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JAW ASSEMBLY FOR MEDICAL DEVICES AND METHODS OF USING THE SAME

Abstract

A medical device that includes a wire assembly including an impediment on a distal portion of the wire assembly, a jaw assembly coupled to the wire assembly with the impediment disposed inside the jaw assembly, and a lever movably coupled to the distal portion and disposed inside the jaw assembly. The jaw assembly is configured to move between a closed state and an opened state. The lever is configured to contact an interior of the jaw assembly. The wire assembly is configured to move the jaw assembly from the closed state towards the opened state in response to the wire assembly translating distally inside the jaw assembly and moving the lever proximally until engaging the impediment. The lever is configured to pivot outwards relative to the jaw assembly upon engaging the impediment, and push against the interior of the jaw assembly, thereby urging the jaw assembly towards the opened state.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] This application claims the benefit of priority of U.S. Provisional Patent Application No. 63/552,293, filed on Feb. 12, 2024, the entirety of which is incorporated herein by reference.

TECHNICAL FIELD
[0002] Various aspects of this disclosure relate generally to medical devices including jaw assemblies for attachment onto medical systems or devices, and related methods. For example, the disclosure includes devices, systems, and related methods for extracting objects (e.g., a tissue sample) from a subject with a medical device including a jaw assembly attached over a shaft of a medical system.
BACKGROUND
[0003] In a medical procedure, an operator may insert a medical system, such as an endoscope or other type of scope, into a body lumen of a subject (e.g., a patient) to access a procedure site. To extract a target object (e.g., a tissue sample) from the procedure site, a medical instrument may extend through a channel of the endoscope and exit from a distal end of the endoscope to obtain the target object. A size of the medical instrument, such as a pair of biopsy jaws, may dictate a size of the target object that may be extracted from the procedure site.
[0004] However, the size of the medical instrument may be restricted by a size and/or a shape of the channel or distal end of the endoscope that the medical instrument is received through, thereby limiting the potential size of the target object that the medical instrument is capable of extracting. As a diagnostic yield of a tissue sample is proportionately greater with a size of the tissue sample that is extracted, a need exists for systems, devices, and/or methods that expand tissue sample extraction capabilities of medical devices.
SUMMARY
[0005] Aspects of the disclosure relate to, among other things, systems, devices, and methods for a medical device including a jaw assembly attached over a shaft of a medical system or device (e.g., an endoscope). The jaw assembly may facilitate illumination, imaging, and access to a procedure site for extraction of a target object (e.g., a tissue sample), 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.
[0006] According to an example, a medical device includes a wire assembly including an impediment on a distal portion of the wire assembly; a jaw assembly coupled to the wire assembly with the impediment disposed inside the jaw assembly, wherein the jaw assembly is configured to move between a closed state and an opened state; and a lever movably coupled to the distal portion and disposed inside the jaw assembly, wherein the lever is configured to contact an interior of the jaw assembly; wherein the wire assembly is configured to move the jaw assembly from the closed state towards the opened state in response to the wire assembly translating distally inside the jaw

assembly and moving the lever proximally until the lever engages the impediment; wherein the lever is configured to pivot outwards relative to the jaw assembly upon engaging the impediment and push against the interior of the jaw assembly, thereby urging the jaw assembly towards the opened state.

[0007] Any of the medical devices described herein may include any of the following features. The wire assembly includes an engagement mechanism on the distal portion such that the engagement mechanism is disposed inside the jaw assembly in at least some configurations of the jaw assembly. The engagement mechanism is configured to translate distally relative to the jaw assembly from a proximal position to a distal position in response to the wire assembly translating distally. The engagement mechanism is disposed inside the jaw assembly when in the proximal position, and extends at least partially outside of the jaw assembly when in the distal position. The wire assembly is configured to rotate relative to the jaw assembly, and the engagement mechanism is configured to rotate in response to rotation of the wire assembly. The engagement mechanism is configured to pierce a tissue positioned adjacent to the jaw assembly in response to the wire assembly translating distally when the jaw assembly is in the opened state. The engagement mechanism is configured to securely engage the tissue in response to the wire assembly rotating relative to the jaw assembly. The engagement mechanism is configured to pull the tissue proximally into the jaw assembly in response to the wire assembly translating proximally relative to the jaw assembly. The jaw assembly is configured to cut the tissue engaged by the engagement mechanism and received inside the jaw assembly in response to the wire assembly translating proximally, thereby causing the jaw assembly to move from the opened state towards the closed state. The engagement mechanism includes a needle, a corkscrew, a hook, or a barbed spike. The wire assembly is configured to translate proximally relative to the jaw assembly and the lever is configured to translate distally relative to the distal portion. The impediment is configured to disengage the lever in response to the lever translating distally, such that continued translation proximal of the wire assembly is configured to pivot the lever inwards within the jaw assembly. The lever is configured to move the jaw assembly towards one another when pivoting inwards, thereby moving the jaw assembly from the opened state towards the closed state. The wire assembly extends through a shaft of an endoscope with the distal portion extending outwardly from a distal tip of the shaft, and the jaw assembly is coupled over the distal tip. The jaw assembly includes an imaging channel aligned with an imaging mechanism on the distal tip and a pair of lighting channels aligned with a pair of lighting mechanisms on the distal tip; and wherein, with the jaw assembly coupled over the distal tip, the imaging mechanism is configured to generate images distally from the jaw assembly through the imaging channel and the pair of lighting mechanisms are configured to emit light distally from the jaw assembly through the pair of lighting channels.

[0008] According to another example, a medical device includes a wire assembly including an impediment on a distal portion of the wire assembly; a jaw assembly coupled to the wire assembly with the impediment disposed inside the jaw assembly, wherein the jaw assembly includes a pair of jaws configured to move between a closed state and an opened state; and a lever movably coupled to the distal portion and disposed inside the jaw assembly, wherein the lever is configured to contact at least one of the pair of jaws; wherein the wire assembly is configured to translate along a distal direction relative to the jaw assembly and the lever is configured to translate simultaneously towards a proximal direction relative to the distal portion; and wherein the impediment is configured to engage the lever and inhibit further translation of the lever towards the proximal direction, such that continued translation of the wire assembly along the distal direction is configured to pivot the lever outwards from within the jaw assembly, and the lever is configured to move the at least one of the pair of jaws away from the other one of the pair of jaws when pivoting within the jaw assembly, thereby moving the pair of jaws from the closed state towards the opened state.

