with another example of this disclosure. Medical device **500** may include a clamp comprising a proximal body **502** and a distal body **504** having an O-shaped (or C-shaped) configuration. In some embodiments, proximal body **502** and distal body **504** may be integral with one other, while in other embodiments, proximal body **502** may be attached to distal body **504** as separate components. Proximal body **502** and distal body **504** may have a generally cylindrical configuration defining a channel that is sized, shaped, and configured to receive shaft **18** therethrough.

(68) Medical device **500** may be configured to receive shaft **18** through proximal body **502** and distal body **504** such that medical device **500** may be selectively slidable along a longitudinal length of shaft **18** to a desired position. As described further herein, a position of proximal body **502** and distal body **504** relative to shaft **18** may become fixed upon actuation of one or more

components of medical device **500**.
(69) Still referring to FIG. **9**, proximal body **502** may define an actuator **508** that is configured to move relative to distal body **504**. For example, actuator **508** may form a bulbous region over proximal body **502**. Actuator **508** may be configured to selectively compress the proximal body **502** upon an inward depression of actuator **508**. Actuator **508** may include one or more protrusions (e.g., gripping features) along an exterior surface that may facilitate manually grasping actuator **508**. As described further below, actuator **508** may be further configured to generate a negative pressure in distal body **504** in response to moving proximal body **502** relative to distal body **504**.
(70) Medical device **500** may further include a fixation member in the form of at least one, e.g., a plurality of, flexible membrane **510** disposed on distal body **504**, e.g., in an annular array. As shown, for example, distal body **504** may include at least six flexible membranes **510**. It should be appreciated that additional and/or fewer flexible membranes **510** may be included on distal body **504**. It should be understood that a location and/or position of flexible membranes **510** along distal body **504** may vary from that shown and described herein without departing from the scope of this disclosure.
(71) Although not shown, it should be understood that medical device **500** may include a proximal cavity disposed in proximal body **502** and a distal cavity disposed in distal body **504**. The proximal cavity may be separated from the distal cavity by a one-way check valve disposed therebetween. The proximal cavity may be prefilled with a pressurized medium (e.g., compressed fluid such as air or other gas, liquid, etc.) and the distal cavity may be in fluid communication with the plurality of flexible membranes **510**. As described in further detail herein, the pressurized medium stored in the proximal cavity may be delivered to the distal cavity (via the one-way check valve) in response to a size, shape, and/or configuration of proximal body **502** being modified (e.g., compressed), such as, for example, in response to an actuation of actuator **508**.
(72) Still referring to FIG. **9**, flexible membranes **510** may be formed of a flexible material such that flexible membranes **510** are configured to expand a volume contained within each membrane **510**. For example, flexible membranes **510** may expand radially outward from, as well as inward toward, distal body **504** upon actuation of actuator **508** and compression of proximal body **502**. Flexible membranes **510** may expand radially inward from distal body **504**, such as, for example, into the channel defined by distal body **504**. Flexible membranes **510** may be in fluid communication with the proximal cavity via the one-way check valve, such that the pressurized medium stored in the proximal cavity may be delivered to flexible membranes **510** when the actuator **508** is depressed.
(73) Medical device **500** may further include a release valve **506** disposed on proximal body **502** and fluidly coupled to the source of pressurized medium, e.g., proximal cavity in proximal body **502**. Release valve **506** may be configured to release the pressurized medium stored in proximal body **502** for atmospheric release upon actuation. In other words, release valve **506** may be configured to remove a portion of pressurized medium included in the plurality of flexible membranes **510** in response to opening release valve **506**. As described further herein, medical device **500** may be configured to deflate the plurality of flexible membranes **510** from the expanded state when actuating the release valve **506**.
(74) According to an exemplary method of using medical device **500** during a procedure, shaft **18** may be inserted through the channel of proximal body **502** and distal body **504** until medical device **500** is positioned at a desired location along shaft **18**. Body **402** may be positioned within receiving aperture **332** such that positioning device **330** is disposed about at least distal body **504**. Positioning device **330** may be located along opening **52** of subject **50** (see FIG. **5**) such that a distal end of shaft **18** may be received into opening **52** when positioned through receiver aperture **332**.
(75) Still referring to FIG. **9**, a user of medical device **500** may engage actuator **508** by applying a downward (e.g., inward) force thereon, causing proximal body **502** to compress inwardly. The

pressurized medium prefilled therein may be diverted from proximal body **502** to distal body **504**, e.g., a distal cavity of distal body **504**. As the pressurized medium is received in distal body **504**, each of the plurality of flexible membranes **510** may receive a portion of the pressurized medium. In this instance, flexible membranes **510** may expand radially outward and radially inward relative to relative to distal body **504** as additional quantities of the pressurized medium is received in distal body **504**. It should be appreciated that, when in the inflated (expanded) state, flexible membranes **510** may engage an exterior of shaft **18** due to a presence of shaft **18** within the channel of distal body **504**. Additionally, flexible membranes **510** may engage positioning device **330** due to a presence of distal body **504** within receiving aperture **332** (see FIG. **7**).

(76) Accordingly, medical device **500** may be configured to secure shaft **18** to positioning device **330** in response to proximal body **502** delivering the pressurized medium to distal body **504**. In this instance, medical device **500** may fix a position of shaft **18** relative to medical instrument **10**, minimize a slackness, and increase a stiffness of shaft **18** when engaged by medical device **500**. Medical device **500** may further maintain a position of shaft **18** relative to a target treatment site, minimize a slippage of shaft **18** when received within the subject, and reduce a need to manually hold shaft **18** during the procedure.