[0009] Any of the medical devices described herein may include any of the following features. The

wire assembly includes an engagement mechanism on the distal portion that is configured to translate towards the distal direction in response to the wire assembly translating towards the distal direction, and rotate in response to the wire assembly rotating relative to the jaw assembly. The engagement mechanism is configured to pierce a tissue positioned adjacent to the jaw assembly in response to the wire assembly translating towards the distal direction when the jaw assembly is in the opened state, and securely engage the tissue in response to the wire assembly rotating relative to the jaw assembly. The engagement mechanism is configured to pull the tissue proximally into the jaw assembly in response to the wire assembly translating towards the proximal direction relative to the jaw assembly; and wherein the jaw assembly is configured to cut the tissue engaged by the engagement mechanism in response to the wire assembly translating towards the proximal direction, thereby causing the pair of jaws to move from the opened state towards the closed state.

[0010] According to a further example, a medical system includes a shaft including a working channel and a distal tip; a wire assembly movably disposed inside the working channel, the wire assembly including a distal portion extending outwardly from the distal tip; a jaw assembly coupled to the wire assembly and positioned over the distal tip such that the jaw assembly abuts against a distalmost face of the distal tip, wherein the jaw assembly is configured to move between a closed state and an opened state; and a lever movably coupled to the distal portion and disposed inside the jaw assembly and outside of the shaft, wherein the lever is configured to contact the jaw assembly; wherein the wire assembly is configured to move the jaw assembly distally away from the distal tip in response to a distal translation relative to the shaft, and move the lever proximally within the jaw assembly in response to further distal translation relative to the shaft; and wherein the lever is configured to pivot outwards within the jaw assembly to push against the jaw assembly, thereby moving the jaw assembly from the closed state towards the opened state.

[0011] 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

[0012] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate exemplary aspects of this disclosure and together with the description, serve to explain the principles of the disclosure.

[0013] FIG. **1**A depicts a perspective view of a proximal end of a medical system including a handle and an insertion portion, according to aspects of this disclosure.

[0014] FIG. **1**B depicts a perspective view of a distal end of the medical system of FIG. **1**A including a distal tip of the insertion portion, according to aspects of this disclosure.

[0015] FIG. **2** depicts a perspective view of an exemplary medical device coupled over the distal end of the medical system of FIG. **1**B, the medical device positioned in a closed state, according to aspects of this disclosure.

[0016] FIG. **3** depicts a perspective view of the medical device of FIG. **2** positioned in an opened state, according to aspects of this disclosure.

[0017] FIG. **4** depicts a partial perspective view of the medical device of FIG. **2**, according to aspects of this disclosure.

[0018] FIG. **5** depicts a perspective view of a handle assembly of the medical device of FIG. **2**, according to aspects of this disclosure.

[0019] FIG. **6** depicts a perspective view of the medical device of FIG. **2** in an extended position relative to the distal end of the medical system of FIG. **1**B, according to aspects of this disclosure.

[0020] FIG. **7** depicts a partial side view of the medical device of FIG. **2** moving from a closed state to an opened state, according to aspects of this disclosure.

[0021] FIG. **8**A depicts a perspective view of another exemplary medical device coupled to the distal end of the medical system of FIG. **1**B, the medical device positioned in a closed state, according to aspects of this disclosure.
[0022] FIG. **8**B depicts a perspective view of the medical device of FIG. **8**A positioned in an opened state, according to aspects of this disclosure.
DETAILED DESCRIPTION
[0023] This disclosure relates, in certain aspects, to medical devices including a jaw assembly coupled over a shaft of a medical system or device (e.g., an endoscope) for facilitating acquisition of a target object (e.g., a tissue sample) from a procedure site in a subject (e.g., patient). For example, medical systems may be equipped with a medical device, and particularly a jaw assembly, that includes components, devices, and/or mechanisms that are arranged relative to various channels of a shaft of the medical system that facilitate illuminating, imaging, accessing, and treating the procedure site. The jaw assembly may be movable (e.g., translatable) relative to the shaft of the medical system from a first (proximal) position to a second (distal) position. The jaw assembly may be automatically movable (e.g., pivotable) between a closed state and an opened state in response to the jaw assembly moving from the first (proximal) position to the second (distal) position.
[0024] In examples, accessing a procedure site may include endoluminal placement of the medical device into the patient, such as through an anatomical passageway via a natural orifice. The orifice can be, for example, the nose, mouth, or anus, and the placement can be in any portion of the GI tract, including the esophagus, stomach, duodenum, large intestine, or small intestine. Placement also can be in other organs or other bodily spaces reachable via the GI tract, other body lumens, or openings in the body. This disclosure is not limited to any particular medical procedure or treatment site within a body.
[0025] 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, pancreatic-biliary tract, any other portion of the gastrointestinal tract, and/or any other suitable patient anatomy (collectively referred to herein as a “target treatment site”). As mentioned above, this disclosure is not limited to any specific medical device or method, and aspects of the disclosure may be used in connection with any suitable medical tool and/or medical method, at any suitable site within the body.
[0026] Reference will now be made in detail to aspects of the disclosure, examples of which are illustrated in the accompanying drawings. Wherever possible, the same or similar reference numbers will be used through the drawings to refer to the same or like parts. The term “distal” refers to a portion farthest away from a user when introducing a device into a patient. By contrast, the term “proximal” refers to a portion closest to the user when placing the device into the subject. As used herein, 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.
[0027] FIGS. **1**A-**1**B depict aspects of an exemplary medical device or system **10**. Medical system **10** may include an insertion device, such as an endoscope, which may be inserted into an esophagus of a patient. FIG. **1**A depicts a proximal portion of medical system **10** including a handle **12** for gripping and operation by a user, and an insertion portion **20** extending distally from handle **12** for at least partial insertion into a subject (e.g., a patient). Handle **12** may include one or more actuators **14**, for example, on a proximal portion of handle **12**. The one or more actuators **14** may be configured and operable to facilitate articulation and/or steering of insertion portion **20**,

including a distal tip **24** of insertion portion **20** (see FIG. **1**B). The one or more actuators **14** may include one or more knobs, buttons, sliders, joysticks, or various other suitable actuators. It will be appreciated that medical system **10** may include any suitable number of actuators **14** on handle **12**.
[0028] Handle **12** may include a port **16** that is configured and operable to provide access to one or more channels of medical system **10**, such as a working channel extending through handle **12** and insertion portion **20**. For example, a medical instrument or other device may be coupled to and/or inserted into medical system **10** via port **16**. The working channel may extend longitudinally through a length of insertion portion **20**, such that the medical instrument received through port **16** may extend through the working channel and exit insertion portion **20** at distal tip **24** (FIG. **1**B). Medical system **10** may include an umbilicus **18** that extends from handle portion **12**, and umbilicus **18** may include one or more wires, cables, and/or conduits for providing, power, signals, and/or fluids to or from handle **12**. For example, umbilicus **18** may be configured and operable to connect handle **12** to one or more user interfaces, monitors, displays, and/or control systems.
[0029] Insertion portion **20** may include a shaft **22** extending distally from handle **12**. Shaft **22** may be flexible and include one or more wires, tubes, channels, and/or other features passing therethrough. Shaft **22** may terminate at distal tip **24**, as depicted in FIG. **1**B, which may be positioned at a procedure site within the subject during use. As shown in FIG. **1**B, distal tip **24** may include a distalmost face **25** that defines a working channel opening **26**. The working channel extending through handle **12** and shaft **20** may terminate at working channel opening **26**, such that the one or more medical instruments or other devices received through port **16** may extend out of the working channel via working channel opening **26**. As described herein, the medical instrument extending distally outwards from working channel opening **26** may be used to perform a medical procedure on the subject, such as extraction of a target object (e.g., a tissue sample) from the procedure site.
[0030] Still referring to FIG. **1**B, medical system **10** may include one or more devices and/or systems at distal tip **24**, such as an imaging mechanism **28**, a pair of lighting mechanisms **30**, and a pair of irrigation openings **32**. In the example, imaging mechanism **28** may include an image sensor and/or a camera, such as a ball grid array (“BGA”)-style camera. Imaging mechanism **28** may be configured to generate a video and/or images in a distal direction from distal tip **24**. For example, imaging mechanism **28** may be configured and operable to provide a signal to a remote monitor (not shown), such that a user of medical system **10** may view a video or image display generated by imaging mechanism **28** while navigating medical system **10** through a body of the subject and performing the medical procedure (e.g., a tissue sample extraction).
[0031] Each of the pair of lighting mechanisms **30** may include one or more (e.g., two) light emitting diodes (“LEDs”), fiber optic light guides, or various other suitable light sources. Each of the pair of irrigation openings **32** may be in fluid communication with one or more irrigation channels extending through handle **12** and insertion portion **20**, such that the irrigation channel(s) may terminate at irrigation openings **32**. In this instance, the pair of irrigation openings **32** may be configured and operable to irrigate a surrounding environment of distal tip **24** when shaft **22** is positioned within the subject and adjacent to the procedure site. In some examples, the one or more irrigation channels extending through shaft **22** and handle **12** may be fluidly coupled to a remote device and/or system via umbilicus **18** (see FIG. **1**A).
[0032] Although a single imaging mechanism **28**, a pair of lighting mechanisms **30**, and a pair of irrigation openings **32** are depicted in the example, it should be appreciated that additional imaging mechanisms **28**, and additional and/or fewer lighting mechanisms **30** and irrigation openings **32**, may be included on distal tip **24** without departing from a scope of this disclosure. Alternatively, in other examples, imaging mechanism **28** and lighting mechanisms **30** may be combined into a single device.
[0033] As depicted in FIG. **1**B, medical system **10** may be “forward-facing.” In other words, features of distal tip **24** (e.g., working channel opening **26**, imaging mechanism **28**, lighting

mechanisms **30**, and irrigation openings **32**) may face distally (i.e., forward of distalmost face **25**). It should be appreciated that aspects of this disclosure also encompass other configurations of distal tip **24**. For example, medical system **10** may be "side-facing" in which one or more of working channel opening **26**, imaging mechanism **28**, lighting mechanisms **30**, and/or irrigation openings **32** may be disposed on a radially outer side of distal tip **24**. In this instance, such openings and/or mechanisms may face and/or point in a radially outward direction, such as approximately perpendicularly to a longitudinal axis of insertion portion **20**.

[0034] Referring now to FIGS. **2-3**, an exemplary medical device **100** is depicted. Medical device **100** may include one or more assemblies coupled to one or more components of medical system **10**, such as handle **12**, shaft **22**, and distal tip **24**. For example, the one or more assemblies of medical device **100** may be received through the working channel of handle **12** and shaft **22**, and one or more additional assemblies of medical device **100** may be coupled over distal tip **24**, such that said assemblies of medical device **100** may extend distally from distalmost face **25**.

[0035] In the example, medical device **100** may include a jaw assembly **110** positioned distally and/or over distal tip **24**, a wire assembly **120** movably disposed through a working channel of handle **12** and shaft **22**, and a handle assembly **150** (see FIG. **5**) coupled to a proximal portion of wire assembly **120** adjacent to handle **12**. Wire assembly **120** may be disposed between and coupled to each of jaw assembly **110** and handle assembly **150**. As described herein, handle assembly **150** may be configured and operable to control movement of jaw assembly **110** via wire assembly **120**.

[0036] Jaw assembly **110** may be disposed adjacent to distal tip **24** and positioned at least partially against distalmost face **25**. In some embodiments, jaw assembly **110** may be at least partially disposed over a portion of distal tip **24**, and particularly distalmost face **25**. With jaw assembly **110** positioned distally of and/or over distal tip **24**, a distal face **112** of jaw assembly **110** may be disposed distally of distalmost face **25**. Handle assembly **150** (FIG. **5**) may be positioned adjacent to handle **12** (FIG. **1**A) for controlling jaw assembly **110**, with wire assembly **120** received by port **16** and extending through the working channel of handle **12** and shaft **22**.