(77) Upon completion of the procedure, shaft **18** may be decoupled from medical device **500** in response to actuating release valve **506**, thereby generating a negative pressure through medical device **500**. In this instance, the pressurized medium received in distal body **504** may be transmitted (e.g., suctioned) toward release valve **506**, thereby releasing the pressurized medium into a surrounding atmosphere of medical device **500**. In other embodiments, a pressure regulator configured to generate a negative pressure may be fluidly coupled to release valve **506** such that the activation of the pressure regulator may provide a vacuum through medical device **500** for removal of the pressurized medium.

(78) Removal of the pressurized medium from distal body **504** may cause the plurality of flexible membranes **510** to deflate, thereby disengaging medical device **500** from shaft **18** and positioning device **330**. Stated differently, the pressurized medium stored within distal body **504** applies an outward force onto flexible membranes **510**, causing flexible membranes **510** to extend outwardly and engage shaft **18** and positioning device **330**.

(79) The pressurized medium removal may terminate the exerting force applied to flexible membranes **510**, thereby allowing flexible membranes **510** to deflate inwardly toward distal body **504**. Flexible membranes **510** may disengage shaft **18** within the channel of distal body **504**, allowing shaft **18** to be removed from within proximal body **502** and distal body **504**. Flexible membranes **510** may further disengage positioning device **330**, allowing distal body **504** to be removed from within receiving aperture **332**.

(80) Each of the aforementioned systems, devices, assemblies, and methods may be used to secure a proximal component of a medical instrument relative to a subject (e.g., a patient) to maintain a position and/or orientation of a distal component of the medical instrument relative to a target treatment site within the subject. By providing a medical device including a clamp having a fixation member configured to move between an unlocked and locked position, a user may stabilize the medical instrument during a procedure. Thus, for example, a user may reduce overall procedure time, increase efficiency of procedures, and/or avoid unnecessary harm to a subject's body caused by the medical instrument inadvertently moving during the procedure or requiring the user's continuous manual control of the medical instrument.

(81) It will be apparent to those skilled in the art that various modifications and variations may be made in the disclosed devices and methods without departing from the scope of the disclosure. Other aspects of the disclosure will be apparent to those skilled in the art from consideration of the specification and practice of the features disclosed herein. It is intended that the specification and examples be considered as exemplary only.

Claims

1. A medical device, comprising: a clamp having a C-shaped body defining a channel, wherein the C-shaped body includes a pair of terminal ends defining the channel at a distal end of the clamp, wherein the pair of terminal ends are spaced to receive a shaft therebetween at the distal end of the clamp and into the channel therein, wherein the clamp includes a mating feature at a proximal end of the clamp, wherein the mating feature is configured to engage a corresponding mating feature of a coupling mechanism of a tube, wherein the mating feature includes a threaded surface of the clamp that is configured to engage a corresponding threaded surface of the coupling mechanism, wherein the tube is configured to suspend the coupling mechanism at a fixed position, and wherein the C-shaped body is movable relative to the coupling mechanism; a fixation member that is configured to move relative to the C-shaped body from an unlocked position to a locked position; and an actuator coupled to the fixation member and configured to move the fixation member from the unlocked position to the locked position, wherein the fixation member extends at least partially into or radially outward from the channel in response to moving from the unlocked position to the locked position.
2. The medical device of claim 1, wherein the fixation member includes a cam disposed within the C-shaped body and positioned along an interior surface of the C-shaped body.
3. The medical device of claim 2, wherein the actuator includes a lever that is disposed along an exterior surface of the C-shaped body, wherein the lever is configured to engage the cam.
4. The medical device of claim 3, wherein the lever is configured to extend the cam into the channel.
5. The medical device of claim 1, wherein the coupling mechanism is secured to a distal end of the tube, and wherein a proximal end of the tube is securable to a support.
6. The medical device of claim 5, wherein the proximal end of the tube includes an adjustable clamp including an actuator that is configured to selectively secure the adjustable clamp to the support.
7. A medical device comprising: a tube having a coupling mechanism at a distal end; a first clamp secured to a proximal end of the tube, wherein the first clamp includes at least one actuator for selectively securing the first clamp to a support such that the tube suspends the coupling mechanism at a fixed position relative to the support; and a second clamp that is selectively securable to the coupling mechanism, the second clamp including: a C-shaped body defining a channel, wherein the C-shaped body includes a pair of terminal ends defining the channel, wherein the pair of terminal ends are spaced to receive a shaft therebetween into the channel therein; wherein a proximal end of the C-shaped body includes at least one threaded surface that is configured to engage at least one threaded surface of the coupling mechanism of the tube, and wherein a distal end of the C-shaped body is movable relative to the distal end of the tube when the coupling mechanism is engaged with the proximal end of the second clamp; a fixation member that is configured to move relative to the C-shaped body from an unlocked position to a locked position; and an actuator coupled to the fixation member and configured to move the fixation member from the unlocked position to the locked position.
8. The medical device of claim 7, wherein the fixation member includes a cam disposed within the C-shaped body and positioned along an interior surface of the C-shaped body, wherein the actuator includes a lever that is disposed along an exterior surface of the C-shaped body and configured to engage the cam, and wherein the lever is configured to extend the cam into the channel in response to moving from the unlocked position to the locked position.
9. The medical device of claim 8, wherein the second clamp includes a pivot joint that pivotably couples the C-shaped body and a portion of the lever received therein.
10. The medical device of claim 7, wherein the interior surface of the C-shaped body is shaped to

complement an exterior surface of the shaft received therein.

11. The medical device of claim 7, wherein the support includes a table, and wherein the first clamp includes at least one locking system configured to be secured to the table.

12. The medical device of claim 7, wherein the at least one threaded surface of the C-shaped body includes an external thread at the proximal end of the C-shaped body, and wherein the at least one threaded surface of the coupling mechanism is an internal thread configured to threadably engage the external thread of the C-shaped body.