[0037] Still referring to FIGS. **2-3**, jaw assembly **110** may include a face plate **111**, an imaging channel **114** and a pair of lighting channels **116** extending distally from face plate **111** (see FIG. **4**), and a pair of jaws including a first (upper) jaw **130** and a second (lower) jaw **140** coupled to face plate **111**. Face plate **111** may be positioned proximal to the pair of jaws **130**, **140**. Imaging channel **114** and the pair of lighting channels **116** may each include enclosed lumens that extend distally from face plate **111** and through lower jaw **140**. For example, imaging channel **114** may be sized, shaped, and positioned relative to lower jaw **140** to align with imaging mechanism **28** when jaw assembly **110** is coupled over distal tip **24**, and particularly with face plate **111** disposed over distalmost face **25**. In the example, imaging channel **114** may extend at least partially outwards from lower jaw **140** in a distal direction, such as distally from distal face **112** of jaw assembly **110**. For example, imaging channel **114** may extend approximately parallel to a central longitudinal axis of jaw assembly **110**.

[0038] In this instance, imaging channel **114** may be configured and operable to provide use of imaging mechanism **28** through lower jaw **140**, and particularly allow imaging in a distal direction from distal face **112** when jaw assembly **110** is coupled over distalmost face **25** of distal tip **24**. In other words, imaging channel **114** may be operable to extend imaging mechanism **28** from distal tip **24** through jaw assembly **110**. In some embodiments, imaging channel **114** may include a glass substrate, a clear lens, and/or various other suitable structures for extending imaging mechanism **28** from distal tip **24** through jaw assembly **110**, and particularly lower jaw **140**. In other embodiments, imaging channel **114** may terminate at distal face **112** such that imaging channel **114** does not extend distally outwards from lower jaw **140**.

[0039] As best seen in FIG. **4**, lighting channels **116** may be sized, shaped, and positioned relative to lower jaw **140** to align with lighting mechanisms **30** when jaw assembly **110** is coupled to distal

tip **24** with face plate **111** disposed over distalmost face **25**. Lighting channels **116** may be entirely disposed within lower jaw **140**. As described herein, lower jaw **140** may include one or more openings **144** aligned with lighting channels **116** to allow a light emitted by lighting mechanisms **30** to extend through lighting channels **116** and distally outwards from jaw assembly **110**, and particularly lower jaw **140**, via openings **144**. In this instance, lighting channels **116** may be configured and operable to provide use of lighting mechanisms **30** through lower jaw **140**, and particularly allow for illumination in a distal direction from distal face **112** when jaw assembly **110** is coupled to distal tip **24** with face plate **111** disposed over distalmost face **25**. In other words, lighting channels **116** may be operable to extend lighting mechanisms **30** from distal tip **24** through jaw assembly **110**.

[0040] Referring back to FIGS. **2-3**, lower jaw **140** may include one or more openings **144** positioned along distal face **112** of jaw assembly **110**. The one or more openings **144** may be aligned with corresponding lighting channels **116** extending through lower jaw **140**. Each of lighting channels **116** may be coupled to a respective lighting mechanism **30** at distal tip **24**. As such, lighting channels **116** and openings **144** may be configured and operable to facilitate uninterrupted use of lighting mechanisms **30** through jaw assembly **110** despite medical device **100** being coupled to distal tip **24** and positioned over distalmost face **25**.

[0041] In the example, and as best seen in FIG. **4**, jaw assembly **110** may include a pair of lighting channels **116** and lower jaw **140** may include a pair of openings **144** corresponding to the pair of lighting mechanisms **30** on distal tip **24**. It should be appreciated that a quantity, a size, and a location of lighting channels **116** and openings **144** may be adjusted based on the corresponding properties of lighting mechanisms **30** on distal tip **24**.

[0042] Still referring to FIGS. **2-3**, face plate **111** may be disposed between distalmost face **25** and the pair of jaws **130**, **140** when jaw assembly **110** is coupled to distal tip **24**. It should be appreciated that jaw assembly **110** is sized and/or shaped such that the pair of jaws **130**, **140** cannot pass through the working channel of handle **12** and shaft **22** of insertion portion **20**. As such, jaw assembly **110** is disposed over distal tip **24**. Upper jaw **130** may include a plurality of teeth **132** and lower jaw **140** may include a plurality of teeth **142**. Upper jaw **130** and lower jaw **140** may be configured to mate with one another, with the plurality of teeth **132** engaging (e.g., interdigitating with) the corresponding plurality of teeth **142** when jaw assembly **110** is in a closed state, as seen in FIG. **2**. As described herein, jaw assembly **110** may be configured to extract a target object (e.g., a tissue sample) from the procedure site within the subject (e.g., a patient) in response to the plurality of teeth **132**, **142** severing and/or separating the target object from a surrounding environment (e.g., tissue) of the procedure site.

[0043] In the example, upper jaw **130** may be configured to move relative to face plate **111** and/or lower jaw **140** to interchangeably transition jaw assembly **110** between the closed state (FIG. **2**) and an opened state (FIG. **3**). In this instance, lower jaw **140** may remain fixed relative to upper jaw **130**, such that lower jaw **140** is immovable. In other embodiments, lower jaw **140** may be configured to move in lieu of and/or simultaneously with upper jaw **130**, such as relative to face plate **111**. An upper surface of upper jaw **130** may include an opening **134** that is sized, shaped, and/or otherwise configured to allow one or more residual materials (e.g., fluid) to exit upper jaw **130** when jaw assembly **110** is moving from the opened state to the closed state, such as to release the residual material and maintain sufficient volume within an interior cavity of jaw assembly **110** for receiving the target object during extraction.

[0044] Jaw assembly **110** (e.g., face plate **111**) may include a pair of irrigation apertures **113** that are positioned in and/or on face plate **111** to align with the pair of irrigation openings **32** when jaw assembly **110** is coupled to distal tip **24** with face plate **111** disposed over distalmost face **25**. Jaw assembly (e.g., face plate **111**) **110** may further include a working aperture **115** that is positioned in and/or on face plate **111** to align with working channel opening **26** when jaw assembly **110** is coupled to distal tip **24**.

[0045] Still referring to FIGS. **2-4**, a distal portion **125** of wire assembly **120** may extend out of the working channel of shaft **22** via working channel opening **26** and into jaw assembly **110** via working aperture **115** on face plate **111**. As described herein, jaw assembly **110** may be configured to move (e.g., translate) relative to distal tip **24** from a first (proximal) position (FIG. **2**) to a second (distal) position (FIG. **6**) in response to actuation of handle assembly **150** (FIG. **5**). Jaw assembly **110** may be further configured to move (e.g., pivot) upper jaw **130** relative to lower jaw **140** from the closed state (FIG. **2**) to the opened state (FIG. **3**) in response to further actuation of handle assembly **150**.

[0046] Wire assembly **120** may include an engagement mechanism **122** at distal portion **125** and a movable lever **124** slidably coupled to distal portion **125**. Movable lever **124** may be positioned proximal to engagement mechanism **122**. Engagement mechanism **122** may be sized, shaped, and/or otherwise configured to engage the target object (e.g., a tissue sample) that is received within jaw assembly **110** prior to the pair of jaws **130**, **140** separating the target object from the surrounding environment (e.g. tissue) at the procedure site. In the example, engagement mechanism **122** may include a needle, a corkscrew, a hook, a barbed spike, and/or various other suitable devices for grasping, piercing, puncturing, and/or attaching wire assembly **120** to the target object. As described herein, engagement mechanism **122** may be configured to pierce the target object in response to translating towards the target object, and intertwine the target object onto the wire assembly in response to rotating inside and/or adjacent to the target object.

[0047] Still referring to FIGS. **2-4**, movable lever **124** may be slidably coupled to distal portion **125** of wire assembly **120**, with distal portion **125** having a longitudinal length defined between an impediment **123** on wire assembly **120** and engagement mechanism **122**. Impediment **123** may define a ledge, a protrusion, an abutment, a stop, a step, and/or another structural impediment formed along an exterior surface of wire assembly **120** at a proximal end of distal portion **125**. Impediment **123** may define a proximalmost position that movable lever **124** may move (e.g., translate) along distal portion **125** of wire assembly **120**. In other words, impediment **123** may be configured to engage movable lever **124**, thereby inhibiting proximal translation of movable lever **124** relative to distal portion **125** beyond the proximalmost position defined by impediment **123**. As described herein, impediment **123** may be configured to disengage movable lever **124** in response to a distal translation of movable lever **124** relative to distal portion **125**.

[0048] Engagement mechanism **122** may define an opposing, distalmost position that movable lever **124** may move along distal portion **125** of wire assembly **120**. In other words, a proximal end of engagement mechanism **122** may define a corresponding protrusion, abutment, stop, and/or impediment that is positioned at a distal (opposite) end of distal portion **125** from impediment **123**. In this instance, engagement mechanism **122** may be configured to engage movable lever **124**, thereby inhibiting distal translation of movable lever **124** relative to distal portion **125** beyond the distalmost position defined by engagement mechanism **122**. In some embodiments, wire assembly **120** may include a second impediment at the distal end of distal portion **125** (and/or proximal end of engagement mechanism **122**) that is substantially similar to impediment **123** shown and described above.

[0049] Movable lever **124** may include a proximal ring **126** and a distal leg **128** positioned opposite of proximal ring **126**, with a longitudinal length of movable lever **124** defined between proximal ring **126** and distal leg **128**. Proximal ring **126** may include an opening that is sized, shaped, and/or otherwise configured to receive distal portion **125** of wire assembly **120**, thereby slidably coupling movable lever **124** to wire assembly **120**. Distal leg **128** may include a peg, a protrusion, an abutment end, a tab, and/or various other suitable interfaces that is sized, shaped, and/or otherwise configured to abut against an interior surface of upper jaw **130**. In some embodiments, distal leg **128** may be in continuous contact with the interior surface of upper jaw **130** when jaw assembly **110** is in the closed state (FIG. **2**) and the opened state (FIG. **3**). In other embodiments, distal leg **128** may be configured to disengage the interior surface of upper jaw **130** when jaw assembly **110**

is in the closed state.
[0050] Movable lever **124** may be configured to move jaw assembly **110** from the closed state to the opened state in response to distal leg **128** urging (e.g., pushing) upper jaw **130** outwards (e.g., upwards) relative to lower jaw **140** as proximal ring **126** moves (e.g., translates) proximally away from engagement mechanism **122** and towards impediment **123** along distal portion **125**. In other words, jaw assembly **110** may be configured to move from the closed state to the opened state in response to movable lever **124** (e.g., proximal ring **126** of movable lever **124**) translating proximally along wire assembly **120** from the first (proximal) position (with proximal ring **126** positioned adjacent to engagement mechanism **122** relative to impediment **123**) to the second (distal) position (with proximal ring **126** positioned adjacent to impediment **123** relative to engagement mechanism **122**). In this instance, movable lever **124** (e.g., distal leg **128** of movable lever **124**) may pivot outwards (e.g., upwards) relative to proximal ring **126**, thereby causing distal leg **128** to apply a force against upper jaw **130** in an outwards (upwards) direction to open jaw assembly **110**.
[0051] Movable lever **124** may be further configured to move jaw assembly **110** from the opened state to the closed state in response to distal leg **128** ceasing to urge (e.g., push) upper jaw **130** outwards (upwards) relative to lower jaw **140** as proximal ring **126** moves (e.g., translates) distally towards engagement mechanism **122** and away from impediment **123** along distal portion **125**. Stated differently, jaw assembly **110** may be configured to move from the opened state to the closed state in response to movable lever **124** (e.g., proximal ring **126** of movable lever **124**) translating distally along wire assembly **120** from the second (distal) position to the first (proximal) position. In this instance, movable lever **124** (e.g., distal leg **128** of movable lever **124**) may pivot inwards (e.g., downwards) relative to proximal ring **126**, thereby causing distal leg **128** to cease application of the force against upper jaw **130** in the outwards (upwards) direction to close jaw assembly **110**.
[0052] As best seen in FIG. **4**, irrigation channels **32** on distal tip **24** are not covered and/or obstructed by upper jaw **130** and lower jaw **140** when jaw assembly **110** is coupled to distal tip **24** with face plate **111** disposed over distalmost face **25**. As such, irrigation channels **32** are exposed to an interior cavity of jaw assembly **110**, collectively defined between upper jaw **130** and lower jaw **140**, via irrigation apertures **113** on face plate **111**. As such, irrigation channels **32** may be configured and operable to provide irrigation in a distal direction from distal tip **24** despite jaw assembly **110** being coupled to distal tip **24** and face plate **111** being disposed over distalmost face **25**.
[0053] FIG. **5** depicts handle assembly **150** of medical device **100**. Handle assembly **150** may include a main body **152**, a first actuator **154** rotatably coupled to main body **152**, a second actuator **156** slidably coupled to main body **152**, a distal portion **158**, and a coupler **159** along distal portion **158**. Handle assembly **150** may be coupled to wire assembly **120** such that actuation of first actuator **154** and/or second actuator **156** may provide a corresponding movement of wire assembly **120**. In the example, a proximal portion **121** of wire assembly **120** may be releasably coupled to handle assembly **150** via coupler **159**. Accordingly, handle assembly **150** may be configured and operable to selectively decouple wire assembly **120** by detaching proximal portion **121** from coupler **159**. In some embodiments, wire assembly **120** may extend through distal portion **158** and main body **152** with each of first actuator **154** and second actuator **156** coupled to at least a portion of wire assembly **120**.
[0054] In the example, first actuator **154** may be configured and operable to rotate wire assembly **120** in response to a rotation of first actuator **154** relative to main body **152**. In this instance, by rotating proximal portion **121** of wire assembly **120**, the opposite distal portion **125** of wire assembly **120** may simultaneously rotate, thereby causing rotation of engagement mechanism **122** (see FIG. **4**). In this instance, upon moving jaw assembly **110** to the opened state and positioning engagement mechanism **122** adjacent to and/or against the target object, first actuator **154** may be configured to rotate engagement mechanism **122** into the target object, thereby causing engagement

mechanism **122** to securely engage the target object. In other words, first actuator **154** may be configured to puncture and/or screw the target object with engagement mechanism **122** via rotation of first actuator **154** relative to main body **152**. It should be appreciated that with distal portion **125** extending through the opening of proximal ring **126**, wire assembly **120** may rotate relative to proximal ring **126** without causing movable lever **124** to rotate.

[0055] Still referring to FIG. **5**, second actuator **156** may be configured and operable to translate wire assembly **120** in response to a translation of second actuator **156** relative to main body **152**, such as in a proximal direction and a distal direction. In this instance, by translating proximal portion **121** of wire assembly **120** in the proximal and/or distal direction, the opposite distal portion **125** of wire assembly **120** may simultaneously translate in the same direction, thereby causing a corresponding movement of engagement mechanism **122** (see FIG. **4**) in the same direction.

[0056] As seen in FIG. **6**, second actuator **156** may be configured to translate wire assembly **120** distally relative to distal tip **24**, thereby detaching face plate **111** from distalmost face **25** and jaw assembly **110** from distal tip **24** of shaft **22**. In this instance, a user may position jaw assembly **110** adjacent to the target object by actuating second actuator **156** and moving jaw assembly **110** away from distal tip **24** and towards the target object. It should be appreciated that movable lever **124** may be configured to translate proximally relative to wire assembly **120** and/or engagement mechanism **122** as wire assembly **120** and engagement mechanism **122** translate in the distal direction due to distal leg **128** abutting against the interior surface of upper jaw **130**. Stated differently, movable lever **124** may move in an opposite direction of wire assembly **120** and/or engagement mechanism **122** until proximal ring **126** engages impediment **123**.

[0057] In this instance, as seen in FIG. **7**, second actuator **156** may be configured to transition jaw assembly **110** from the closed state to the opened state in response to a further distal translation of second actuator **156** relative to main body **152**. With proximal ring **126** engaged against impediment **123** and distal leg engaged with upper jaw **130**, movable lever **124** may be configured to pivot outwards (upwards) relative to proximal ring **126** as wire assembly **120** continues to translate distally from the corresponding distal translation of second actuator **156**. Distal leg **128** may be configured to pivot upper jaw **130** outwards (upwards) away from lower jaw **140** as movable lever **124** pivots outwards (upwards) relative to proximal ring **126**, thereby opening jaw assembly **110** towards the opened state. With jaw assembly **110** moved to the opened state, engagement mechanism **122** may be exposed from within the internal cavity between upper jaw **130** and lower jaw **140** for attachment with the target object.

[0058] In exemplary use, medical device **100** may be coupled to medical system **10** with handle assembly **150** positioned adjacent to handle **12** and wire assembly **120** extending proximally through working channel opening **26** and into the working channel of insertion portion **20** and handle **12** until exiting port **16**. In other words, wire assembly **120** may be back-loaded into medical system **10** via working channel opening. Proximal portion **121** of wire assembly **120** may be coupled to handle assembly **150** via coupler **159**. After medical device **100** is coupled to medical system **10**, distal portion **125** of wire assembly **120** may be positioned outside of working channel opening **26** of distal tip **24** with jaw assembly **110** disposed over distalmost face **25** of distal tip **24**. In this instance, wire assembly **120**, and particularly engagement mechanism **122** and distal portion **125**, may be disposed within the internal cavity defined between upper jaw **130** and lower jaw **140**.

[0059] Imaging mechanism **28** and lighting mechanisms **30** may facilitate navigation of insertion portion **20** through one or more bodily lumens of the subject as medical system **10** is moved towards the procedure site. Despite jaw assembly **110** being disposed over distalmost face **25** of distal tip **24**, medical device **100** may be configured to allow imaging mechanism **28** to provide a visual navigation of insertion portion **20** within the subject via imaging channel **114**. Stated differently, imaging channel **114** may be aligned with imaging mechanism **28** when jaw assembly **110** is coupled over distal tip **24**, such that imaging mechanism **28** may continue to generate a visual display of the surrounding environment of distal tip **24** through jaw assembly **110** via

imaging channel **114**.
[0060] Additionally, medical device **100** may be configured to allow lighting mechanisms **30** to illuminate the surrounding environment of distal tip **24** via lighting channels **116**. In other words, lighting channels **116** may be aligned with lighting mechanisms **30** when jaw assembly **110** is coupled over distal tip **24**, such that lighting mechanisms **30** may continue to emit light outwards towards the surrounding environment of distal tip **24** through jaw assembly **10** via lighting channels **116**. Insertion portion **20** may be navigated through the subject and distal tip **24** may be positioned at the procedure site via actuation of the one or more actuators **14** on handle **12** (FIG. **1**A).
[0061] In this instance, second actuator **156** of handle assembly **150** may be moved distally relative to main body **152** to extend jaw assembly **110** and wire assembly **120** distally relative to distal tip **24**, thereby separating jaw assembly **110** from distalmost face **25** (see FIG. **6**). Second actuator **156** may be operable to pivot jaw assembly **110** from the closed state (FIG. **2**) towards the opened state (FIGS. **3** and **7**) in response to continued distal translation relative to main body **152**.
[0062] Upon positioning the target object (e.g., a tissue sample) between upper jaw **130** and lower jaw **140**, first actuator **154** may be rotated to securely fasten engagement mechanism **122** with the target object. In other instances, second actuator **156** may be actuated (e.g., translated distally relative to main body **152**) to extend engagement mechanism **122** distally out of jaw assembly **110** and into the target object to pierce the tissue sample prior to actuating (e.g., rotating) first actuator **154**. In either instance, with the target object attached to engagement mechanism **122**, second actuator **156** may be operable to pull the target object proximally into the internal cavity between upper jaw **130** and lower jaw **140** in response to a proximal translation of second actuator **156** relative to main body **152**.
[0063] Second actuator **156** may be further operable to pivot jaw assembly **110** from the opened state (FIG. **3**) towards the closed state (FIG. **2**) in response to continued proximal translation relative to main body **152**, thereby causing the plurality of teeth **132**, **142** to reengage one another and sever any tissue positioned between upper jaw **130** and lower jaw **140**. In this instance, the target object attached to the engagement mechanism **122** and disposed within the internal cavity of jaw assembly **110** may be separated from the surrounding tissue by the plurality of teeth **132**, **142** severing and/or cutting the tissue sample from the surrounding tissue.
[0064] It should be appreciated that irrigation openings **32** may be configured to provide irrigation to distal tip **24** and into jaw assembly **110**, such as towards the target object collected therein, through irrigation apertures **113** on face plate **111**. Any residual material (e.g. bodily fluids and/or irrigation fluid) collected within the internal cavity of jaw assembly **110** may be released via opening **134** on upper jaw **130**. Upon collecting the tissue sample within the internal cavity of jaw assembly **110**, insertion portion **20** may be withdrawn from the subject with the tissue sample securely collected within jaw assembly **110** for extraction from the procedure site. Wire assembly **120** may be decoupled from handle assembly **150** and the tissue sample stored within jaw assembly **110** may be collected for analysis.
[0065] Referring now to FIGS. **8**A-**8**B, another exemplary medical device **200** is depicted. Medical device **200** may be substantially similar to medical device **100** except for the differences explicitly described herein. Accordingly, the same reference numerals are used to identify substantially similar components. Additionally, medical device **200** may be configured and operable similar to medical device **100**, such that medical device **200** may be integrated with medical system **10** in a substantially similar manner as medical device **100** shown and described above.
[0066] In the example, medical device **200** may include a jaw assembly **210**, wire assembly **120** (not shown), and handle assembly **150** (see FIG. **5**). Jaw assembly **210** may include a pair of jaws, such as a first (lateral) jaw **230** and a second (lateral) jaw **240**. In the example, jaw assembly **210** may be sized, shaped, and/or otherwise configured as half-jaws such that the pair of jaws **230**, **240** are coupled to distal tip **24** of shaft **22** only along a (half) portion of distalmost face **25**. In other

words, jaw assembly **210** may be disposed over distal tip **24** with the pair of jaws **230**, **240** positioned over a subset (e.g., a bottom half) of distalmost face **25**. In this instance, jaw assembly **210** may not fully cover distalmost face **25** such that one or more openings, channels, and/or mechanisms of distal tip **24** may be freely exposed from jaw assembly **210**.
[0067] For example, referring specifically to FIG. **8**A with jaw assembly **210** in a closed state, the pair of jaws **230**, **240** may be engaged with one another along a bottom half of distal tip **24** such that imaging mechanism **28** and imaging mechanisms **30** may be disposed between the pair of jaws **230**, **240**. Working channel opening **26** and irrigation channels **32** may be uncovered by the pair of jaws **230**, **240** when jaw assembly **210** is in the closed state. To facilitate navigation of insertion portion **20** towards the procedure site, jaw assembly **210** may be moved from the closed state towards an opened state to allow imaging mechanism **28** to provide visualization and lighting mechanisms **30** to provide illumination out of jaw assembly **210**, as seen in FIG. **8**B.
[0068] Still referring to FIG. **8**B, first jaw **230** may include one or more teeth **232** and second jaw **240** may include one or more teeth **242**. In the example, jaw **230** may include a single tooth **232** and second jaw **240** may include a single tooth **242**. Tooth **232**, **242** may define a sharpened edge and/or a blade that may be configured and operable similar to teeth **132**, **142** shown and described above for severing tissue received therebetween. It should be appreciated that the half-jaw configuration of jaw assembly **210** may be configured and operable to provide an enhanced grasp of the target object (e.g., tissue sample). Additionally, jaw assembly **210** may be configured and operable to provide enhanced visualization capabilities from imaging mechanism **28** as jaw assembly **210** may be moved towards the opened state to not obstruct a field of view of imaging mechanism **28** during use.
[0069] While principles of this disclosure are described herein with the reference to illustrative examples for particular applications, it should be understood that the disclosure is not limited thereto. Those having ordinary skill in the art and access to the teachings provided herein will recognize additional modifications, applications, and substitution of equivalents all fall within the scope of the examples described herein. Accordingly, the invention is not to be considered as limited by the foregoing description.

Claims

1. A medical device, comprising: a wire assembly including an impediment on a distal portion of the wire assembly; a jaw assembly coupled to the wire assembly with the impediment disposed inside the jaw assembly, wherein the jaw assembly is configured to move between a closed state and an opened state; and a lever movably coupled to the distal portion and disposed inside the jaw assembly, wherein the lever is configured to contact an interior of the jaw assembly; wherein the wire assembly is configured to move the jaw assembly from the closed state towards the opened state in response to the wire assembly translating distally inside the jaw assembly and moving the lever proximally until the lever engages the impediment; wherein the lever is configured to pivot outwards relative to the jaw assembly upon engaging the impediment and push against the interior of the jaw assembly, thereby urging the jaw assembly towards the opened state.
2. The medical device of claim 1, wherein the wire assembly includes an engagement mechanism on the distal portion such that the engagement mechanism is disposed inside the jaw assembly in at least some configurations of the jaw assembly.
3. The medical device of claim 2, wherein the engagement mechanism is configured to translate distally relative to the jaw assembly from a proximal position to a distal position in response to the wire assembly translating distally.
4. The medical device of claim 3, wherein the engagement mechanism is disposed inside the jaw assembly when in the proximal position, and extends at least partially outside of the jaw assembly when in the distal position.

5. The medical device of claim 4, wherein the wire assembly is configured to rotate relative to the jaw assembly, and the engagement mechanism is configured to rotate in response to rotation of the wire assembly.
6. The medical device of claim 5, wherein the engagement mechanism is configured to pierce a tissue positioned adjacent to the jaw assembly in response to the wire assembly translating distally when the jaw assembly is in the opened state.
7. The medical device of claim 6, wherein the engagement mechanism is configured to securely engage the tissue in response to the wire assembly rotating relative to the jaw assembly.
8. The medical device of claim 7, wherein the engagement mechanism is configured to pull the tissue proximally into the jaw assembly in response to the wire assembly translating proximally relative to the jaw assembly.
9. The medical device of claim 7, wherein the jaw assembly is configured to cut the tissue engaged by the engagement mechanism and received inside the jaw assembly in response to the wire assembly translating proximally, thereby causing the jaw assembly to move from the opened state towards the closed state.
10. The medical device of claim 6, wherein the engagement mechanism includes a needle, a corkscrew, a hook, or a barbed spike.
11. The medical device of claim 1, wherein the wire assembly is configured to translate proximally relative to the jaw assembly and the lever is configured to translate distally relative to the distal portion.
12. The medical device of claim 11, wherein the impediment is configured to disengage the lever in response to the lever translating distally, such that continued translation proximal of the wire assembly is configured to pivot the lever inwards within the jaw assembly.
13. The medical device of claim 12, wherein the lever is configured to move the jaw assembly towards one another when pivoting inwards, thereby moving the jaw assembly from the opened state towards the closed state.
14. The medical device of claim 1, wherein the wire assembly extends through a shaft of an endoscope with the distal portion extending outwardly from a distal tip of the shaft, and the jaw assembly is coupled over the distal tip.
15. The medical device of claim 14, wherein the jaw assembly includes an imaging channel aligned with an imaging mechanism on the distal tip and a pair of lighting channels aligned with a pair of lighting mechanisms on the distal tip; and wherein, with the jaw assembly coupled over the distal tip, the imaging mechanism is configured to generate images distally from the jaw assembly through the imaging channel and the pair of lighting mechanisms are configured to emit light distally from the jaw assembly through the pair of lighting channels.
16. A medical device, comprising: a wire assembly including an impediment on a distal portion of the wire assembly; a jaw assembly coupled to the wire assembly with the impediment disposed inside the jaw assembly, wherein the jaw assembly includes a pair of jaws configured to move between a closed state and an opened state; and a lever movably coupled to the distal portion and disposed inside the jaw assembly, wherein the lever is configured to contact at least one of the pair of jaws; wherein the wire assembly is configured to translate along a distal direction relative to the jaw assembly and the lever is configured to translate simultaneously towards a proximal direction relative to the distal portion; and wherein the impediment is configured to engage the lever and inhibit further translation of the lever towards the proximal direction, such that continued translation of the wire assembly along the distal direction is configured to pivot the lever outwards from within the jaw assembly, and the lever is configured to move the at least one of the pair of jaws away from the other one of the pair of jaws when pivoting within the jaw assembly, thereby moving the pair of jaws from the closed state towards the opened state.
17. The medical device of claim 16, wherein the wire assembly includes an engagement mechanism on the distal portion that is configured to translate towards the distal direction in

response to the wire assembly translating towards the distal direction, and rotate in response to the wire assembly rotating relative to the jaw assembly.

18. The medical device of claim 17, wherein the engagement mechanism is configured to pierce a tissue positioned adjacent to the jaw assembly in response to the wire assembly translating towards the distal direction when the jaw assembly is in the opened state, and securely engage the tissue in response to the wire assembly rotating relative to the jaw assembly.

19. The medical device of claim 18, wherein the engagement mechanism is configured to pull the tissue proximally into the jaw assembly in response to the wire assembly translating towards the proximal direction relative to the jaw assembly; and wherein the jaw assembly is configured to cut the tissue engaged by the engagement mechanism in response to the wire assembly translating towards the proximal direction, thereby causing the pair of jaws to move from the opened state towards the closed state.

20. A medical system, comprising: a shaft including a working channel and a distal tip; a wire assembly movably disposed inside the working channel, the wire assembly including a distal portion extending outwardly from the distal tip; a jaw assembly coupled to the wire assembly and positioned over the distal tip such that the jaw assembly abuts against a distalmost face of the distal tip, wherein the jaw assembly is configured to move between a closed state and an opened state; and a lever movably coupled to the distal portion and disposed inside the jaw assembly and outside of the shaft, wherein the lever is configured to contact the jaw assembly; wherein the wire assembly is configured to move the jaw assembly distally away from the distal tip in response to a distal translation relative to the shaft, and move the lever proximally within the jaw assembly in response to further distal translation relative to the shaft; and wherein the lever is configured to pivot outwards within the jaw assembly to push against the jaw assembly, thereby moving the jaw assembly from the closed state towards the opened state.